NSW GOVERNMENT

QUALITY OF INITIAL TEACHER EDUCATION IN NSW

LEARNING TO TEACH PRIMARY MATHEMATICS

GREAT TEACHING, INSPIRED LEARNING – A BLUEPRINT FOR ACTION
ACTION 3.1 – THE QUALITY OF INITIAL TEACHER EDUCATION PROGRAMS WILL BE ASSESSED AND PUBLICLY REPORTED ON AN ANNUAL BASIS

QUALITY TEACHING COUNCIL

BOSTES
BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

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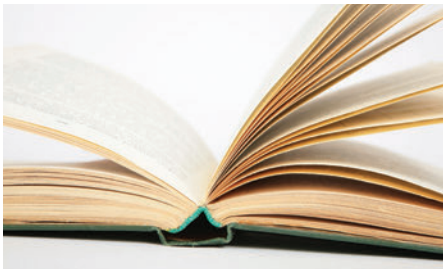


LIST OF ABBREVIATIONS

AAMT
Australian Association of Mathematics Teachers

ACER
Australian Council for Education Research

AITSL
Australian Institute for Teaching and School Leadership

ALTC
Australian Learning and Teaching Council

AMSI
Australian Mathematical Sciences Institute

APST
Australian Professional Standards for Teachers

AQF
Australian Qualifications Framework

ARC
Australian Research Council

BOSTES
Board of Studies, Teaching and Educational Standards NSW

DET
NSW Department of Education and Training

DOE
NSW Department of Education

EFTSL
Equivalent Full Time Student Load

GTIL
Great Teaching, Inspired Learning – A Blueprint for Action

GTS
Graduate Teaching Standards

ICT
Information and Communication Technology

IT
Information Technology

ITE
Initial Teacher Education

ITEC
Initial Teacher Education Committee

KLA
Key Learning Area

LANCR
Literacy and Numeracy for Classroom Readiness

LANTITE
Literacy and Numeracy Tests for Initial Teacher Education

MAGLAN
Ministerial Advisory Group Literacy and Numeracy

MANSW
Mathematics Association of NSW

MCEECDYA
Ministerial Council for Education, Early Childhood Development and Youth Affairs

NAPLAN
National Assessment Program – Literacy and Numeracy

NSWIT
NSW Institute of Teachers

OECD
Organisation for Economic Co-operation and Development

PISA
Programme for International Student Assessment

QTC
Quality Teaching Council

SCK
Subject Content Knowledge

STEM
Science, Technology, Engineering and Mathematics

TEMAG
Teacher Education Ministerial Advisory Group

TIMSS
Trends in International Mathematics and Science Study

TQAP
Teacher Qualifications Advisory Panel

GREAT TEACHING, INSPIRED LEARNING – A BLUEPRINT FOR ACTION

Research shows that quality teachers are crucial for achieving an overall improvement in student learning outcomes.

In 2013, the NSW Government released *Great Teaching, Inspired Learning – a Blueprint for Action* (GTIL), which outlines 47 actions to improve the already high standards of teaching in NSW.

Responding to extensive community feedback about teaching quality, the plan includes actions to:

- better understand and share what makes an excellent teacher
- ensure beginning teachers are well suited and thoroughly prepared for the classroom
- make the Australian Professional Standards for Teachers central to delivering fair and accountable performance and accreditation processes and high-quality professional development for all teachers
- ensure career pathways and improved support for school leaders.

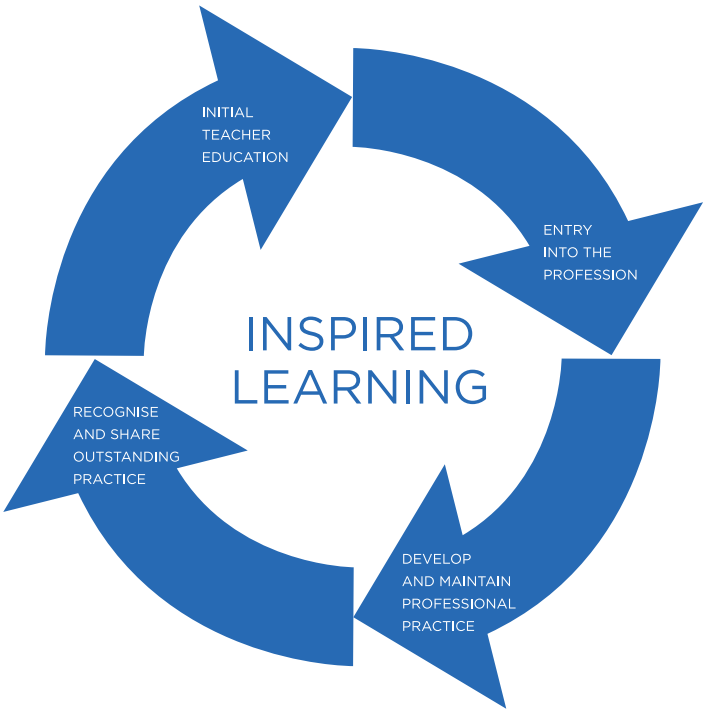
The Blueprint is designed to help students to achieve better results by researching and sharing what makes an excellent teacher, and supporting the career-long professional development of all teachers.

The Board of Studies, Teaching and Educational Leadership (BOSTES), the NSW Department of Education (DoE), the Catholic Education Commission NSW (CEC) and the Association of Independent School of NSW (AIS) are working together to implement the Blueprint's reforms across NSW.

Visit www.nswteachers.nsw.edu.au to find out how the Blueprint is improving the quality of teaching and student leaning outcomes in NSW schools.

The Blueprint is designed to help students to achieve better results by researching and sharing what makes an excellent teacher.

INSPIRED LEARNING DIAGRAM



EXECUTIVE SUMMARY

While this review of NSW initial teacher education (ITE) programs has been conducted under the auspices of the ongoing implementation of GTIL, it occurs within a context of renewed debate about the quality of study in Science, Technology, Engineering and Mathematics (STEM) generally in Australia, across all levels of education.

Indicative of issues raised in these debates are documents prepared by the Australian Mathematical Sciences Institute (AMSI). Its 2015 report *Vision for a Maths Nation* outlines concerns over the decline in prerequisites of mathematics for entry to science and engineering tertiary courses, the numbers of Years 7–10 school mathematics classes taught by non-mathematics trained teachers (report states at least 30%) and concern over the participation of girls in mathematics especially at tertiary level.

The AMSI report card on Year 12 mathematics participation (2015), reports a national decline, between 1995 and 2013, in the proportion of Australian Year 12 students studying advanced maths (14.2% to 9.6%) and studying intermediate maths (27.3% to 19.1%). Recommendations to government in *Vision for a Maths Nation* include priority being given to strengthening teaching and learning in core mathematics and science disciplines, and making science, technology and mathematics subjects compulsory at senior school levels.

In NSW, statistics held by the Board of Studies, Teaching and Educational Standards (BOSTES) show that mathematics is the most popular elective in the Higher School Certificate (HSC), with about 82% of students awarded the HSC in 2014 completing one or more HSC mathematics courses. While total entries have largely kept pace with enrolment growth over the last decade, there has been a shift from the more advanced Mathematics 2 Unit course (down by 20%) to the General courses. Entries in the Extension courses dropped by about 10% between 2004 and 2007 but have been essentially stable since.

The figures for the 2015 HSC show about 81% completing a Mathematics course, with the drift from the Mathematics 2 unit course towards lower level courses continuing.

The Chief Scientist of Australia has repeatedly drawn attention to the need for strengthened study of STEM subjects.

Underpinning an agenda for improved participation and achievement in STEM subjects, is the agreed necessity for a strong foundation in mathematical knowledge and expertise in primary education.

The Office of the Chief Scientist of Australia published in December 2015, as this review was being finalised, a position paper 'Transforming STEM Teaching in Australian Primary Schools: everybody's business'. This report is consistent with the direction advocated in this paper.

The then Chief Scientist, Professor Ian Chubb, stated clearly in May 2015 that 'science and mathematics have to be so compellingly well taught that students will want to study them'.

This review into ITE programs offered by NSW tertiary education institutions in respect of their preparation of graduates to teach primary mathematics takes place in the context of this ongoing public debate.

It also occurs in the context of a long history in NSW of strong interest by the schooling sector in the content of teacher education programs and an evolving set of regulatory arrangements.

Most recently, NSW has implemented a set of specifications which govern the preparation of graduates to teach their various subjects at a secondary level, and in each of the primary curriculum Key Learning Areas (KLAs), including Mathematics. This program accreditation process is nearing the end of its second cycle and the provisions applying to each of the approval cycles (2007–2011 and 2012–2015) underpin this review into the preparation to teach primary mathematics and are set out in the appendices of this report.

While an integrated approach to strengthening STEM study is a national priority, care must be taken in attributing causes to any decline in candidature in higher-level mathematics courses. This current review into primary teacher preparation to teach mathematics examines the units of study in ITE programs accredited in NSW since 2012. Year 12 HSC students in 2015 in NSW would have been taught primary mathematics by teachers graduating

The Chief Scientist of Australia has repeatedly drawn attention to the need for strengthened study of STEM subjects.

from programs no later than 2007, prior to either of the two complete cycles of program accreditation where the current requirements applied.

Choices about senior school mathematics will undoubtedly be affected by many issues, including perceived usefulness for maximising overall university entrance. Nonetheless, it is reasonable to consider that the strongest possible preparation to teach primary mathematics, and then its consistent delivery in schools, lays the essential foundation for later confidence to pursue further mathematical study.

NSW school results in NAPLAN tests are relatively stable over recent years.

- NSW ranks third in Year 3 and Year 5 Numeracy in all measures (mean score, percentage at or above minimum standard and percentage in highest band), except in Year 5 percentage in highest band, where it's ranked first.
- About 95% of NSW Year 3 and Year 5 students are above minimum standard in Numeracy.
- There has been little change in Numeracy scores since NAPLAN commenced in 2008.

The international TIMSS (Trends in Mathematics and Science Study) tests, held every four years (most recently in 2011), are conducted for Year 4 and Year 8.

- In 2011, Australia ranked 18th out of 50 countries in Year 4 mathematics.
- Australia is underperforming in comparison to 17 countries, including Northern Ireland, England, the Russian Federation, the United States, Lithuania, Portugal and Ireland.
- NSW is above the national average, but ranked third in mathematics in 2011, behind ACT and Victoria. In 2007 NSW ranked first, second in 2003 and third in 1995.
- The average performance for NSW Year 4 students in mathematics improved by a significant 29 mean score points between 1995 (496) and 2011 (525), but dropped slightly by 9 mean score points between 2007 (534) and 2011 (525).
- In 2011, 73.8% ±5.5 of NSW Year 4 students achieved at or above the intermediate international standard for maths compared to 70.2% ±2.7 nationally and the international median of 69%.
- In the two top performing countries, Korea and Singapore, 97% and 94% of students achieved at or above the intermediate international standard for mathematics, and in Hong Kong, the United States and England, 96%, 81% and 78% respectively, achieved at or above this 2011 international benchmark.
- NSW results for Year 4 mathematics have fluctuated over the past three assessment cycles, improving considerably in 2007 (from 68.2% ±9.5 in 2003 to 76.3% ±6.0 in 2007) but dropping again in 2011 (73.8% ±5.5). However, trends since 2003 are not statistically significant.
- In 2011, Australia ranked 12th out of 45 countries in Year 8 maths, with significant outperformance from six countries. NSW was above the national average, ranked second in 2011 with average performance in mathematics – not significantly different in 2011 from that in 1995.

A further context is the proposed commencement of a revised approach to accrediting ITE programs to begin in 2016, one focused to a much greater degree on evidence of the quality of delivery of the programs, particularly on the demonstrated capacity of graduates to positively impact on their students' learning and on the overall outcomes of the programs and the graduates commencing their teaching careers.

This review is primarily focused on the units of study within programs devoted to primary numeracy and mathematics, in programs accredited between 2012 and 2015. These are the programs that are currently preparing the next cohort of graduates for NSW primary schools.

The cooperation of the fourteen tertiary institutions delivering primary programs in NSW has been indispensable to the review, as were the contributions of the members of an expert panel of teachers, teacher educators, school advisors and BOSTES curriculum inspectors who reviewed the summary of all the mathematical units across the programs.

The review considered 36 undergraduate programs, 10 postgraduate programs and a total of 65 units of study.

The study involved producing a summary of all units devoted to primary mathematics, across all primary preparation programs, including those that also included an additional early childhood or secondary focus. Summaries were provided to the respective ITE providers for validation and correction where necessary.

A background paper was prepared for the convening of an expert panel drawn from across the school and tertiary sectors of the profession. The review team also analysed the units of study, and taking into account the outcomes of the expert panel and relevant literature, has commenced preparing individual advice to each institution as well as finalising this report.

The review identifies a number of key aspects of primary mathematics teacher preparation and offers a general overview of the current units of study in the accredited programs. The review also develops a number of recommendations from both the expert panel and the review team,

which set out a forward-looking program to develop an authoritative professional consensus across the tertiary and schooling sectors as to the best practices in teaching primary mathematics.

The overall focus of the review and its recommendations is on building the authority of a shared professional understanding of what constitutes strong primary mathematics teaching, and preparation for it within tertiary programs. The review strongly supports the continued academic preparation of primary teaching graduates within tertiary institutions. There is a widely shared view, long supported in reviews of teacher education, for far stronger partnerships between schools and the ITE providers. The recommendations from this review are designed to assist in the integration of teacher education practices, professional experience placements, shared conceptions of the implications of the Graduate Teacher Standards (GTS) career stage of the Australian Professional Standards for Teachers (APST) for mathematics teaching, and the formal accreditation processes governing the teaching profession in NSW.

Recommendations address individual advice to institutions regarding their current units of study and programs, the adequacy of the overall requirements for primary mathematics in ITE programs, more specific delineation of best practice in professional experience placements around mathematics, supervising and mentoring practice, assessment of student teachers and support for graduates through induction and their professional development through their developing careers. There is a recommendation for the development of mathematics-specific components within the evidence provided by primary teachers for proficient and expert teacher accreditation.

The review urges all sections of the profession to collaborate in a three-year project to achieve an internationally benchmarked level of professional knowledge and practice in primary mathematics teaching and preparation of graduates that is shared across the profession in NSW.

The overall focus of the review and its recommendations is on building the authority of a shared professional understanding of what constitutes strong primary mathematics teaching, and preparation for it within tertiary programs.

PART A: BACKGROUND

Introduction

The NSW Government adopted all of the recommendations of the *Great Teaching, Inspired Learning: A blueprint for action* (GTIL)[1] in March 2013. The blueprint made recommendations for an annual process to review and report on different aspects of initial teacher education (ITE) programs. In 2015, it was decided to review the teacher preparation programs in the primary curriculum area of mathematics. The Board of Studies, Teaching, and Educational Standards (BOSTES)[2] is responsible for producing annual public reports to the Minister for Education on agreed areas of ITE programs, as well as providing an individual report to each provider in light of the review. Any relevant issues arising will be discussed between BOSTES and the relevant ITE provider.

The review examines the content of programs that prepare graduates to teach the K–6 component of the *NSW Mathematics K–10 Syllabus for the Australian Curriculum*. It makes suggestions for areas where ITE programs may be further developed and improved, including providing individual feedback to each provider. As the numeracy strand of the National Priority Area (NPA) elaboration in literacy and numeracy is generally integrated within the K–6 units of mathematics, attention is also given to this aspect of teacher education.

This review was undertaken concurrently with a revision of the *Accreditation of Initial Teacher Education Programs in Australia: Standards and Procedures* (the Standards and Procedures) by the Australian Institute for Teaching and School Leadership (AITSL) in collaboration with all states and territories. The revised Standards and Procedures were endorsed by Ministers for Education in the Education Council in December 2015. Accordingly, the review was cognisant of the emerging context for program accreditation focused on the assessment of evidence of the quality of program delivery, graduate impact and program outcomes, and recommendations are made to assist providers and accreditation panels in transitioning to the revised approach.

The review was assisted by input from an expert group of teacher educators (listed at Appendix 6), school system advisers and teachers, as well as BOSTES curriculum inspectors.

The review team is responsible for the preparation of individual reports to ITE providers, as well as preparing the overall public report on the state of program and unit design for preparation to teach primary mathematics.

Subject Content Knowledge

Specification of requirements relating to Key Learning Areas (KLA) in teacher preparation has a long history in NSW. Prior to the establishment of the NSW Institute of Teachers (NSWIT) in 2004, the then NSW Department of Education and Training (NSWDET) undertook a form of program approval from 1991 through the Teacher Qualifications Advisory Panel (TQAP). Prior to that, a similar process was undertaken through the Teachers Certificate Classifiers Committee which operated from 1943 to 1991 pursuant to a regulation under the Public Service Act. The basis of these approval procedures was suitability of the graduates to be employed in the government schooling system, and linked to this general provision, the identification of subject-based employment codes.

The underlying principle was that the government schooling system, as the major provider of school education, was entitled to develop its requirements for teaching the various school subjects and that universities (and prior to that Colleges of Advanced Education, and Teachers Colleges) needed to prepare their graduates accordingly to ensure they met the professional requirements for employment as a teacher in the government school system.

With the establishment of NSWIT, a new profession-wide structure was given the legislative power to approve ITE programs that would entitle graduates to be granted Provisional Accreditation and effectively licensed to teach in any NSW school, government and non-government. With the explicit power to approve programs on the basis of the NSW Professional Teaching Standards, NSWIT took over the role of approving programs from the NSWDET and TQAP. NSWIT established the *Policy and Procedures for the Approval of ITE Programs* (the Policy and Procedures) which commenced operation in 2007. Over the next five years all ITE programs delivered by NSW teacher education institutions were reviewed by NSWIT panels, with recommendations for formal approval then submitted to the Minister for Education once the programs were judged to meet the requirements of the Policy and Procedures. The NSWIT Initial Teacher Education Committee (ITEC) oversighted this process and finalised the recommendations to the Minister.

In relation to K–6 mathematics, two provisions of the Policy and Procedures were central. First, NSWIT

1 *Great Teaching, Inspired Learning – a Blueprint for Action*, http://www.nswteachers.nsw.edu.au/great-teaching-inspired-learning/blueprint-for-action/
2 Following the merger of the NSW Institute of Teachers and the Board of Studies NSW in January 2014

developed requirements setting out the minimum number of units required in each KLA for both undergraduate and postgraduate programs. In summary they were:

- undergraduate four-year programs required at least three units devoted to mathematics/numeracy (three out of 32 units in a standard 4 EFTSL[3] program)
- postgraduate programs required at least two units in mathematics/numeracy (two out of 12 for 1.5 EFTSL programs and two out of 16 for 2 EFTSL programs).

The effect of these requirements on postgraduate programs was to remove the possibility of a one-year (one EFTSL) Graduate Diploma of Education for primary teacher preparation. A minimum of eighteen months was needed to meet the revised requirements, though most providers moved quickly to a two-year program and all have now done so.

Second, NSWIT developed general descriptions of the content of KLA-based units. The Subject Content Knowledge (SCK) requirements policy was used by program accreditation panels from 2009 (The SCK policy can be found at http://www.nswteachers.nsw.edu.au/higher-education-providers/get-teaching-programs-accredited/prepare-programs-for-submission/). The requirements for K–6 mathematics are found at Appendix 2.

An additional relevant requirement of the NSW system during this period was the numeracy entry requirement for undergraduate programs. Prior to changes introduced through GTIL, entrants to undergraduate primary programs were required to meet a numeracy benchmark by having achieved at least Band 4 in the NSW HSC (or interstate equivalents) in General Mathematics or completed the Mathematics 2 Unit course. Where they did not, they were required to complete additional study in mathematics during their ITE program. Initially this requirement for extra study was seen as an extra unit outside the program itself but in many cases became a further mathematics unit within the program (resulting in four units of mathematics in a number of programs).

These numeracy requirements have now been replaced a new Literacy and Numeracy Test following recommendations from GTIL in 2013 and TEMAG in 2014. Pilot tests were undertaken in 2015 and from 2016 all ITE students will need to complete the Literacy and Numeracy for Classroom Readiness (LANCR) test prior to undertaking their final professional experience placement.

Between 2007 and 2011 all ITE programs were submitted for approval on the basis of the NSWIT Policy and Procedures and the requirements for K–6 Mathematics indicated above were implemented.

With the establishment of AITSL in 2010, the Ministerial Council for Education, Early Childhood Development and Youth Affairs (MCEECDYA) approved the development of a national approach to the accreditation of ITE programs. In April 2011 the Standards and Procedures were approved by MCEECDYA.

With legislative authority for the approval of teacher preparation programs remaining the preserve of State and Territory Governments, the Policy and Procedures were amended to become the *Accreditation of Initial Teacher Education Programs in NSW: Policy and Procedures* (NSW Policy and Procedures) and incorporate the new National Standards and Procedures. The NSW Minister approved the new approach in 2011, with revised National Priority Areas and SCK requirements being retained and the National Standards and Procedures being incorporated into the NSW Policy and Procedures.

The Standards and Procedures set a revised and reduced quantum of discipline-specific units in mathematics/numeracy and English/literacy within primary ITE programs. As a result the SCK requirements setting out the number of units in each KLA were revised to require only 2 units of mathematics/numeracy as mentioned above. Despite this change many NSW programs remained aligned to the previous pattern. While the revised requirements are less prescriptive, they still require discipline and discipline-specific pedagogy and curriculum studies across all primary KLAs to make up half the program (16 units in four-year undergraduate programs or 8 units in two-year postgraduate programs). The requirements are at Appendix 3.

From 2007 NSW program approval requirements included specific reference to coverage of a selection of agreed priority areas on teacher education. These Mandatory Areas covered:

- Literacy
- Aboriginal education
- Teaching students from non-English speaking backgrounds
- Special education
- Classroom and behaviour management, and
- Information and communication technologies

3 Equivalent Full Time Student Load (EFTSL) is the standard measure of an annual full-time study program. In regular mode a 2-EFTSL program runs for two academic years, and a 1.5- EFTSL for one and a half years.

The National Priority Areas replaced these NSW requirements, with the addition of specific numeracy requirements coupled to the literacy area. The National Priority Area elaboration in Literacy and Numeracy is found at Appendix 4.

Key provisions of the National Standards and Procedures include the following:

- Program structures must be sequenced coherently to reflect effective connections between theory and practice.
- Primary programs must prepare graduates to teach all primary learning areas, across all years of primary schooling.
- In undergraduate programs at least one-quarter of a year of full-time equivalent study of discipline and discipline-specific curriculum in each of English/literacy and mathematics/numeracy (usually 2 units of study) and one-eighth of a year of full-time equivalent study of discipline and discipline-specific curriculum in science (usually 1 unit of study).
- In postgraduate programs at least one-quarter of a year of full-time equivalent study of discipline and discipline-specific curriculum in each of English/literacy and mathematics/numeracy (usually 2 units of study) and one-eighth of a year of full-time equivalent study of discipline and discipline-specific curriculum in in science (usually 1 unit of study).
- Programs such as Early Childhood/primary programs, middle years' programs covering primary and lower secondary, and those covering K–Year 12 are required to cover all years of the primary curriculum – for present purposes, K–6 Mathematics.

From 2012, NSW ITE providers progressively submitted their programs to NSWIT, and later to BOSTES, as their five-year approvals expired or as they commenced new programs. The new provisions have been applied in these programs and this current round of program accreditations was finalised in 2015.

Program Accreditation

This review examines the program design and content of all NSW programs approved for the preparation of primary teachers, including those approved in 2015 for commencement in 2016. It includes programs that also have an additional early childhood focus or a secondary teaching option.

NSW programs are typically approved for five years. The cyclical nature of program assessments means that a small number of programs will be due for re-accreditation in 2017, for delivery from 2018 with all other programs timetabled for re-accreditation across 2018–2020.

As mentioned, concurrently with this review, BOSTES and ITE providers have participated in a revision of the Standards and Procedures that underpin the nationally consistent approach to ITE program accreditation.

In December 2015, the Education Council approved the revised approach to program accreditation that introduces a strong focus on the development of data and evidence relevant to the capacity of graduates and the overall outcomes of the programs. The rules and procedures that will govern the accreditation of new programs, and re-accreditation of existing and revised programs will be incorporated into the NSW Policy and Procedures for Ministerial approval. The key focus of the revised approach is to introduce:

- a stronger rationale and design statement for the program as well as an explicit design for the generation of evidence of quality of implementation and the outcomes of the program, and
- re-accreditation substantially on the basis of evidence of the capacity of graduates of the program to impact on the learning of their students, and the overall outcomes of the program.

As became clear during the review, and particularly during the forum with the expert panel, a number of opportunities arise from the recommendations for BOSTES to work constructively with ITE providers to inform the approach to evidence they might adopt, particularly in the area of primary mathematics but in principle, more broadly. This is addressed in Part D.

This review examines the program design and content of all NSW programs approved for the preparation of primary teachers, including those approved in 2015 for commencement in 2016. It includes programs that also have an additional early childhood focus or a secondary teaching option.

Methodology

The focus of the review is primarily on the units of study dedicated to K–6 mathematics/numeracy within the NSW teacher education programs for primary teaching.

This included undergraduate primary programs, combined early childhood and primary programs and combined primary and secondary programs, as well as graduate-entry programs. Altogether there were 36 undergraduate programs and 10 graduate-entry programs, delivered in fourteen of the seventeen initial teacher education providers within NSW.

The review team undertook the task of summarising all of the units of study, focusing on the general description of the unit, the learning outcomes, and the content and assessment tasks outlined in the program documentation submitted for accreditation.

These summaries were revised on the basis of institutional feedback to the initial drafts. Under agreed information sharing arrangements between BOSTES and each institution, the full agreed summaries are published in this review report as Appendix 5.

As the focus of this review is on the design and content of the ITE programs to prepare graduates for primary school mathematics teaching, the review has included those units providers have submitted in 2015 for approval, to commence teaching in 2016. Accordingly, a small number of the programs under review have not yet been taught. However, as the focus is on the design and content of the mathematics teaching preparation of the programs, rather than evidence of quality of program delivery or evidence of the quality of the outcomes of the programs it was considered that the most up-to-date expression of each provider's designs and intentions was the relevant material to include in this review. It will be these units that are the basis of future program re-accreditation.

An expert panel was convened to examine the summaries. Members of the panel with relevant expertise were sought from the NSW Council of Deans of Education, the NSW Department of Education, the Catholic Education Commission of NSW, the Association of Independent Schools NSW, and the Mathematics Teachers Association of NSW. They joined the BOSTES Mathematics and Primary Inspectors and the review team members. Membership of the expert panel is included at Appendix 6.

The panel was provided with a background paper and copies of the unit summaries. It met on 8 October 2015, and a summary of discussions, along with recommendations from the panel, were finalised to guide the substance of the review.

The review team undertook its own consideration of the suites of units from each of the institutions in light of the advice from the expert panel, first to inform the review report and second to prepare specific advice to each institution. Advice to each ITE provider will be completed following the adoption of the report by the BOSTES Board.

The review team has included all recommendations from the expert panel within this report, along with advice on implementation of these and further recommendations for consideration by BOSTES.

The review team also considered the approach to primary mathematics teaching preparation contained in the major textbooks adopted by the various programs and other selected journal and research materials, reports and media commentary on primary mathematics teaching.

PART B: PROGRAM CONTENT

Preliminary Comments

An overview of the programs as a whole indicates that while the substance of preparation to teach primary mathematics is to be found in designated mathematics units, a complete review of a program's approach to mathematics would include other components. These include references to treatment of elements of the NPA elaboration in numeracy in units other than specific mathematics/numeracy units. They are included in accreditation documentation in the sources of evidence templates. Generally such references relate to elements of numeracy within other KLAs or, less frequently, general units on curriculum, pedagogy or assessment.

Given the level of generality usually found in references to numeracy within such units, it is difficult in many cases to form a view on exactly what might be addressed in such elements of the program, and the depth of treatment.

Graduate Teaching Standard (GTS) 2.5.1 requires that graduates of ITE programs

> *Know and understand literacy and numeracy teaching strategies and their application in teaching areas.*

The related template used by ITE providers to show evidence of where in their program graduates meet GTS 2.5.1 requires an indication of a range of places in the program where this Standard is addressed. Further, program accreditation documentation which relates to the NPA elaborations in numeracy requires more detailed evidence, some of which is typically located outside the specific mathematics/numeracy units.

The expert panel considered the importance of numeracy and mathematics across the curriculum and noted that their relevance to all areas of social life should be a strong component of primary teacher preparation.

Attention is drawn to the *National Numeracy Review Report* (Council of Australian Governments, 2008) where there is an extensive treatment of the place of numeracy across the curriculum and its relation to the formal mathematics curriculum. While aspects of this report have been superseded by more recent significant developments (such as the development of the Australian Curriculum and its embodiment within jurisdictional documents and the development of the APST) there is considerable advice and guidance in this report that would improve the design and inclusions within a number of the primary ITE programs.

Given the absence of any reference to the numeracy implications of the non-mathematics KLA units in a number of instances, it would be worthwhile for a guide to existing resources and exemplars illustrating the ways numeracy can be addressed within these KLAs to be prepared for advice to ITE providers.

Review Recommendation 1

That BOSTES prepare a guide to existing resources and exemplars illustrating ways numeracy can be addressed across the curriculum for advice to ITE providers.

A significant issue of the specificity of mathematical practice within a number of non-KLA specific Graduate Teacher Standards was identified by the expert group and deserves transparent attention within program design.

Without denying the validity of general or holistic approaches to curriculum, pedagogy, and assessment, the specific demands of mathematics education need to be directly addressed.

The expert panel and review team considered a number of standards where the particular demands of developing mathematical knowledge and understanding might be included in units where these standards are separately addressed.

Panel Recommendation 1

That BOSTES lead development of support materials which address issues/options/strategies for ways mathematics units might incorporate a number of the Graduate Teacher Standards, including:

- Standard 1.1.1 (eg mathematics anxiety; confidence and competence)
- Standard 1.2.1 (how students learn mathematics and implications for teaching)
- Standard 1.3.1 (how to cater for students who are not fluent in English)
- Standard 1.5.1 (differentiation)
- Standard 2.6.1/3.4.1 (use of technology in mathematics)
- Standard 3.4.1/3.5.1/4.1.1 (engagement/participation)
- Standard 3.6.1 (evaluation of teaching programs)
- Standard 5.1.1/5.3.1 (assessment)
- Standard 5.2.1 (feedback to students).

The expert panel considered the importance of numeracy and mathematics across the curriculum and noted that their relevance to all areas of social life should be a strong component of primary teacher preparation.

It is the prerogative of providers to organise their programs to address these and other Standards in unit content and assessment tasks according to the design principles they adopt. However, it is the conclusion of this review that in a number of programs there should be a clearer agenda to develop these Standards specifically in relation to mathematical learning, particularly within those units which broadly address curriculum knowledge, planning, teaching and learning strategies, and assessment. In a context where all pre-service teachers may not be equally or sufficiently confident in their mathematical competence or knowledge it would be important for there to be some requirements within course options for mathematics specific tasks to be included in student work beyond that required in the specific numeracy and mathematics units.

The mathematics-specific evidence guide that this review recommends is developed for the Proficient Teacher Standards should be a useful resource for inclusion of mathematical content within programs as they address these Graduate Teaching Standards.

While in principle the content of all KLAs (beyond their specific units) should inform such program design, the specific demands of mathematics and the possible propensity of some pre-service teachers to avoid this area if given options, warrants ensuring a systematic approach to addressing primary mathematical teaching and learning in such general units.

Mathematics Units

As mentioned above, NSW has a history of requirements for ITE program approval that include an emphasis on strong subject content knowledge. With the adoption of the National Standards and Procedures in 2011, a modified version of the NSW provisions for KLA units within programs was adopted. However, as at 2015 a number of other Australian jurisdictions have yet to apply these requirements to a majority of their programs (that is, a majority of programs in some jurisdictions have not been accredited under the national system). Further, as there are no national elaborations of what meeting KLA curriculum/syllabus requirements entails, there is no firm basis for a national view, or judgement of national comparability, of the content of the KLA units where the programs have been accredited under the national system in other jurisdictions.

As noted in Part A above, the 2011 national requirements reduced the number of specified units in English and mathematics to two each, but simultaneously required the total number of KLA-based studies to comprise at least half of the program (Program Standard 4.4).

Graduate-entry programs require at least half of a two-year program to be devoted to KLA studies, and at least two units on each of English and mathematics. Entrants to these programs must have included at least one year of full-time equivalent study relevant to one or more learning areas of the primary school curriculum (Program Standards 4.4 and 3.3).

Further, programs that prepare graduates to teach in both early childhood settings and primary schools are expected to prepare graduates for teaching the curriculum in both contexts (Program Standard 4.7). This is to be read along with Program Standard 4.4 which refers to primary teachers being prepared to teach all KLAs across the years of the primary school.

An examination of the programs in NSW reveals the following pattern of interpretation and implementation of these provisions across the ITE providers:

- Of 24 undergraduate primary programs, only two adopt the minimum of 2 mathematics/numeracy units (see note under Table 1).
- Sixteen programs include 3 units, five programs include 4 units and one program includes 5 units.
- Nine graduate-entry programs include the stipulated 2 units, with one program including 3 units.
- Of the combined early childhood/primary programs, five include 3 units, two include 4 units and one includes 5 units.
- Three combined primary/secondary programs (K–Year 12), include 2 units with one program including a further unit.

The examination of unit coverage of the mathematics curriculum and its NSW syllabus across the programs and provider institutions shows that providers almost universally determine that three units of mathematical/numerical study is the minimum necessary for adequate preparation in an undergraduate program, and in six programs it is 4 or 5 units.

Undoubtedly, the programs with 4 and 5 units of mathematics exhibit strength of coverage, both in breadth and depth, as well as a sequentially forceful design that provides the opportunity for addressing the characteristics of strong programs identified in this review.

A clear example of this is the capacity to have pre-service teachers engage in a variety of assessment tasks that incorporate different forms of interaction with school students through planning, and delivering, lessons, assessing students work and redesigning work for students on the basis of the data from the individual assessments.

It should be noted that the NSW program approval process requires explicit examination of the *Mathematics K–10 Syllabus for the*

TABLE 1: UNITS OF MATHEMATICS/NUMERACY OFFERED WITHIN NSW ITE PROGRAMS 2012–2015.

Course Type	Number of Mathematics Units Offered			
	Two	Three	Four	Five
Undergraduate	2	16*	5	1
Postgraduate	9	1	N/A	N/A
Early Childhood/ Primary	N/A	5	2	1
K–12	3	1**	N/A	N/A

* Included within this figure from two institutions are units that are shared with other KLAs and in effect are half units dedicated to mathematics/numeracy. One of these institutions also requires students to study 2 discipline units in each of four (of the six) NSW KLAs. Mathematics is one option although it is not compulsory.

** A further combined Numeracy/Literacy unit is added to two core mathematics units.

Australian Curriculum (in particular Volume 1 *Mathematics K–6*). As noted on page 7 of that document, BOSTES syllabuses 'include the agreed Australian curriculum content and content that clarifies the breadth and depth of learning and scope for mathematics. The Australian curriculum achievement standards underpin the syllabus outcomes and the stage statements for Early Stage 1 to Stage 5'.

It is a clear expectation of the NSW program approval requirements that the explicit requirements and organisation of the curriculum found in the BOSTES K–6 Mathematics syllabus are addressed. A small number of programs also successfully integrate reference to interstate frameworks where there is a significant cross-border candidature within their programs.

Mathematics K–6 Syllabus

An examination of the syllabus content coverage reveals that there was a clear distinction between programs that were sequenced according to the NSW K–6 syllabus stages (with all strands within a stage addressed synchronously) and those sequenced by strand content (all stages in a strand addressed with a focus on the continuum of learning within the content area).

Whatever the approach adopted, the review considers it important that the continuum of learning should be strongly evident in the design of the program and developed within and across units. Graduates need to become confident and competent in developing their own strategies to handle content.

Importantly, all programs, whether combined early childhood/primary programs, primary programs or programs addressing both primary and secondary preparation, need to address this continuum of learning across the whole of the primary syllabus, including the transitions from early childhood into primary and the transition into the Stage 4 syllabus. All pre-service teachers need sufficient study, and practice, within their programs to develop this expertise.

It is difficult to see this expectation being adequately met in undergraduate programs with only two units of mathematics or in programs which reflect more perfunctory coverage (in breadth and depth) of the upper primary curriculum. Given the range of student ability in numeracy/mathematics in many classes, a clear focus on prior to school number development is also necessary for all graduates.

Those programs that exhibit an overall coherence in design across mathematical units, with a clear development of the continuum of learning in both mathematical concepts and pedagogy, should be the benchmark for program accreditation. Unit outlines that indicate a list of topics with little indication of the pedagogical purpose or approach of the program to teaching these topics should not be considered sufficient by program accreditation panels.

The expert panel emphasised the essential part of the learning process of Working Mathematically which underpins the teaching of the content strands of the NSW Mathematics

Those programs that exhibit an overall coherence in design across mathematical units, with a clear development of the continuum of learning in both mathematical concepts and pedagogy, should be the benchmark for program accreditation.

syllabus. In a small number of programs the following issues were noted:

- the separation of Working Mathematically as five interrelated components – Communicating, Problem-solving, Reasoning, along with Fluency and Understanding – from the rest of the syllabus content
- the marginal treatment or near absence of Working Mathematically in some programs
- unclear design for addressing Working Mathematically in some programs.

A majority of the programs, especially those with a strong organisation across three or more units, handle this aspect systematically.

Pre-service teachers require confidence in developmental sequencing and conceptual understanding in mathematics. The panel noted the utility of strategies such as disruptive learning experiences to challenge accumulated preconceptions around mathematical learning and expectations derived from prior school experiences in many cases.

The report has already drawn attention to the need for numeracy strategies to be embedded systematically across other KLAs. It is desirable for the mathematical/numeracy narrative within program design to clearly express the conceptual integration of the overall approach to mathematical learning within the program.

Given the comments on the relative strength of programs with only two units on mathematics compared with those with three or particularly four or five units, and their capacity to adequately and sequentially cover the whole of the primary syllabus, the issue of the adequacy of the standard pattern and minimum required two units in graduate-entry programs arises.

In this regard there is an even greater premium to be placed on the strength and coherence of design in the approach to mathematics. This is evident in a number of programs but the lack of equivalence with undergraduate programs cannot be ignored. While it is more difficult to include a third unit of mathematics within a 16-unit program, it should be noted that the National Program Standard 4.4 provides that such programs may include up to one-quarter of a year of full-time equivalent study (two units generally) of relevant discipline studies as elective units for those who do not fully meet prerequisite discipline study requirements.

This provision is intended to accommodate those entrants who do not meet the requirement for a full year (8 units) of relevant discipline study. However, given the lack of any national specification to guide decisions around appropriate foundational discipline study the use of this provision for this nominated purpose is likely to be minimal. There is a case for a further unit of mathematics being included within these programs. This issue should be considered in tandem with some specification of mathematical study in undergraduate degrees. It should be noted that there are programs that already provide for a linked undergraduate pathway (a number of designated units within a general degree), and that in at least one case this includes two units of mathematics.

Technology

The Australian Curriculum's general capability, information and communication technology (ICT) is embedded across the *NSW Mathematics K–6 Syllabus* document. Its inclusion throughout the document is evident in the process strand of Working Mathematically as well as in all the content strands from Early Stage 1 through to Stage 3. In particular, reference to the use of technology includes its use as a drawing tool to represent, explore and manipulate two-dimensional shapes and three-dimensional objects, to investigate number patterns and relationships and to tabulate and display data.

With its pervasiveness across the curriculum it is essential that primary pre-service teachers are confident in employing digital technologies to enhance their students' understanding in addressing the relevant syllabus outcomes. Therefore there should be appropriate evidence of its inclusion throughout the mathematics units of work. Currently this evidence is uneven. Some ITE programs contain significant reference to technology indicating the extent to which it is covered and how the pre-service teachers engage with it. Other programs briefly mention its inclusion and supply minimal detail about the technology skills that should be gained by the pre-service teachers.

Unit Outlines and Reading Materials

ITE accreditation requirements do not specify a particular template for unit outlines. These are the prerogative of the ITE providers which have their own requirements for unit outlines to meet a number of quality measures within their institution. Broadly, across the institutions the mathematics units include a brief overall description of the unit, a specification of the learning outcomes expected from the unit, an outline of content and details of assessment tasks and associated rubrics. Most have readings and reference materials, plus such other information that the provider institution chooses to include (for instance advice around plagiarism is included in each unit in some institutions but located elsewhere by others). These inclusions are

appropriate and sufficient to be able to exemplify what the particular unit contributes to the accreditation requirements.

The key differences across institutions in the approach to mathematics units lie in the detail provided regarding content, the detail in the weekly elaboration of the content, the detail and specificity of reading materials and online resources in respect to weekly content, and the detail and specificity of assessment tasks and attendant rubrics.

There is a clear issue in relation to a small number of programs and units, where the *NSW Mathematics K–6 Syllabus* (within the K–10 Syllabus) is barely referenced or not at all. The NSW syllabus embodies the Australian Curriculum for mathematics within the preferred organisation of the curriculum and programs accredited in NSW are required to explicitly address these documents. Institutions that need to also address interstate organisation of the curriculum (typically Victoria and Queensland for institutions located near a state border) demonstrate in these units how this can be competently achieved. Institutions whose student market and likely employment destination of graduates are identified closely with a particular national grouping or system of schools can achieve their ends while still addressing the specifics of the NSW syllabus and other requirements.

There is an issue in a small number of units of a failure to identify the pedagogical approach taken to the delivery of the mathematical content. Units that simply specify a list of syllabus topics, without elaboration, scarcely meet the desirable professional practice of putting forward a clearly developed design for the preparation of competent graduates.

This point of course does indicate a limitation of a review simply of units/program documentation if the ultimate goal is to assess the strength of programs in preparing graduates to the necessary standard. Nonetheless, while design is not delivery, without design there is nothing clear on what is to be delivered.

It is not acceptable for classroom teachers to have no planned lesson, no design, for their classes. ITE programs are no different, and programs that teach the necessity of competent lesson planning but rely on vague unit outlines themselves are inadequate. That being said the review finds that such examples, while they do exist, are decidedly in the minority though BOSTES will be advised to follow up individual advice to institutions in this regard.

The degree of detailed specification of readings for weekly components of programs is generally of an impressive standard. Where text books are used, the particular sections are specified along with a number of other readings and/or online resources. The review did not have access to proprietary resources located within provider online systems (nor were they requested as they were beyond the scope of this limited review), but it is clear from many of the outlines that this is the location of considerable support material. In some cases this source of professional resource is very general but in the absence of it being accessed no judgement is possible on its quality.

The short bibliography to this report lists the main texts utilised by institutions. These were considered in the review. It is significant to note that a number of the authors/contributors to these texts are members of the faculties in initial teacher education in NSW, along with interstate colleagues. A sample of some research and theoretical journal articles from the same academics are referenced as well in the bibliography, being resources that appear frequently in the unit resources.

Entrants to ITE Programs

The wide range in mathematical competence and understanding exhibited by pre-service teachers, especially in the first year of their programs, was the subject of considerable discussion by the expert panel.

It is important to note the changing requirements in NSW over recent years, as current practice in many programs reflects earlier arrangements (for instance in the number of units in mathematics and English). The formal requirements are set out in Appendices 2 and 3.

As already noted, previous NSW requirements included HSC mathematics or a further unit of study within or alongside the ITE program. This often resulted in four units of mathematics being included within NSW undergraduate programs. The national Standards and Procedures adopted in 2011 required only two units, but as seen above, in NSW

It is not acceptable for classroom teachers to have no planned lesson, no design, for their classes. ITE programs are no different, and programs that teach the necessity of competent lesson planning but rely on vague unit outlines themselves are inadequate.

nearly all programs retained three or four units. National Program Standard 3.1 provides a general expectation regarding prior study, and the development of the LANTITE/LANCR test addresses competence in numeracy. However, the outcome was effectively to strengthen mathematics with the inclusion of the additional mathematics unit resulting in the study of four units in mathematics/numeracy.

The GTIL action requiring undergraduate admission to teacher education on the basis of HSC Band 5 results in a minimum of three subjects, one of which must be English, provides for a higher general academic attainment standard and has become a requirement from 2016. The alternative entry pathways include the option for restructured programs to require a full year of discipline study either in another degree or in the first year of the education qualification.

Two possible consequences of these policy developments are first, an incentive to avoid HSC mathematics in favour of other subjects, or to take lower level mathematics courses that the student believes will more easily deliver the necessary Band 5 grades and, second, a desirable strategy of the education degree including an assessment of the entrants' mathematical abilities and knowledge in the first year is sidelined.

It is by no means clear from many of the unit outlines examined that a systematic ascertaining of first year mathematical knowledge is in fact undertaken in all programs. However, it seems that a sensible response to any concerns about the effect of the current policies for mathematics would be solved:

- for programs that comply with the revised GTIL action 1.1 entry standards by requiring ITE students to complete a year of discipline study at the beginning of their degree, to mandate at least one of the units to be in mathematics, and
- for postgraduate programs, by including either a third unit of mathematics in the program or by admitting students only if they can show prior completion of a minimum standard of mathematics.

A number of ITE providers already source introductory or foundational mathematics units from the Mathematics Departments/Schools within their institutions. Some providers make them compulsory for school leavers who have not attained Band 4 in relevant HSC mathematics subjects and in some cases for all students.

The assessing of the actual state of students' level of mathematical understanding early in programs would seem to be fundamental and consistent with the pedagogy advocated within most programs for school teaching and the professional teaching standards. The measures suggested above would accommodate this approach.

The expert panel did not determine any position on prerequisites in mathematics and opinions vary. However, this issue should be formally considered following a wider examination of HSC subjects being currently undertaken by BOSTES.

Nonetheless, the expert panel considered that there are a number of issues that deserve further consideration and made the following recommendation:

Panel Recommendation 2

That the current minimum requirements and expectations for K–6 mathematics and numeracy be reviewed and clarified. This review should:

2.1 assess the adequacy of the unit specifications in Standard 4 of the Standards and Procedures in light of the current practice within programs and the suggestions for best practice by the review

2.2 update where necessary the current K–6 mathematics section within the NSW Subject Content Knowledge requirements

2.3 ensure there is clear advice for ITE providers and accreditation panels as to the necessity for all primary programs to effectively address the full K–6 mathematics syllabus, including the transition phases from early years and into Stage 4

2.4 clarify the relationship between the National Priority Area elaboration in numeracy and the K–6 Mathematics syllabus requirements, ensuring there is clear advice around the importance of a numeracy focus within the mathematics units and across other KLAs

2.5 emphasise the key role of Working Mathematically in underpinning the learning of the content strands and that it should appear as an essential and integral part of the mathematics units, and a developmental approach be taken through and across the stages of the three content strands of the syllabus (Number and Algebra, Measurement and Geometry, Statistics and Probability)

2.6 consider strategies to ensure appropriate prior or concurrent mathematical study for entrants to postgraduate programs.

The review team has further considered these issues in line with the report into primary mathematics prepared by the Office of the Chief Scientist of Australia and secondly the release of the Draft National STEM School Education Strategy by the NSW Department of Education which was adopted by the Education Council of Ministers in December 2015. As the current cycle of ITE program accreditation reviews concluded at the end of 2015, there is an opportunity to provide recommendations prior to the next round of program reviews commencing in 2017. This should take into account any relevant actions from these documents as well as the revised National Standards and Procedures and any relevant outcomes from the review of the NSW HSC sylabuses.

Review Recommendation 2

That BOSTES implement Panel Recommendation 2 taking into account any relevant outcomes from the Education Council regarding the Draft National STEM School Education Strategy, the report from the Office of the Chief Scientist of Australia, in tandem with the revised National Standards and Procedures and the outcomes from the current BOSTES review of the NSW HSC syllabuses. This action should be undertaken as a matter of priority in early 2016 and the national/interstate interest in participating in this work should be investigated with a view to establishing a national benchmark for the preparation to teach primary mathematics.

Review Recommendation 3

That in undertaking the examination of required mathematical study proposed in Panel Recommendation 2.6, BOSTES include the following:

- **advice should be sought from ITE providers on the depth of prior mathematical study undertaken by entrants to postgraduate primary teaching programs**
- **consideration should be given to revising the requirement set out in National Program Standard 3.3 for entry to postgraduate primary teaching programs to include tertiary study across a range of primary learning areas (including mathematics), and**
- **postgraduate programs should provide evidence of strategies to provide additional support to entrants without prior study in mathematics (where there is no requirement set) to ensure they graduate with a robust, deep grasp of the relevant mathematical knowledge and associated pedagogy, and require mathematics teaching during professional experience placements.**

Professional Experience

The importance of pre-service teachers working in actual classrooms, supported by related group activities and simulations, was emphasised by the expert panel. It was noted that while all programs of course met or exceeded the Program Standards for the quantum of professional experience placements, there was considerable variation in the detail of expected placement activities across the programs and units. It is difficult to discern from the unit outlines the extent to which pre-service teachers have the opportunity to engage in the desired activities outlined above by the expert panel.

The expert panel emphasised the importance of pre-service teachers, building on their academic preparation and study of research into mathematics teaching, continually practicing and experiencing the classroom, as well as the possibility of rehearsing lessons with peers in order to develop the practice of teaching and predicting student responses.

The panel gave anecdotal reports of some pre-service teachers not adequately experiencing the delivery of mathematics lessons during their professional placement, or not being permitted to practice their program's desired strategies, as they were not supported by the school or the supervising teacher.

As this review is based on an examination of program documentation and has not engaged in a separate study of the quality of program delivery the extent of such practices cannot be ascertained. However, the variation of unit detail around expectations of professional experience suggests that this is a matter that deserves attention.

As will be noted in the section of the report on assessment tasks, many of the programs, or units within them, include very extensive outlines of tasks to be undertaken in professional experience, including very detailed descriptions and rubrics for classroom-based assessment tasks and sophisticated activities with school students. The approach adopted in these programs should be the benchmark of quality in this regard.

The opportunity exists for ITE providers to build clear expectations for the teaching of mathematics during professional experience placements into professional experience partnership agreements with schools. This would be consistent with the prominence given to English and mathematics within primary school teaching programs in NSW, as

advised by BOSTES (some 45%–55% of total teaching time). While the teaching opportunities available to pre-service teachers when on professional experience must be integrated into the operations of the host school, it should be an achievable requirement for there to be a significant engagement with mathematics teaching and learning activities.

It is acknowledged that considerable pressure exists currently on the availability of placements for professional experience. In part this reflects the absence of an agreed framework for supply/demand for primary teaching between tertiary institutions and schooling authorities. The current policy settings around uncapped places for undergraduate study and funding arrangements exacerbate this situation.

Nonetheless, the focus of this review is on supporting high-quality practice, and it is this that should be built progressively into the emerging professional experience partnership agreements.

In summary, the expert panel noted:

- emerging practices of focusing tutorials around shared practice, reflecting a practicum-like classroom experience, as well as locating tutorials in accessible schools through agreed relationships to allow pre-service teachers to observe and identify good practice
- the importance of formal school–ITE provider partnerships, with strong support for the ongoing implementation of the *Framework for High-Quality Professional Experience Placements in NSW Schools* (the PEX Framework) as outlined by GTIL
- the desirability of renewed efforts to develop supporting resources for supervising and mentoring teachers that embody shared approaches to mathematics teaching and that are explicitly referenced in the design of practicum experiences and assessments
- the desirability of developing professional learning modules for supervision and mentoring in mathematics, building on those currently offered through a number of ITE providers and the AITSL online modules
- a promising strategy of linking groups of pre-service teachers working together with remote schools' online technologies.

Panel Recommendation 3

> That exemplar best practice materials be developed focusing on the teaching of mathematics during professional experience placements that support stronger, clearer shared expectations between the ITE providers and schools, including implications for teaching opportunities, supervisory practice and practicum assessments.

Assessment Strategies

The assessment regime within a program is a powerful message system around the approach to course content and pedagogy. The assessment tasks within units and across the program should reflect the diversity and range of assessments to be applied in school classrooms for a diverse range of school students and should exhibit sufficient breadth and depth to ensure that the graduate has demonstrated the knowledge, understanding and expertise expected by the program/unit intentions and the Graduate Teaching Standards more generally.

The review notes the very strong and detailed approach to assessment tasks exhibited in a number of the programs, in some cases consistently across the program. It further notes the greater capacity to engage pre-service teachers more thoroughly with the content of the program and related practice across the whole syllabus requirements where there are at least three units of mathematical study, and most certainly with four units.

Some examples of good assessment tasks include:

- assessments which involved development of materials, resources, designs and plans which are subsequently implemented. It is noted that not all such resources need to be newly created – there being a legitimate place for the thoughtful selection, application and evaluation of existing instruments and resources
- group creation of resources with individual implementation and evaluation is one indicative approach, with a preference for orientation to practice in assessments rather than reliance on reflections on readings
- assessment tasks which unpack activities in terms of the NSW syllabus outcomes can be part of an approach to adjust programs, streamlining them by focusing on teaching purposes and desired outcomes
- activities which focus on an identified area of weakness within the pre-service teacher's understanding/competence in mathematics, involving the diagnosis/identification of the issue, research and unpacking the issue, preparation of approach to addressing, and mastering the issue, including presentation to peers on the process and outcomes. It was noted that various units do include assessment tasks focused on extended diagnostic activities, analysis, reformulation of teaching strategies, with detailed

assessment instructions involving school students
- annotating and analysing student work samples.

On the other hand, there is evidence in the unit summaries of some programs' excessive reliance on assessment tasks which appeared to be content exams, with little detail about the focus or purpose of such exams and minimal connection evident with pedagogical practice.

The review accepts the challenge for institutions in ensuring integrity in assessments and grades, including the necessity to address the possibility of plagiarism, and recognises the role formal examinations might play in this regard. Nonetheless, the clear superiority of demanding exercises that bring together research, theory/theories and practice, and the evident consistency between this mode of assessment within a program and the generally dominant pedagogical theories and practices put forward for consideration within the program indicates a preferred approach. As mentioned, under the revisions to the National Standards and Procedures, institutions will be required to provide substantial evidence of graduate outcomes to meet re-accreditation requirements. This preferred approach to assessment would provide precisely some of that evidence if folded into the overall design of evidence to be developed.

Suggestions on how to connect intended learning outcomes with exams in ITE include:

- the provision of a rationale and purpose for the exam content
- the inclusion of scenario questions in exams that require responses on how to teach a particular topic to a specified group of students
- essays on theories could also require reference to research evidence and implications for practice.

The expert panel noted that there was a considerable difference between unit assessment tasks where the pre-service teacher was able to implement/deliver/undertake the task in real or virtual time compared to exams, particularly where exams did not reflect the contextualisation of scenario strategies indicated above.

Planning for assessments for school students is a necessary component of teacher preparation, including identification and use of 'assessable moments'. The utility of the 'lesson study' approach was raised as a strategy within the expert panel to bring unit study close to actual practice through shared close examination of a lesson and its strategies.

The utility of portfolios, as opposed to journals as an assessment instrument was supported by the expert panel, including the elements that make it a valuable resource for graduates as well.

The expert panel raised the following further issues in relation to the quality of the programs, as reflected in the standards set through the assessment regime:

- instances of exam-dominated assessments particularly in final year of study, with little demand for demonstration of practice
- that cohorts differ across ITE providers and there is no cross-institutional measure of standards of assessment
- the necessity for an evident standard being embedded in the overall ITE assessment regime that gives confidence that graduates can become effective teachers and that the Graduate Teacher Standards have in fact been realistically met
- the desirability of some process of cross-institutional moderation or benchmarking.

It is proposed by the review that the comments on assessment contained in this report should be incorporated within accreditation panel training and the work undertaken in implementing the relevant recommendations from the review. The individual advices to ITE providers prepared by the review will reflect these comments.

Panel Recommendation 4

That resources to support high-quality and varied assessment strategies and tasks within K–6 mathematics units in ITE programs be developed by BOSTES in partnership with ITE providers. These resources should include exemplars and advice and should draw on the best practices exemplified in programs considered in this review, and should be made available to ITE providers and BOSTES accreditation panels.

Panel Recommendation 5

That BOSTES undertake, in partnership with the NSW Council of Deans of Education and the Deans and Heads of School of the individual ITE providers and under agreed protocols, strategic/targeted cross-institutional benchmarking of assessments within K–6 mathematics.

Feedback to ITE Providers

An important element of this review is the preparation of a brief report to each ITE provider on their program's preparation to teach primary mathematics.

While accepting that all programs have been accredited and as such the minimum requirements have been met by all programs, the review provides an opportunity to provide feedback to institutions on the basis of a professional judgement on the strength of the programs in identified areas of mathematics preparation, and advice drawn from a comparative assessment and identification of strong practice across institutions and programs of different kinds.

Individual reports will be finalised in light of the acceptance of the review final report by BOSTES and the Minister for Education. This is important in that it allows the feedback to be framed in terms of relevant general recommendations for work on improving the practice of mathematics teaching preparation in NSW over the next three years to be integrated into the individual institutional reports. As well, it will allow the individual advice in the reports and any actions proposed by BOSTES to be aligned with the proposed actions to be taken in 2016 following the revision of the Standards and Procedures and its consideration by the NSW Minister for Education for adoption in NSW. Suggestions for this alignment and actions that might support ITE providers in this regard are addressed in Part D.

Panel Recommendation 6

That the review's preparation of individual feedback reports to initial teacher education providers specifically address the following:

6.1 The quality of approach to the NSW syllabus content within the units, including depth of treatment, the place of Working Mathematically, authentic integration across content, and clarity of design for a developmental approach through and across the NSW syllabus strands

6.2 The clarity of approach to pedagogy and assessment in primary mathematics teaching, and its alignment/consistency with the pedagogical practices and assessments employed in delivering the units themselves

6.3 The quality (including variety and purpose) of the assessment tasks within the units.

The three broad focus areas indicated in this recommendation effectively summarise more detailed considerations of the units which are addressed in the following sections of this report.

PART C: TEACHING WITHIN A PROFESSIONAL CONTINUUM

GTIL recognised that teacher preparation extends beyond an initial formal qualification (including in-school professional placements) through induction of graduates into their first teaching engagements, and thereafter through ongoing professional learning as accredited teachers.

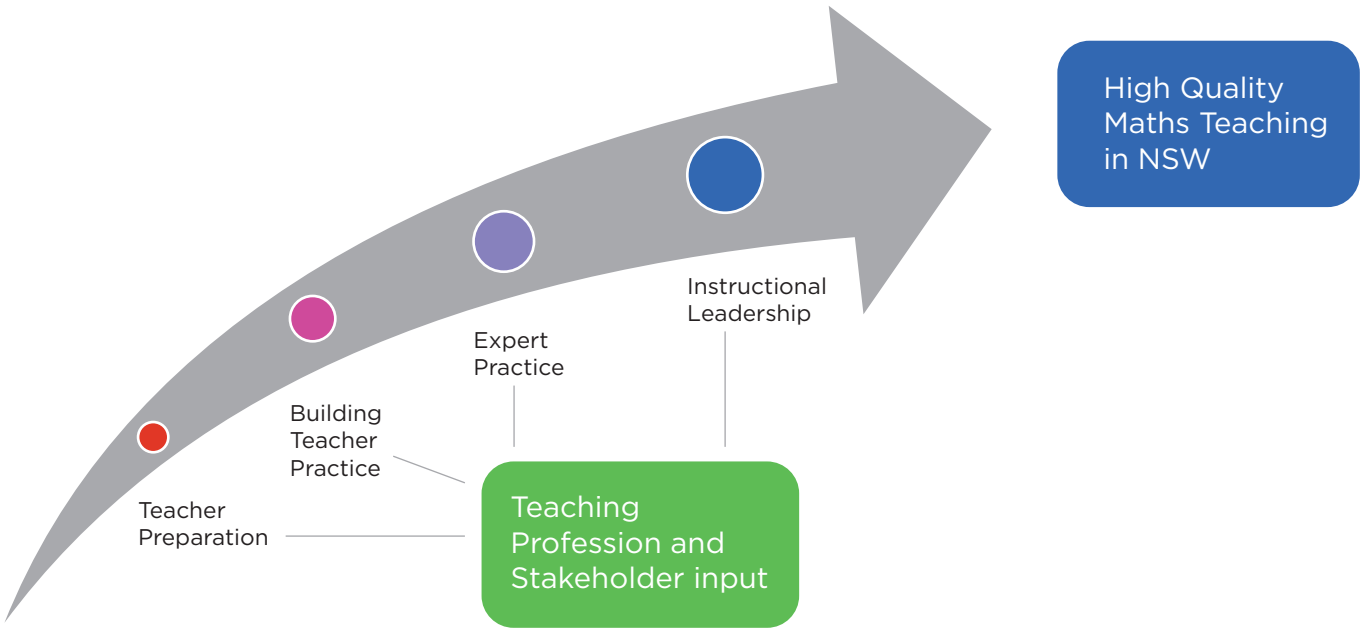
Accordingly, it is important to view ITE units in primary mathematics in the context of the extent to which they provide a sound foundation to this later teacher development. Greater continuity between the content of teacher preparation units in mathematics and the focus of early career induction programs around mathematics teaching would seem to be an obvious professional necessity.

For this to be achieved there needs to be a considerable evolution in the professional dialogue between schools and the ITE providers and the steady development of a more explicit and detailed professional consensus on what constitutes expert primary mathematics teaching, the related reasonable expectations for graduates and for the attainment of Proficient Teaching accreditation, and the necessary components of teacher preparation programs to provide the foundation for this professional continuum.

The expertise of all parts of the profession will be needed to achieve this, building on the best practice that can be identified currently in place in ITE providers and schools. No one part of the profession can achieve such an outcome, yet the ideal of an authoritative professional consensus about expert knowledge and practice in primary mathematics teaching, one that can underpin discernment of emerging innovation that is effective as well as identify fads and poor practice, is of great importance.

The expert panel considered a number of challenges in this regard, along with observing well-researched practice that is effective. Primary mathematics teaching preparation sits as a subset of teacher education generally and is subject to the same general challenges that confront ITE providers, students and schools. Tension between the requirements of schools and systems in terms of numbers of primary teachers needed and the policies and practices of tertiary

A PROFESSIONAL CONTINUUM



institutions, including legislative and funding frameworks, are relevant and well known. Pressure for professional experience placements on schools is enormous in NSW and elsewhere. The lack of engagement with, and responsibility for, the preparation of the next generation of teachers from some schools and teachers, and the expedient practice of accepting supervisors and mentors in schools in some instances irrespective of suitability for the skilled guidance and assessment of pre-service teachers add to the challenges.

Further, any clash between the dominant pedagogical practices of a school, or of the supervising teachers, and that embedded within the teacher education program, needs to be professionally and constructively handled by all concerned.

The expert panel also observed the occurrence of new teachers reverting to forms of practice derived from the memory and experience of their own school days under the pressure of early career teaching, often despite having initially embarked on strategies informed by more recent research and supported practice.

Great Teaching, Inspired Learning

The importance of a number of the GTIL initiatives in regard to these issues, and especially the considerable implementation steps that have been taken, cannot be underestimated. Along with strong practice present in many schools, and in the relationships between schools and ITE providers in many instances, the ongoing GTIL actions provide a platform for further initiatives that can strongly contribute to the more authoritative articulation of a professional consensus around expert teaching. This includes its recognition by the public and our social institutions generally, and the embedding of expert teaching as the touchstone of teacher career development from preparation through to the adoption of instructional leadership in our schools.

Key GTIL actions underway in this regard which address some of these issues, and which can be further developed to strengthen the practice of mathematics teaching in primary schools, and teacher preparation for it, include:

- the requirement for three HSC Band 5 results, including English, for entry into undergraduate programs, or the successful completion of a year of discipline study prior to education studies and accessing a practicum place (GTIL 1.1)
- the development of specialist options within primary teacher preparation programs (GTIL 2.2)
- the annual reviews of aspects of teacher preparation programs (GTIL 3.1)
- the development of a comprehensive Professional Experience Framework governing partnerships between ITE providers and schools, and associated actions from GTIL (GTIL 4)
- the development by the NSW Department of Education of formal individual agreements with universities for high-quality partnerships and improved professional experience practice (GTIL 4.2)
- a significant commitment to funded induction and mentor support across all government schools for new teachers in their first two years (GTIL 6 & 7)
- new performance and development processes negotiated, or under development, in the majority of schools across the sectors, that explicitly apply the Australian Professional Standards for Teaching in shared examination of practice and professional development planning (GTIL 11)
- the inclusion of all NSW teachers within the BOSTES accreditation framework (GTIL 10.1).

Primary Specialisation

Within the GTIL actions under implementation providing for specialist studies in primary programs is particularly significant for this review. Working with ITE providers and other stakeholders BOSTES has prepared a policy framework for optional specialist strands in mathematics, science and technology teaching within both undergraduate and graduate-entry programs. The framework sets out the further units in specialist study required and describes the subject content requirements for these units. At least six units in discipline and related pedagogy are required for undergraduate programs, and three units in graduate-entry programs building on at least four units of discipline study in the underlying undergraduate degree.

The policy includes a number of further quality measures relating to academic attainments, commitment, and specialised support, including through mentoring and professional experience arrangements.

A number of NSW ITE providers will begin offering these specialist options from 2016. Over time and following their induction into teaching and gaining of Proficient Teacher accreditation such teachers will be well placed to become a source of significant support to strong mathematics teaching within their teaching faculties.

The implementation of these specialist studies within NSW primary programs should make a significant contribution to the collaborative approach to further defining a professional consensus around expert mathematics teaching advocate by this review.

This review has identified a number of further steps that should be taken, based on these GTIL initiatives and the accreditation framework that could help address the renewed public agenda for a considerable enhancement of expertise in STEM subjects.

BOSTES

A firm foundation in primary mathematics education is strategically central to a serious focus on improved STEM learning at all levels of education.

An imperative and opportunity exist for there to be a greater degree of explicit professional consensus, based on research and practice, on what comprises high-quality primary mathematics teaching. It is a key element in the definition of professional practice that such an authoritative body of knowledge and accepted standards of practice exist and are shared across all sections of the profession.

The recommendations from this review are directed at the following desirable outcomes:

- There should be strengthened connections between ITE providers and schools around practices in mathematics teaching, including an explicit primary mathematics focus in mentoring, supervision and teacher accreditation.
- Professional development strategies, including BOSTES registered courses for maintenance of accreditation, should be considered as completing the suite of measures directed at an ongoing strengthening of the quality of primary mathematics teaching in NSW schools.
- Mathematics teaching in schools, and the approach to teacher preparation, should be brought together in a number of strategic ways to mutually inform each other and address tensions and clashes of approach that are commonly reported and which were remarked upon in the panel forum.

Indeed without such an approach it is difficult to see how current difficulties commonly reported in practicum placements and graduate school-based assessments can be resolved. This approach should go some way to alleviating the challenges for beginning teachers, as their initial preparation and sometimes settled school approaches to teaching can be in tension or even seriously clash.

A strategic avenue to support such an approach was provided by bringing together the NSW school curriculum and assessment authority and the teaching profession regulatory body within BOSTES in 2014. BOSTES determines the content and requirements of the primary mathematics syllabus in NSW, approves teacher education programs, specifies the requirements for such approvals, develops support materials, determines requirements and monitors processes for teacher accreditation at all levels (Graduate, Proficient, Highly Accomplished and Lead Teacher), and registers professional development courses for the maintenance of accreditation by members of the teaching profession in NSW.

The capacity exists then for new steps to be taken at various points within this range of functions to support the development of a clearer, more explicit shared conception of high-quality primary mathematics teaching, especially by drawing on knowledge and expertise drawn from across the profession.

The following recommendations build on those in PART B directed first at the development of resources to support high-quality assessment tasks within ITE programs and the development of exemplar best practice materials to support the teaching of mathematics during professional experience placements. Both of these will provide the basis for mutual engagement between ITE providers and school supervisors and mentors, and will support the development of more widely shared professional standards and practice.

As new graduates enter the profession they begin to deal with the expectations embedded in the Proficient Teacher standards and through induction, mentoring and developing experience move towards their accreditation as Proficient Teacher.

To support final-year students and new graduates, the expert panel proposed that a resource be developed to help them understand their own developing practice in relation to a broad set of expectations of primary mathematics teaching. This resource would be made available to graduates and their supervisors/mentors in their new schools. It would rely on a subject-specific evidence guide to primary mathematics teaching and would embody a shared understanding of the profession across ITE providers and schools. Developing the resource in the form of a self-assessment tool is not to be construed as the proposal of a new formal assessment within the teaching program, nor an assessment tool for accreditation. Rather it is proposed as

A firm foundation in primary mathematics education is strategically central to a serious focus on improved STEM learning at all levels of education.

a self-assessment tool, with associated evidence guide, that might be shared with induction mentors and teaching colleagues as the graduates develop their expertise and examine their practice within the specific setting of their employment.

Panel Recommendation 7

That BOSTES develop, and make available to graduates, ITE providers and schools, a self-assessment tool for key aspects of K–6 mathematics teaching to support graduating and early career teaching.

Subject-specific Accreditation Guidelines

In 2015, BOSTES commenced a review of the requirements and processes for accreditation at Proficient, Highly Accomplished and Lead Teacher. In NSW there currently exist developed evidence guides to the APST at these three levels. Like the Standards themselves, the evidence guides are generic and apply across the all KLAs and across secondary and primary teaching.

It is not the intention of this review to suggest that the formal architecture of accreditation based around generic teaching standards be changed. However, it can be noted that in secondary teaching, the typical professional qualification and employment of a teacher is in terms of one or two teaching methods and that accreditation as Proficient, Highly Accomplished and Lead Teacher contains a strong, although not exclusive, focus on meeting the relevant standards within the demands of the teaching disciplines and their specific pedagogy. In primary teaching, the typical professional preparation and employment of teachers as generalist teachers demands specific competence within the demands of the six teaching KLAs of the NSW curriculum (English, Mathematics, Human Society and Its Environment, Science and Technology, Creative Arts, Personal Development, Health and Physical Education).

It follows that there is a strong case for resources to be developed, by way of evidence guides at a minimum, perhaps with specific inclusions within the accreditation requirements for the specific demands of individual KLAs to be addressed. In the context of this review, and given the importance of mathematics within the primary curriculum and a public agenda of focusing of high-quality STEM teaching and learning at all levels of education, the knowledge and pedagogy of mathematics should be specifically addressed within the BOSTES accreditation scheme.

The BOSTES review of accreditation processes in 2015 included the commissioning of two reports into the overall accreditation processes and the specific examination of Proficient Teacher accreditation reports and the associated external assessor reports. An implementation plan for the revision and further development of accreditation processes will be developed in early 2016. This presents an ideal opportunity to further the approach of this review that supports development of an authoritative shared professional understanding of high-quality primary mathematics across ITE providers and the profession.

The review envisages that as the specific implications of expert mathematics teaching are articulated at Highly Accomplished and Lead Teaching and built into accreditation processes, greatly strengthened partnerships between ITE providers and schools in this area will be developed. This should include such teachers taking an increasingly authoritative professional leadership role, as well as their oversighting practicum and internship placements, and the induction of new colleagues into the profession (including support towards Proficient Teacher accreditation).

Panel Recommendation 8

That accreditation processes and requirements for Proficient Teacher, Highly Accomplished Teacher and Lead Teacher be revised to incorporate options for the recognition of evidence and practice specific to K–6 mathematics (and in principle, other KLAs) including explicit referencing of supervisory and mentoring practice, particularly with Highly Accomplished and Lead Teacher accreditation.

Mentoring and Induction

The foregoing discussion and recommendation importantly references the explicit expertise in primary mathematics teaching of school-based supervisors and mentors of pre-service teachers and beginning teachers. Their expertise should be consistent with the understanding and expertise of ITE provider-based academic staff who support professional experience placements and the lecturers in primary mathematics units. The review already commented on the necessity for there to be a substantial compulsory component of mathematics teaching by pre-service teachers across their professional experience placements. Further steps are necessary to support the quality of these placements, and ultimately the quality of assessments against mathematics-specific implications of the Graduate Teacher Standards particularly in professional experience assessments.

It is recognised that induction into the profession is primarily the responsibility and prerogative of schools and school authorities. The

capacity for resourcing induction and appropriate time for mentoring activities resides with the schools and their authorities, and schools vary considerably through geography, size and other factors that will affect the approaches they take to supporting new teachers. Further, with many graduates' first experience of teaching being as a casual or temporary teacher, and often across schools or even sectors, the challenge for consistent support for such teachers can be considerable.

Consistent with all of the recommendations from the expert panel, it is imperative that BOSTES work through its relevant committees and in partnership with the teacher education and schools sectors and with strong participation of the profession.

Panel Recommendation 9

That BOSTES explore with schools/employing authorities and ITE providers, the development of specific support materials and targeted professional development for supervisors and mentors of pre-service teachers and beginning teachers (through induction) focusing on K–6 mathematics teaching. An explicit element of this work would be to develop greater continuity and stronger shared approaches to primary mathematics teaching across teacher preparation, induction and proficient and expert practice.

Quality Professional Development

Following their induction NSW teachers undertake accreditation as Proficient Teacher, on the basis of the APST. This then begins a five-year cycle (for full-time teachers, seven years for part-time and casual teachers) of maintenance of accreditation. Annual performance and development processes linked to the Standards are being introduced within the different schooling sectors. Teachers undertake professional development activities and courses including those drawn from the professional development register, as well as completing a maintenance of accreditation report.

The Quality Teaching Council (QTC) approves professional development providers in NSW for this purpose and registers individual courses.

There are a number of courses focused on primary mathematics available to teachers within this framework. It would be consistent with the directions of the recommendations of this review for these courses to be clearly aligned with a professional consensus as to the best practice in primary mathematics teaching. As all sections of the profession are being invited to participate in a number of projects to more clearly develop such a consensus across pre-service through to Highly Accomplished and Lead Teacher accreditation, it follows that the supporting professional development courses available for primary mathematics should embody the best practice identified in this process.

Review Recommendation 4

That BOSTES develop a process to review and assess the quality of QTC registered professional development courses addressing primary mathematics and numeracy and that this assessment be communicated to accredited primary teachers.

Way Forward

It would be desirable for BOSTES to prepare an implementation plan that brings together all of the recommended actions from this review. The establishment of a representative and expert Primary Mathematics Advisory Group, that incorporates explicit links with the Mathematics Association of NSW in its work program, could be given a three-year time frame to steer the full implementation of these recommendations.

It is of course the prerogative of BOSTES to determine the appropriate processes to address these issues.

Review Recommendation 5

That BOSTES work with relevant stakeholders to develop an implementation plan for the recommendations of this review for the next three years.

The implementation plan should consider the inclusion of an annual conference held in NSW to be organised by a representative stakeholder group led by BOSTES to promote and recognise that high-quality primary mathematics teaching is a shared enterprise across the profession.

PART D: ACCREDITATION 2016 AND BEYOND

While this review was being finalised, revised National Standards and Procedures for the program accreditation were approved by the Education Council of Ministers.

The first essential change is the addition of a requirement at initial accreditation of a program for a plan for demonstrating the impact of the program (to outline an approach to evidence of graduate performance and program outcomes that will form the basis of re-accreditation). Re-accreditation will be on the basis of:

- an analysis and interpretation of evidence as outlined in the initial plan for demonstrating impact in relation to graduate performance, graduate outcomes and program changes and planned improvements
- an updated plan for collecting evidence over the next accreditation period
- evidence of adherence to the Program Standards.

The revised system, if adopted in NSW, would be phased in. In NSW, all programs – including those reviewed in this report – would be required to prepare and submit to BOSTES in 2016 a plan of evidence in relation to the quality of the program.

As currently accredited NSW programs will be scheduled for re-accreditation from 2017 to 2020, the plans of evidence for programs distributed over this period will necessarily be of differing degrees of detail, given the limited opportunity for such evidence gathering for programs due for re-accreditation early in this period.

The nature of the current review into K–6 Mathematics teacher preparation has been necessarily restricted to a consideration of the unit outlines for mathematics, essentially a consideration of the program designs in this area. It could not extend to an examination of the quality of the delivery of the program, and had no access to data on program outcomes.

As is clear from Part B of the review and Appendix 5, while a comparative examination of the design of the programs can give a degree of insight into the probable capacity of the respective programs to prepare graduates well for beginning to teach primary mathematics, design is not delivery.

This review considers there is considerable merit in BOSTES working with NSW ITE providers in early 2016 to develop a number of options to generate credible evidence of the quality of program delivery, including the capacity of graduates and the overall outcomes of the programs.

The revised Standards and Procedures envisage annual reports that will address agreed areas, and the plan for data to underpin re-accreditation. GTIL requires annual reviews of selected areas of ITE programs. This K–6 mathematics review is one and reviews were also completed in 2014 on Classroom Management and Special Education and Literacy Learning in the Early Years.

It seems that an opportunity exists for the general findings of these reviews, along with the specific advice to ITE providers regarding their particular programs to be integrated into the annual reports from ITE providers and into possible focus areas for evidence to be addressed in re-accreditation.

One advantage of such an approach would be to maximise the value to ITE providers of the involvement they have in the reviews undertaken by BOSTES and to fold any responses that might be appropriate to either general findings or provider-specific advice into the planned approach to re-accreditation.

This would also provide an avenue, within the emerging procedures rather than external to them, for important matters of professional knowledge and practice in teacher preparation identified by such reviews, to be addressed in a timely manner.

Panel Recommendation 6 included in PART B already proposes that

BOSTES and the NSW Council of Deans pursue a cross-institutional benchmarking of assessments within K–6 mathematics units. This could constitute a prime example of the general approach proposed here, with outcomes from that exercise informing institutional responses in annual reports as well as providing the basis for evidence of program quality and actions to adapt programs on the basis of relevant findings.

In light of the other recommendations included within this review report, there is the opportunity for BOSTES and ITE providers to develop specific agreed options for inclusion within the proposed 2016 initial plans for evidence to underpin re-accreditation. Planning for 2017 and 2018 re-accreditations would necessarily need to be realistic in their expectations. Given the centrality of mathematics within primary school teaching it would be desirable for BOSTES to pursue with ITE providers the inclusion of aspects of the recommendations of this review within the new processes, at the very least as options but preferably with some commonality across all institutions.

Review Recommendation 6

That BOSTES work with ITE providers to include issues identified in the recommendations from this review in their plans for demonstrating impact as required under the revised National Standards and Procedures for ITE program accreditation.

PART E: RECOMMENDATIONS

Recommendations from this review are in two parts. First, the expert panel was convened by the BOSTES review team on 7 October 2015 to consider the summaries of units across all programs devoted to K–6 mathematics. These recommendations are included here in full.

Second, the review team developed further recommendations during the preparation of the report and drafting the individual advice to each ITE provider. These further recommendations are in part procedural in relation to the substantive recommendations from the expert panel, designed to promote an effective and expeditious work plan to implement them. Further recommendations are substantive and were developed with the advantage of advice on the final draft of the revised Standards and Procedures that was considered by the Education Council of Ministers in December 2015, the drawing out of more explicit suggestions from the deliberations of the expert panel, specialist input from the BOSTES Mathematics and Primary Inspectors, and consideration of relevant reports and research material.

Recommendations from the Expert Panel

The expert panel proposed a number of actions to be considered for implementation by BOSTES through its relevant committees and in partnership with the teacher education and school sectors, and the full engagement of the profession generally within any working committees or reference groups for particular initiatives. An explicit intention of the work proposed by these recommendations would be to develop greater continuity and stronger shared approaches to primary mathematics teaching across teacher preparation, induction and proficient and expert practice.

Panel Recommendations

Panel Recommendation 1

That BOSTES lead development of support materials which address issues/options/strategies for ways mathematics units might incorporate a number of the Graduate Teacher Standards, including:

- Standard 1.1.1 (eg mathematics anxiety; confidence and competence)
- Standard 1.2.1 (how students learn mathematics and implications for teaching)
- Standard 1.3.1 (how to cater for students who are not fluent in English)
- Standard 1.5.1 (differentiation)
- Standard 2.6.1/3.4.1 (use of technology in mathematics)
- Standard 3.4.1/3.5.1/4.1.1 (engagement/participation)
- Standard 3.6.1 (evaluation of teaching programs)
- Standard 5.1.1/5.3.1 (assessment)
- Standard 5.2.1 (feedback to students).

Panel Recommendation 2

That the current minimum requirements and expectations for K–6 mathematics and numeracy be reviewed and clarified. This review should:

2.1 assess the adequacy of the unit specifications in Standard 4 of the Standards and Procedures in light of the current practice within programs and the suggestions for best practice by the review

2.2 update where necessary the current K–6 mathematics section within the NSW Subject Content Knowledge requirements

2.3 ensure there is clear advice for ITE providers and accreditation panels as to the necessity for all primary programs to effectively address the full K–6 Mathematics syllabus, including the transition phases from early years and into Stage 4

2.4 clarify the relationship between the National Priority Area elaboration in numeracy and the K–6 Mathematics syllabus requirements, ensuring there is clear advice around the importance of a numeracy focus within the Mathematics units and across other KLAs

2.5 emphasise the key role of the Working Mathematically strand in underpinning the learning of the content strands and that it should appear as an essential and integral part of the mathematics units, and a developmental approach be taken through and across the stages of the three content strands of the syllabus (Number and Algebra, Measurement and Geometry, Statistics and Probability)

2.6 consider strategies to ensure appropriate prior or concurrent mathematical study for entrants to postgraduate programs.

Panel Recommendation 3

That exemplar best practice materials be developed focusing on the teaching of mathematics during professional experience placements that support stronger, clearer shared expectations between the ITE providers and schools, including implications for teaching opportunities, supervisory practice and practicum assessments.

Panel Recommendation 4

That resources to support high-quality and varied assessment strategies and tasks within K–6 mathematics units in ITE programs be developed by BOSTES in partnership with ITE providers. These resources should include exemplars and advice and should draw on the best practices exemplified in programs considered in this review, and should be made available to ITE providers and BOSTES accreditation panels.

Panel Recommendation 5

That BOSTES undertake, in partnership with the NSW Council of Deans of Education and the Deans and Heads of School of the individual ITE providers and under agreed protocols, strategic/targeted cross-institutional benchmarking of assessments within K–6 mathematics.

Panel Recommendation 6

That the review's preparation of individual feedback reports to initial teacher education providers specifically address the following:

6.1 the quality of approach to the NSW syllabus content within the units, including depth of treatment, the place of Working Mathematically, authentic integration across content, and clarity of design for a developmental approach through and across the NSW syllabus strands

6.2 the clarity of approach to pedagogy and assessment in primary mathematics teaching, and its alignment/consistency with the pedagogical practices and assessments employed in delivering the units themselves

6.3 the quality (including variety and purpose) of the assessment tasks within the units.

Panel Recommendation 7

That BOSTES develop, and make available to graduates, ITE providers and schools, a self-assessment tool for key aspects of K–6 Mathematics teaching to support graduating and early career teaching.

Panel Recommendation 8

That accreditation processes and requirements for Proficient Teacher, Highly Accomplished Teacher and Lead Teacher be revised to incorporate options for the recognition of evidence and practice specific to K–6 Mathematics (and in principle, other KLAs) including explicit referencing of supervisory and mentoring practice, particularly with Highly Accomplished and Lead Teacher accreditation.)

Panel Recommendation 9

That BOSTES explore with schools/employing authorities and ITE providers, the development of specific support materials and targeted professional development for supervisors and mentors of pre-service teachers and beginning teachers (through induction) focusing on K–6 mathematics teaching. An explicit element of this work would be to develop greater continuity and stronger shared approaches to primary mathematics teaching across teacher preparation, induction and proficient and expert practice.

Review Recommendations

Review Recommendation 1

That BOSTES prepare a guide to existing resources and exemplars illustrating ways numeracy can be addressed authentically across the curriculum for advice to ITE providers.

Review Recommendation 2

That BOSTES implement Panel Recommendation 2 taking into account any relevant outcomes from the Education Council regarding the Draft National STEM School Education Strategy, the report from the Office of the Chief Scientist of Australia, in tandem with the revised National Standards and Procedures and the outcomes from the current BOSTES review of the NSW HSC syllabuses. This action should be undertaken as a matter of priority in early 2016 and the national/interstate interest in participating in this work should be investigated with a view to establishing a national benchmark for the preparation to teach primary mathematics.

Review Recommendation 3

That in undertaking the examination of required mathematical study proposed in Panel Recommendation 2.6, BOSTES include the following:

- advice should be sought from ITE providers on the depth of prior mathematical study undertaken by entrants to postgraduate primary teaching programs
- consideration should be given to revising the requirement set out in National Program Standard 3.3 for entry to postgraduate primary teaching programs to include tertiary study across a range of primary learning areas (including mathematics), and
- postgraduate programs should provide evidence of strategies

to provide additional support to entrants without prior study in mathematics (where there is no requirement set) to ensure they graduate with a robust, deep grasp of the relevant mathematical knowledge and associated pedagogy and require mathematics teaching during professional experience placements.

Review Recommendation 4

That BOSTES develop a process to review and assess the quality of QTC registered professional development courses addressing primary mathematics and numeracy and that this assessment be communicated to accredited primary teachers.

Review Recommendation 5

That BOSTES work with relevant stakeholders to develop an implementation plan for the recommendations of this review for the next three years.

The implementation plan should consider the inclusion of an annual conference held in NSW to be organised by a representative stakeholder group led by BOSTES to promote and recognise that high-quality primary mathematics teaching is a shared enterprise across the profession.

Review Recommendation 6

That BOSTES work with ITE providers to include issues identified in the recommendations from this review in their plans for demonstrating impact as required under the revised National Standards and Procedures for ITE program accreditation.

APPENDIX 1: GRADUATE TEACHER STANDARDS

National Graduate Teacher Standards

The Graduate Teacher Standards make explicit the professional expectations of those graduating from initial teacher education programs. They describe the professional knowledge, professional practice and professional engagement at the first of the four career stages defined in the *Australian Professional Standards for Teachers*. Because they define what graduate teachers should know and be able to do, the Graduate Teacher Standards are the key to the accreditation of programs.

For programs to be accredited, providers need to show how their graduates meet the Graduate Teacher Standards.

The following is an extract from the *Australian Professional Standards for Teachers* that describes the Graduate Teacher Standards. The Standards have been developed, revised and validated through nationwide consultation and a national validation process involving several thousand teachers across the country.

Graduate teachers

Graduate teachers have completed a qualification that meets the requirements of a nationally accredited program of initial teacher education. The award of this qualification means that they have met the Graduate Teacher Standards.

On successful completion of their initial teacher education, graduate teachers possess the requisite knowledge and skills to plan for and manage learning programs for students. They demonstrate knowledge and understanding of the implications for learning of students' physical, cultural, social, linguistic and intellectual characteristics. They understand principles of inclusion and strategies for differentiating teaching to meet the specific learning needs of students across the full range of abilities.

Graduate teachers have an understanding of their subject/s, curriculum content and teaching strategies. They are able to design lessons that meet the requirements of curriculum, assessment and reporting. They demonstrate the capacity to interpret student assessment data to evaluate student learning and modify teaching practice. They know how to select and apply timely and appropriate types of feedback to improve students' learning.

Graduate teachers demonstrate knowledge of practical strategies for creating rapport with students and managing student behaviour. They know how to support students' wellbeing and safety working within school and system curriculum and legislative requirements.

They understand the importance of working ethically, collaborating with colleagues, external professional and community representatives, and contributing to the life of the school. Teachers understand strategies for working effectively, sensitively and confidentially with parents/carers and recognise their role in their children's education.

Professional Knowledge

Standard 1 — Know students and how they learn

Focus area	Graduate
1.1 Physical, social and intellectual development and characteristics of students	Demonstrate knowledge and understanding of physical, social and intellectual development and characteristics of students and how these may affect learning.
1.2 Understand how students learn	Demonstrate knowledge and understanding of research into how students learn and the implications for teaching.
1.3 Students with diverse linguistic, cultural, religious and socioeconomic backgrounds	Demonstrate knowledge of teaching strategies that are responsive to the learning strengths and needs of students from diverse linguistic, cultural, religious and socioeconomic backgrounds.
1.4 Strategies for teaching Aboriginal and Torres Strait Islander students	Demonstrate broad knowledge and understanding of the impact of culture, cultural identity and linguistic background on the education of students from Aboriginal and Torres Strait Islander backgrounds.
1.5 Differentiate teaching to meet the specific learning needs of students across the full range of abilities	Demonstrate knowledge and understanding of strategies for differentiating teaching to meet the specific learning needs of students across the full range of abilities.
1.6 Strategies to support full participation of students with disability	Demonstrate broad knowledge and understanding of legislative requirements and teaching strategies that support participation and learning of students with disability.

Standard 2 — Know the content and how to teach it

Focus area	Graduate
2.1 Content and teaching strategies of the teaching area	Demonstrate knowledge and understanding of the concepts, substance and structure of the content and teaching strategies of the teaching area.
2.2 Content selection and organisation	Organise content into an effective learning and teaching sequence.
2.3 Curriculum, assessment and reporting	Use curriculum, assessment and reporting knowledge to design learning sequences and lesson plans.
2.4 Understand and respect Aboriginal and Torres Strait Islander people to promote reconciliation between Indigenous and non-Indigenous Australians	Demonstrate broad knowledge of, understanding of and respect for Aboriginal and Torres Strait Islander histories, cultures and languages.
2.5 Literacy and numeracy strategies	Know and understand literacy and numeracy teaching strategies and their application in teaching areas.
2.6 Information and Communication Technology (ICT)	Implement teaching strategies for using ICT to expand curriculum learning opportunities for students.

Professional Practice

Standard 3 — Plan for and implement effective teaching and learning

Focus area	Graduate
3.1 Establish challenging learning goals	Set learning goals that provide achievable challenges for students of varying abilities and characteristics.
3.2 Plan, structure and sequence learning programs	Plan lesson sequences using knowledge of student learning, content and effective teaching strategies.
3.3 Use teaching strategies	Include a range of teaching strategies.
3.4 Select and use resources	Demonstrate knowledge of a range of resources, including ICT, that engage students in their learning.
3.5 Use effective classroom communication	Demonstrate a range of verbal and non-verbal communication strategies to support student engagement.
3.6 Evaluate and improve teaching programs	Demonstrate broad knowledge of strategies that can be used to evaluate teaching programs to improve student learning.
3.7 Engage parents/carers in the educative process	Describe a broad range of strategies for involving parents/ carers in the educative process.

Standard 4 — Create and maintain supportive and safe learning environments

Focus area	Graduate
4.1 Support student participation	Identify strategies to support inclusive student participation and engagement in classroom activities.
4.2 Manage classroom activities	Demonstrate the capacity to organise classroom activities and provide clear directions.
4.3 Manage challenging behaviour	Demonstrate knowledge of practical approaches to manage challenging behaviour.
4.4 Maintain student safety	Describe strategies that support students' well-being and safety working within school and/or system, curriculum and legislative requirements.
4.5 Use ICT safely, responsibly and ethically	Demonstrate an understanding of the relevant issues and the strategies available to support the safe, responsible and ethical use of ICT in learning and teaching.

Standard 5 — Assess, provide feedback and report on student learning	
Focus area	**Graduate**
5.1 **Assess student learning**	Demonstrate understanding of assessment strategies, including informal and formal, diagnostic, formative and summative approaches to assess student learning.
5.2 **Provide feedback to students on their learning**	Demonstrate an understanding of the purpose of providing timely and appropriate feedback to students about their learning.
5.3 **Make consistent and comparable judgements**	Demonstrate understanding of assessment moderation and its application to support consistent and comparable judgements of student learning.
5.4 **Interpret student data**	Demonstrate the capacity to interpret student assessment data to evaluate student learning and modify teaching practice.
5.5 **Report on student achievement**	Demonstrate understanding of a range of strategies for reporting to students and parents/carers and the purpose of keeping accurate and reliable records of student achievement.

Professional Engagement

Standard 6 — Engage in professional learning

Focus area	Graduate
6.1 Identify and plan professional learning needs	Demonstrate an understanding of the role of the Australian Professional Standards for Teachers in identifying professional learning needs.
6.2 Engage in professional learning and improve practice	Understand the relevant and appropriate sources of professional learning for teachers.
6.3 Engage with colleagues and improve practice	Seek and apply constructive feedback from supervisors and teachers to improve teaching practices.
6.4 Apply professional learning and improve student learning	Demonstrate an understanding of the rationale for continued professional learning and the implications for improved student learning.

Standard 7 — Engage professionally with colleagues, parents/carers and the community

Focus area	Graduate
7.1 Meet professional ethics and responsibilities	Understand and apply the key principles described in codes of ethics and conduct for the teaching profession.
7.2 Comply with legislative, administrative and organisational requirements	Understand the relevant legislative, administrative and organisational policies and processes required for teachers according to school stage.
7.3 Engage with the parents/carers	Understand strategies for working effectively, sensitively and confidentially with parents/carers.
7.4 Engage with professional teaching networks and broader communities	Understand the role of external professionals and community representatives in broadening teachers' professional knowledge and practice.

APPENDIX 2: NSW SUBJECT CONTENT KNOWLEDGE REQUIREMENTS

PRIMARY UNDERGRADUATE AND GRADUATE STUDY REQUIRED TO MEET AUSTRALIAN GRADUATE TEACHER STANDARD DESCRIPTOR 2.1.1

Undergraduate initial teacher education program	Graduate-entry initial teacher education program
Type of program	
At least a four-year undergraduate integrated professional qualification, eg Bachelor of Education (Primary), or an undergraduate combined or double degree covering discipline knowledge and professional studies, eg Bachelor of Arts/Bachelor of Education (Primary) or Bachelor of Science/Bachelor of Teaching (Primary)	A graduate-entry initial teacher education qualification of at least two years of equivalent full-time study (2 EFTSL), eg graduate-entry Bachelor of Teaching (Primary) or Bachelor of Education (Primary), or Master of Teaching (Primary)
Relevant to National Program Standard 3.1 – entry standards and capacity to engage in a rigorous higher education program and the intellectual demands of teaching	
Programs will be approved for the purposes of teacher accreditation where: ▶ the program's entry standards are: ▶ at least three HSC Band 5 results one of which must be English; or ▶ HSC results and the successful completion of one or more bridging units in discipline areas to achieve the equivalent of at least three HSC Band 5s including English; or ▶ the completion of at least a full year of discipline studies in another higher education award (eg first year of a Bachelor of Arts or a one year Diploma of Arts); or ▶ admission through a bona fide alternative admission pathway that has been approved by BOSTES as being comparable to at least three Band 5s including English. OR the program is a double degree or combined degree program that is structured so that a full year of approved discipline studies is successfully completed prior to any discipline-specific curriculum and pedagogical studies and any supervised professional experience placement.	Completion of a relevant undergraduate degree (and, if applicable, appropriate postgraduate studies) that includes at least one year of full- time equivalent study (1 EFTSL) relevant to one or more learning areas of the primary school curriculum.1 For areas of study related to a Learning Areas see Column 4, pp. 5-10. A decision on appropriate study as described in this document is determined by the provider. 1A provider may require an applicant who does not meet these requirements to complete concurrent study or appropriate bridging units before graduation.
Relevant to National Program Standard 3.1 – personal literacy and numeracy equivalent to the top 30% of the population	
In NSW this is demonstrated by successful completion of the BOSTES-approved personal literacy and numeracy assessment before the final professional experience placement and prior to graduation.	In NSW this is demonstrated by successful completion of the BOSTES-approved personal literacy and numeracy assessment before the final professional experience placement and prior to graduation

Undergraduate initial teacher education program	Graduate-entry initial teacher education program
Relevant to National Program Standard 4 – program structure and content	
Programs must include study in each of the learning areas of the primary school curriculum sufficient to equip teachers to teach across the years of primary schooling. At least two years of full-time equivalent study (2.0 EFTSL) must be dedicated to the study of the discipline of each Key Learning Area and discipline-specific curriculum and pedagogical studies. This must include at least 0.25 EFTSL of discipline and discipline-specific curriculum and pedagogical studies in each of **English/literacy**, **mathematics/numeracy**, and at least 0.125 EFTSL of discipline-specific curriculum and pedagogical studies in **science**. Unit study may integrate and balance discipline knowledge with pedagogy. In NSW, a recommended allocation of discipline and discipline-specific curriculum and pedagogical studies continues to be at least two units for each Key Learning Area. The remainder of the program may be structured to include extension or specialist studies in priority areas or related curriculum areas. **English/literacy** studies must have a strong literacy focus and include the pedagogy of reading, with a range of models including instruction on how to teach phonemic awareness, phonics, fluency, vocabulary knowledge, grammar and text comprehension, writing, spelling, speaking and listening and related issues of child development and inclusiveness. **Mathematics/numeracy** studies must have a strong numeracy focus with emphasis on the foundation concepts of quantity, measurement, spatial representation, generalisation and mathematical reasoning.	Programs must include study in each of the learning areas of the primary school curriculum sufficient to equip teachers to teach across the years of primary schooling. Programs must comprise at least two years of full-time equivalent (2.0 EFTSL) professional studies in education which include at least one year of full-time equivalent study of discipline-specific curriculum and pedagogical studies across the Key Learning Areas of the primary school curriculum. This must include at least 0.25 EFTSL of discipline-specific curriculum and pedagogical studies in each of **English/literacy** and **mathematics/numeracy**, and at least 0.125 EFTSL of discipline-specific curriculum and pedagogical studies in **science**. In NSW, a recommended allocation of discipline-specific curriculum and pedagogical studies continues to be at least one unit for each Key Learning Area. Programs may include up to 0.25 EFTSL of relevant discipline studies as elective units which could be undertaken by applicants who do not fully meet prerequisite discipline study requirements. **English/literacy** studies must have a strong literacy focus and include the pedagogy of reading, with a range of models including instruction on how to teach phonemic awareness, phonics, fluency, vocabulary knowledge, grammar and text comprehension, writing, spelling, speaking and listening and related issues of child development and inclusiveness. **Mathematics/numeracy** studies must have a strong numeracy focus with emphasis on the foundation concepts of quantity, measurement, spatial representation, generalisation and mathematical reasoning.

PRIMARY MATHEMATICS KEY LEARNING AREA

STANDARD 2: KNOW THE CONTENT AND HOW TO TEACH IT

Undergraduate initial teacher education programs must include study of content described in the *Relevant areas of discipline study for inclusion in an undergraduate program* column below.

Admissions to Graduate-entry initial teacher education programs must have completed undergraduate study as per the *Relevant areas of discipline study for admission to a graduate-entry program* column below.

Descriptor 2.1.1		Relevant areas of discipline study for inclusion in an undergraduate program	Relevant areas of discipline study for admission to a graduate-entry program
Demonstrate knowledge and understanding of the concepts, substance and structure of the content and teaching strategies of the teaching area	**Content**	▶ nature and role of mathematics in describing and modelling patterns and relationships that can be generalised, and as a means of interpreting the world ▶ broad and critical knowledge and understanding of the mathematics discipline ▶ nature and role of mathematics as a form of communication and thinking ▶ function of mathematics as a language to meet social, aesthetic and cultural needs ▶ mathematical concepts and processes: such as Hindu–Arabic numeration system, quantification of space and time, geometries ▶ working with data (basic statistical literacy) including planning, gathering, organizing, applying data to solve problems, and communicating results through the selection of appropriate representations	Areas of discipline study related to the Mathematics Key Learning Area are: ▶ pure or applied mathematics ▶ other studies of mathematics that are relevant to the central concepts, modes of enquiry and structure of the content/ discipline(s) (only one unit of statistics may be counted)
	Teaching Strategies	▶ knowledge base underpinning the principles and practices of teaching and learning mathematics ▶ models of pedagogy for teaching and assessing primary mathematics ▶ range of strategies for teaching and assessing primary mathematics ▶ mathematical thinking and problem-solving techniques ▶ planning, conducting and communicating results of mathematical processes ▶ central ideas in mathematics and common student misconceptions ▶ ways of differentiating curriculum to meet the diverse needs of learners in the mathematics classroom ▶ role and value of mathematics in the broader school curriculum and the relationship between mathematics, numeracy and literacy ▶ place of primary mathematics in the continuum of learning in K–12, including a particular understanding of the links between Stage 3 and Stage 4 ▶ Mathematics K–6 Syllabus, Support Documents and NSW Primary Curriculum Foundation Statements	

APPENDIX 3: NATIONAL PROGRAM STANDARDS

Standard 4: Program structure and content

4.1 Program structures must be sequenced coherently to reflect effective connections between theory and practice.

4.2 Professional studies in education include discipline-specific curriculum and pedagogical studies, general education studies and professional experience. The professional studies in education will comprise at least two years of full-time equivalent study.

4.3 Discipline studies will normally be completed either in a separate discipline degree completed prior to a graduate-entry initial teacher education program, or as part of an integrated undergraduate teaching degree or combined teaching/discipline degree program.

4.4 Primary programs

Teacher education programs that prepare primary teachers must include study in each of the learning areas of the primary school curriculum sufficient to equip teachers to teach across the years of primary schooling.

In undergraduate primary programs, at least one half of the program (ie normally two years of full-time equivalent study) must be dedicated to the study of the discipline of each primary learning area and discipline-specific curriculum and pedagogical studies. This must include at least one-quarter of a year of full-time equivalent study of discipline and discipline-specific curriculum and pedagogical studies in each of English/literacy, mathematics/numeracy, and at least one-eighth of a year of full-time equivalent study of discipline-specific curriculum and pedagogical studies in science.

The remainder of the program may be structured to include extension or specialist studies in priority areas or related curriculum areas.

Graduate-entry primary programs must comprise at least two years of full-time equivalent professional studies in education.

These programs must include at least one year of full-time equivalent study of discipline-specific curriculum and pedagogical studies across the learning areas of the primary school curriculum. Programs must include at least one-quarter of a year of full-time equivalent study of discipline-specific curriculum and pedagogical studies in each of English/literacy and mathematics/numeracy, and at least one-eighth of a year of full-time equivalent study of discipline-specific curriculum and pedagogical studies in science.

These programs may include up to one-quarter of a year of full-time equivalent study of relevant discipline studies as elective units which could be undertaken by applicants who do not fully meet prerequisite discipline study requirements.

APPENDIX 4: NATIONAL PRIORITY AREA – LITERACY AND NUMERACY

Initial teacher education program outcomes

Initial teacher education programs should ensure that graduate teachers have demonstrated skills and/or knowledge, as noted below.

Knowledge

- Understanding of the literacy and numeracy demands of the curriculum areas they teach
- Understanding of the pervasive nature of literacy and numeracy and their role in everyday situations, and of the importance of home and community literacy and numeracy practices
- Awareness that all students can be literate and numerate
- Understanding of the diversity of literacy and numeracy abilities and the needs of learners, including English as a Second or Other Language needs
- Understanding of the explicit teaching of reading and writing, speaking and listening appropriate to their level and area of teaching
- Sound knowledge of mathematics appropriate to their level and area of teaching
- Knowledge of contemporary understanding of research evidence related to teaching reading, writing, speaking, listening and mathematics appropriate to their level and area of teaching
- Knowledge of a range of resources to support students' literacy and numeracy learning, appropriate to their level and area of teaching.

Teaching strategies

- Ability to identify the literacy and numeracy needs of students and understand a range of strategies to support those needs
- Ability to analyse the literacy and numeracy demands of the subjects and curriculum in their teaching areas
- Ability to recognise and exploit opportunities to support literacy and numeracy learning within their curriculum areas
- Ability to develop units of work and teaching plans that embody a literacy and numeracy focus and incorporate the effective use of literacy and numeracy strategies and assessment tasks to inform teaching and the selection of subject matter
- Ability to analyse student work samples to identify areas of literacy and numeracy need
- Ability to provide accurate written and oral feedback for students in relation to their literacy and numeracy development
- Ability to develop specific strategies to cater for students requiring additional support
- Ability to interpret data (school-based and system) to make informed decisions about student literacy and numeracy needs in the context of their subject and in a broader whole school context
- Ability to teach reading and writing, speaking and listening and mathematics appropriate to their level and area of teaching using approaches based on knowledge and evidence
- Where relevant, ability to use a range of effective teaching and assessment strategies in reading, writing, speaking, listening and mathematics
- Where relevant, ability to sequence reading, writing and mathematical learning experiences appropriately.

Program design

Initial teacher education programs may address these issues in specific units of study or by embedding them across the program of study.

The Ministers' priority areas link to the Australian Professional Standards for Teachers (Graduate stage). All professional standards have a bearing on the skills and abilities required by the priority areas. .

The literacy and numeracy priority area is specifically relevant to the Standards noted below

Standard 2: Know the content and how to teach it **Focus area 2.1**: Content and teaching strategies of the teaching area	**Standard 2: Know the content and how to teach it** **Focus area 2.5**: Literacy and numeracy strategies

APPENDIX 5: PROVIDER SUMMARIES

BOSTES Summaries of K–6 Mathematics Units from Initial Teacher Education Providers

The following unit outlines are summaries developed by the BOSTES review team that have been approved by each initial teacher education provider as a true reflection of each institutions program and units of study.

Summaries from the 14 initial teacher education providers are listed in this document in their alphabetical order:

1. Alphacrucis College
2. Australian Catholic University
3. Avondale – College of Higher Education
4. Charles Sturt University
5. Excelsia College
6. Macquarie University
7. Southern Cross University
8. University of Newcastle
9. University of New England
10. University of Notre Dame Australia – Sydney Campus
11. University of Sydney
12. University of Technology, Sydney
13. University of Wollongong
14. Western Sydney University

ALPHACRUCIS COLLEGE

Alphacrucis College offers:

- **Bachelor of Education (Primary)**
- **Master of Teaching (Primary)**

Preparation to teach K–6 Mathematics

1 Approach

- Alphacrucis College provides a four-year program in primary education, in which three core units cover mathematics and numeracy. Content is taught in the context of a Christian Worldview.
- In the first year of study, students are introduced to numeracy as a theoretical concept and how it and literacy are used in all learning areas. It is in the second and third year that students are introduced to discipline and pedagogical studies in mathematics, including how to teach mathematics in different learner contexts.
- Most of the assessments focus on teaching mathematics, and incorporating issues observed in the classroom to research and theoretical understanding. The students' numeracy knowledge is tested once in their second year to assess their knowledge at General Mathematics HSC level.
- Alphacrucis also provides a two-year master of teaching primary program which contains two core units of learning and teaching mathematics.
- The units focus on mathematics curriculum, the teaching and learning of mathematics, teaching pedagogies for conceptual development, incorporating ICT, integration across curriculum, differentiation and assessment.
- The assessments focus on getting students to develop skills in becoming reflective practitioners.

2 Content

(a) CRS104 Numeracy and Literacy

This unit provides a theoretical and practical overview of literacy and numeracy, and its application and integration with other learning areas in addition to English and Mathematics. Pedagogies and theories on literacy and numeracy are explored with a Christian Worldview. Students are introduced to the Australian Curriculum (General Capabilities) F–10 to be able to develop lesson and unit plans.

Unit learning outcomes:

- Define literacy and numeracy according to ACARA and from a Christian Worldview
- Identify and explain the difference and importance of literacy and numeracy as opposed to the subjects of English and Mathematics
- Identify a range of pedagogical skills appropriate for integrating literacy into their chosen learning areas
- Interpret the relevant K–6 curriculum and be able to select and apply this information to authentic and engaging learning experiences for diverse learners
- Select relevant ICT resources and skills for integration with numeracy
- Recognise the concepts that underpin literacy and numeracy and their importance within different cultural belief systems, including Australian Indigenous communities.

Topics include:

- Introduction. What is ACARA and what are the General Capabilities
- General Capabilities: Literacy (and the difference between English and literacy) and numeracy (and the difference between Mathematics and numeracy)
- Becoming literate (literacy continuum, organising elements for literacy) and lesson planning for literacy
- Literacy across the curriculum (In English, Mathematics, Science, History, Health)
- Becoming numerate (numeracy continuum) and lesson planning for numeracy
- Numeracy across the curriculum (In English, Mathematics, Science, History, Geography, Health and PE)
- Critical numeracy (the use of statistics in media, sports, tourism and hospitality) and the ethical and unethical use of statistics for various purposes
- Critically engage with teaching pedagogies and theories for integrating literacy and numeracy in light of a Christian Worldview
- Applying 'Backwards by Design' in lesson planning and assessment
- Technology and Interactive Whiteboard pedagogies for integrating literacy and numeracy across the curriculum, Technological Pedagogical Content Knowledge (TPACK) Framework
- ICT resources and digital resource selection for integrating literacy and numeracy across the curriculum, focusing on Scootle resources within ACARA
- Literacy and Numeracy for ESL and Aboriginal and Torres Strait Islanders: pedagogical issues; the role of Aboriginal Education Officers and other support strategies.

Assessments

Assessment of the unit involves four equally weighted tasks. The first assessment is a 1000-word written report or a short digital story that requires an interview with a primary school teacher and how they integrate literacy and numeracy into one or two learning areas (eg Science, History, English, Mathematics, Health). The second and third assessments involve the development of a lesson plan for literacy and numeracy, respectively, where students demonstrate how they would integrate literacy/numeracy into a learning area of choice. The final assessment is a creative literature review where students provide their perspective on four chosen source materials on literacy and numeracy. The review can be creatively presented, for instance as a series of mini-essays, podcasts or videos.

General comments

The unit lists a full page of references to textbook publications on mathematics and literacy, journals on mathematics, literacy and teaching, and links to websites including the Australian Curriculum, the Australian Catholic University Teaching and Learning Centre, Ofsted mathematics resources site, and teacher associations for Mathematics and English.

(b) CRS214 Mathematics: Part A

The aim of this unit is to prepare the teaching of mathematics and numeracy in primary schools. The unit introduces the Australian Curriculum (Mathematics) F–10 with the purpose of students being capable of developing a lesson plan in accordance with their own personal philosophy on mathematics learning and in the context of a Christian Worldview.

Unit learning outcomes:

- Demonstrate a basic understanding of concepts that underpin mathematics knowledge and understanding
- Demonstrate proficiency in mathematical knowledge, skills and the ability to communicate mathematically with appropriate terminology
- Demonstrate skills in using ICT resources in mathematics processing
- Examine and demonstrate a range of pedagogical skills appropriate for teaching primary mathematics
- Identify and explain the difference and importance of mathematics and numeracy as well as conceptual and procedural knowledge. Also explain the importance of these aspects within difference cultural belief systems, including Australian Indigenous communities
- Design curriculum materials, lesson plans, and assessment items for Stages 1–3 based on the relevant K–6 Mathematics syllabus within a theoretical and practical framework
- Analyse the relevant K–6 curriculum and be able to select and apply this information to authentic and engaging learning experiences for diverse learners.

Topics include:

- Introduction. How do our personal attitudes, beliefs and emotions impact on our teaching philosophy? Reflection on personal experiences with Mathematics
- What is mathematics and how do we learn mathematics? Stages of growth and development in mathematical concepts
- Syllabus / Australian Curriculum development: Content strand – Number and Algebra (Whole numbers, number patterns, algebraic reasoning)
- Syllabus / Australian Curriculum: Content strand – measurement and geometry
- Syllabus / Australian Curriculum: Content strand – statistics and probability
- Mathematical processes: working mathematically, understanding, fluency, problem-solving strategies
- Critical Numeracy (the use of statistics in media, sports, tourism and hospitality) and the ethical and unethical use of statistics for various purposes
- Critically engage with teaching pedagogies and theories for mathematics learning and teaching (constructivism, humanism, direct/explicit instruction, socio-constructivism, constructionism, Skemp's instrumental and relational learning, Flemming Model) in light of a Christian Worldview.

Assessments

Students are required to sit an entrance numeracy test in the first week to assess their knowledge of General Mathematics HSC level (or equivalent). This assessment is weighted 10 percent. The second assessment, weighted at 10 percent, is a reflection journal detailing the student's past and current experiences and beliefs on learning and teaching primary mathematics. The third assessment is an interview with a primary teacher on their experiences of learning and teaching mathematics, and presenting it through a 1500 written report or a short digital story. The assessment also requires an observation of the teacher in their classroom and an analysis of the teacher's approach to teaching with current research. This assessment is weighted 30 percent. The final assessment weighted 50 percent, requires the student to design a unit of work to run over one term on one of the relevant K–6 Mathematics curriculum topics and conduct an interactive 10-minute mini-lesson.

General comments

The unit lists a full page of textbook publications, mostly on teaching primary mathematics, and some that integrate a Christian perspective to teaching. Five journals on mathematics are also listed, and websites including the Australian Curriculum on Mathematics, the Australian Catholic University Teaching and Learning Centre for Mathematics, and the Australian Association of Mathematics Teachers. The *NSW Mathematics K–10 Syllabus* and supporting documents are not referenced. The assessment tasks are highly structured and detailed.

(c) CRS314 Mathematics: Part B

This unit builds on the existing mathematical knowledge and understanding that students developed in the previous Part A unit. The focus on this unit is the classroom and how students can plan, teach and assess learners in a variety of contexts. The unit also addresses integration of numeracy across the curriculum, assessing and reporting with a focus on identification of mis-constructs, planning and differentiation using technology and innovative practices, and provides an overview of recent developments in mathematics including ICT, national testing and the Australian Curriculum.

Unit learning outcomes:

- Appraise ICT resources for effectiveness in concept development in Mathematics
- Identify a student's strengths and weaknesses including those at risk in Mathematics lessons using a variety of assessment instruments and plan a course of action to further the student's learning
- Create and implement appropriate planning, programming, teaching and assessing of mathematical concepts within and across the curriculum
- Construct lessons and differentiated learning experiences for using ICT and innovative practices in Mathematics
- Critique and recommend intervention strategies and approaches for students who are unable to engage fully in the class. These may include special education needs, social and emotional issues or cultural and linguistic diversity, including Aboriginal and Torres Strait Islander students.

Topics include:

- Numeracy and mathematics across the curriculum
- Innovating practices: Using Children's Literature as a springboard to Mathematics and integrating Mathematics across the curriculum, Interactive Whiteboard lessons, the use of YouTube, TeacherTube, IMovie, social media and other online resources, learning objects. Explore the TPAC model; problem-solving (Polya, Cognitive Research Trust (CoRT) and Math Trails, investigative approaches
- Communicating Mathematics: perspectives from classroom practice and current research (Touch on planning, assessing and recording mathematical communications ie journaling, oral reflections, drawing pictures, group work)
- Scaffolding conceptual development, engagement, building understanding through questioning (open and closed), levels of questions, fostering creative and higher-order thinking, problem-solving strategies, concrete materials with Mathematics K–10 syllabus; Identification and evaluation of ICT resources for effectiveness in mathematical concept development, including websites and interactive whiteboard activities. (Dipity, audio boo, Instagram, Interactive Whiteboard, Google Earth, Google maps, video games)
- National testing and identifying common misconceptions. Discuss remediating the mathematical concept and encouraging risk taking and alternative solutions (revisiting POLYA & other strategies in mathematics)
- Designing, evaluating and using multiple assessment tools, documenting results against outcomes. Creating learning experiences based on diagnosis, monitoring and recording progress. (Waddington Maths, NAPLAN, CAMS & STAMS); Basic interpreting results of professional teaching and how we can use it in the classroom to help students (eg professional diagnosis, school-based records and data collection, TIMMS and OECD comparisons, national testing benchmarking), including communication to parents
- Organisation for learning and integration of ICT – social construction of mathematics, student-centred, negotiated involvement of students, small group, ability and multi-staged groups, peer teaching
- Learning enrichment and differentiation experiences for teaching mathematics.

Assessments

Throughout the semester, students are required to contribute to an online forum on topics covered in the unit, submitting posts that should demonstrate originality, understanding and engagement with the class discussion and literature. At the end of the semester, students select their best three responses for assessment, which is weighted at 20 percent. The second assessment, weighted at 30 percent, is a case study where the student is to observe and analyse one school student undertaking a diagnostic mathematics test (eg NAPLAN), then analyse their strengths and weaknesses to write an action plan to further their learning. The assessment also requires a brief literature review evaluating research into Mathematics education and three pedagogical strategies, problem-solving strategies and how these strategies embrace or reflect a Christian Worldview. The third assessment is an ICT and Numeracy Group Creative Assignment, weighted at 20 percent. A group of two to four people are required to create a video clip illustrating a concept or numeracy in the community or photo-story illustrating how mathematics can be taught and learnt, and pose three follow-up class discussion questions. The final assessment, weighted at 30 percent, is developing a unit plan and two lessons to teach in a school, which incorporates at least two different teaching strategies and ICT.

General comments

The unit lists a full page of textbook publications on teaching mathematics. The list of journals is the same mathematic-based publications as the previous unit, with the addition of journals on gifted and talented and remedial and special education. The websites are the same as the previous unit.

(d) EDU514 Learning and Teaching Mathematics: Part A

The main focus of this subject is on the pre-service teacher's own knowledge, skills, confidence, belief systems and values in mathematics with a view to appreciating mathematics in everyday life as a way of interpreting the world. This subject traces the growth and development of mathematical constructs in children through primary school: Mathematics K–10 syllabus. Pre-service teachers will be exposed to the socio-cultural and multicultural contexts of mathematics, critique a range of teaching methods and approaches, with a view to developing their own philosophy and teaching approach.

Unit learning outcomes:

- Demonstrate skill with the use of computers and other ICT resources in mathematical processing
- Demonstrate increased proficiency in mathematical knowledge, skills and the ability to communicate mathematically with appropriate terminology, exhibiting a range of numeracy strategies for the development of creative and critical thinking and problem-solving in Mathematics
- Critically analyse the relevant Mathematics K–10 syllabus and various teaching approaches in order to be able to select and construct authentic and engaging learning experiences for diverse learners from K–6
- Explain in detail the impact of knowledge and belief systems about Mathematics amongst different cultures including, Australian Indigenous communities. Construct a personal philosophy of teaching Mathematics and how it relates to a Christian worldview.

Topics include:

- How people learn Mathematics, stages of growth and development in mathematical concept development
- Numeracy across the curriculum / Literacy – making meaning of mathematical terminology / Evaluation and application of ICT resources in concept development
- Mathematics and culture, Australian Indigenous and cultural ways of knowing, interpreting and communicating research and statistics
- Personal inventory of mathematical skills and knowledge
- Personal philosophy of Mathematics education and Christian worldview

- Syllabus development through stages in syllabus strands and sub-strands: Process strand – Working Mathematically; Content strands – Number and Algebra, Measurement and Geometry, Statistics and Probability
- Mathematics in Society: Numeracy (media, community, sport, hospitality and tourism). Statistical literacy (planning, gathering, organizing, applying data to solve problems and communicate results). Numeracy and the ethics of manipulating data for society's products and services. Teaching pedagogies for mathematical concept development: Approaches – deductive, inductive, direct instruction, constructivist, socio-constructivist, Skemp's instrumental and relational learning. Problem-solving heuristics (Polya, CoRT) and investigative approaches
- Application of teaching and learning principles authentic and rich tasks, contextual, connected to learners, significance, engaging, deep intellectual quality and self-monitoring for meaning making, quality learning environment. Evaluation and application of computer-mediated learning (graphics calculators and skill development software).

Assessments

There are four assessments of variable weighting for this unit. The first assessment is an entrance exam on numeracy, the second assessment is a critical reflective paper and the third assessment is an action research exercise consisting of three parts. The final assessment is made up of forum posts that students contribute to weekly. The action research assessment accounts for 55% of the total assessment for this unit and requires students to complete the assessment in three parts:

- Part A – requires students to critically review three different approaches to teaching mathematical concept development, identifying strengths and weaknesses of each approach.
- Part B – requires students to interview a class teacher teaching an age group of choice on a range of criteria.
- Part C – requires students to compose their own philosophy of teaching approach(es) they intend to follow in relation to mathematics.

General comments

This unit requires students to commit to a total of ten hours workload per week and is offered in a variety of delivery modes. In addition to current curriculum requirements, there is a full page list of representative references as texts, journals and relevant websites. There is considerable detail for each assessment listed and there is an outline for how essays are marked. EDU401 Foundations in Christian Learning and Teaching is outlined as a prerequisite for this unit.

(e) EDU515 Learning and Teaching Mathematics: Part B

This subject builds on EDU514 Learning and Teaching Mathematics: Part A, with a focus on the classroom and how learners construct Mathematical concepts. It further develops the pre-service teacher's ability to plan, teach and assess in both integrated and streamed teaching contexts. It will investigate ways in which programs can be developed to integrate numeracy across the curriculum. Assessing and reporting, with a focus on the identification of mis-constructs will be examined. Planning learning experiences and assessment strategies for students with special needs or circumstances will be addressed. Recent developments in Mathematics across Australia with regard to ICT, outcomes-based reporting, national testing, Gifted and Talented will be critiqued.

Unit learning outcomes:

- Evaluate and recommend remediation and intervention strategies for students who are unable to engage fully in the class through special education needs, social and emotional issues or cultural and linguistic diversity, including Aboriginal and Torres Strait Islander students
- Construct and implement appropriate planning, programming, teaching and assessing of mathematical concepts within and across the curriculum;
- Identify and diagnose in detail students at risk in Mathematics lessons using a variety of assessment instruments
- Construct enrichment learning experiences for Gifted and Talented students in Mathematics
- Critically analyse student transcripts for teacher scaffolding and concept development
- Critically appraise ICT resources for effectiveness in concept development in Mathematics.

Topics include:

- Communicating Mathematics: perspectives from classroom practice and current research including the language of Mathematics and assessing and recording mathematical communications
- Identifying common misconceptions and remediating in mathematical concept development, encouraging risk taking and alternative solutions, verbalising processing and metacognition
- Designing, evaluating and using multiple assessment tools, documenting results against outcomes. Creating learning experiences based on diagnosis, monitoring and recording progress
- Interpreting results of professional testing (eg professional diagnosis, school-based records and data collection, TIMMS and OECD comparisons, national testing benchmarking), including communicating to parents
- Analysis of transcripts and scaffolding in teacher and student classroom exchanges, taking into consideration the special education needs, social and emotional issues or cultural and linguistic diversity of students
- Scaffolding conceptual development, engagement, building understanding through questioning (open and closed), levels of questions, fostering creative and higher-order thinking, problem-solving strategies, concrete materials with Mathematics K–10 syllabus.
- Identification and evaluation of ICT resources for effectiveness in mathematical concept development, including websites and interactive whiteboard activities
- Organisation for learning – social construction of mathematics, student-centred, negotiated involvement of students, small group, ability and multi-staged groups, peer teaching
- Learning enrichment experiences for teaching Mathematics to gifted and talented students including classroom and school provisions as well as professional challenges and competitions
- Using Children's Literature as a springboard to mathematics and integrating mathematics across the curriculum.

Assessments

There are four assessments of variable weighting for this unit. The first assessment requires students to complete a literature review, the second assessment requires students to design a series of five lessons on a key mathematical construct, the third assessment requires students to write a critical reflection on the five lessons developed in the second assessment. The final assessment is made up of forum posts that students contribute to fortnightly.

General comments

This unit requires students to commit to a total of ten hours workload per week and is offered in a variety of delivery modes. In addition to current curriculum requirements, there is over a full page list of representative references as texts, journals and relevant websites. There is considerable detail for each assessment listed and there is an outline for how essays and lesson plans are marked. Prerequisites for this unit include EDU401 Foundations in Christian Learning and Teaching and EDU415 Learning and Teaching Mathematics: Part A. This unit aims to build on the concepts delivered through the Part A unit of this program.

AUSTRALIAN CATHOLIC UNIVERSITY

Australian Catholic University (ACU) offers:

- **Bachelor of Education (Primary)**
- **Bachelor of Education (Early Childhood and Primary)**
- **Master of Teaching (Primary)**

Preparation to teach K–6 Mathematics

1 Approach

- ACU offers two undergraduate programs and a postgraduate program.
- There are four core mathematics/ numeracy units in the B.Ed.(P) of which three are also studied in the B.Ed.(EC and P) program (prior to revised version)
- The M. Teach program features two units which have been revised and are currently subject to national accreditation. Both the approved and revised units have been included in this summary.

Note: ACU is a national university that has seven campuses. Initial teacher education degree programs are developed nationally and offered at individual campus locations. The national development of unit outlines generates a generic unit outline that is then extended at individual campus level to an extended unit outline. The extended unit outline accommodates information specific to each state jurisdiction. The information below that has been used to generate this summary is drawn from the national generic unit outlines. It should be noted that the extended unit outlines contain additional state based information including:

- State/Territory Specific Texts
- State/Territory Specific Curriculum Documents, Policies and Procedures
- Web-based learning material specific to school jurisdictions within the State/Territory
- State/Territory Mathematics Journals as per individual Associations
- Assessment tasks specific to jurisdictions.
- Assessment due dates and marking rubrics
- Learning Management System (Moodle/LEO) online support

Therefore the summaries below provide an overview of unit in relation to focus, content, learning outcomes and indicative assessment. They do not include the detail listed above.

To support this review, a summary of an extended unit outline that details specific references, journals, websites, assessments and associated rubrics within a NSW-specific context has been developed.

2 Content – Common units: B. Ed (P) & B. Ed (EC and P)

(d) EDMA163/EDMA103 Exploring Mathematics 1

This unit uses a problem-solving approach and an emphasis on deep learning and deep knowledge of important mathematical content knowledge needed for teaching. The mathematical focus areas are whole number, measurement and space. There is a particular emphasis on pre-service teachers diagnosing their own understanding of these areas and engaging in practices, discussions and their own engagement with the research literature to broaden and deepen their understanding. The content and assessment in this unit not only support this, but also embed this understanding in realistic contexts. A consideration of the historical and cultural development of these focus areas will situate mathematics in a multicultural and global society, and will provide better understanding of the importance of mathematics as a tool in identifying power differences among socio-economic classes, and racial, ethnic and gender groups. Approaches to learning and teaching advocated for Learning and Teaching Mathematics 1 and Learning and Teaching Mathematics 2 are modelled in this unit.

Unit learning outcomes:

On successful completion of this unit, pre-service teachers should be able to:

- demonstrate enhanced understanding of mathematics through a search for further knowledge relevant to meeting the professional requirements for teaching mathematics
- identify the structure inherent in various mathematical systems and undertake mathematical modelling, thereby developing expertise in the field of mathematics
- critically analyse and solve a variety of mathematical problems
- demonstrate an open-mindedness and receptiveness to new ideas by exploring a variety of approaches to solving a given problem
- demonstrate an understanding of the historical and cultural development of number, measurement and space

Topics include:

- Problem-solving and mathematical modelling
- Space
- Whole number (with appropriate links to algebra)
- Measurement
- Mathematics in other cultures
- History of mathematics
- Mathematics as empowerment.

Assessment

Assessment Task 1 – (weighting is 30%)

Investigation: Uses of Mathematics: A report that focuses on a real-life application of mathematics. This application might include a historical/cultural link and/or contextualised mathematics from the present world and/or the use of mathematics in another aspect of primary school curriculum. The report could be in either written or digital format.

Assessment Task 2 – (weighting is 30%)

Problem Folio or Presentation: demonstrating capacity in problem-solving and procedural proficiency.

Assessment Task 3 – (weighting is 40%)

Written examination: demonstrating an understanding of key mathematical content and problem-solving skills.

General comments

This unit is the first unit in the Mathematics suite of units.

(b) EDMA262/EDMA202 Mathematics: Learning and Teaching 1

This unit is designed to provide an introduction to early childhood (prior to school) and primary school mathematics education by investigating current directions in research and state and national documents. The unit will introduce theories of learning mathematics and effective teaching and learning in the contexts of Whole Number, Measurement and Geometry.

Emphasis will be placed on an approach to learning and teaching mathematics that is respectful of each child's background and culture. The role of manipulatives, technology, language and mental processes in children's developing concepts, understanding and skills will also

be a focus, alongside the role of assessment interviews in identifying children's current mathematical understanding. The use of this information to inform teaching, and develop positive attitudes to mathematics will be studied.

Unit learning outcomes:

On successful completion of this unit, students should be able to:

- explain why concerns for justice and for the dignity of all human beings are fundamental principles in mathematics education and the important role of self-esteem and positive attitudes to mathematics
- demonstrate an ability to critically reflect on theories of and research informing children's mathematical learning and children's development of mathematical concepts and processes in Whole Number, Measurement and Geometry as addressed in state and national documents, from early childhood (prior to school) and through the primary school years
- demonstrate an ability to critically reflect on the role of manipulatives and technology in children's mathematical learning while investigating and developing teaching strategies that are relevant to various stages of learning, that are responsive to a range of abilities and that promote meaningful mathematical understanding as addressed in state and national documents from early childhood (prior to school) and the primary school years
- demonstrate an ability to critically reflect on the role of mathematics and numeracy education across the curriculum as addressed in state and national documents at all stages of learning for full participation in community life, work and further education.

Topics include:

- This unit's mathematical content will focus on whole number including computational choice (mental, written, calculator, other) with appropriate links to measurement and geometry as detailed in state and national documents as well as the General Capability, Numeracy in the Australian Curriculum and relevant elements of Learning Outcomes in the Early Years Learning Framework.
- The role of the one-to-one interviews (related to specific jurisdictions) is prioritised in this unit where students actively engage with approaches to learning and teaching mathematics that reflect a concern for justice and for the dignity of all human beings that promotes the importance of the affective domain in learning mathematics.
- Theories of learning mathematics including relational and instrumental understanding will be linked to typical pathways/ trajectories in young children's mathematical learning, from early childhood (including prior to school) to the later primary years.
- This unit will focus on the appropriate use of manipulatives (eg mathematical tools, games, materials and children's literature) as well as the use of technology as a means to promote meaningful mathematical understanding.
- Relevant national, state and territory curriculum documents and assessment.

Assessment

Assessment Task 1 – (50% weighting)

A case study of a child's mathematical knowledge based on the use of a one-to-one interview. Judgments about the child's mathematical development must be linked to a theoretical framework. The framework must also be used to inform the design of a follow-up activity and teaching strategies which targets students' further conceptual development in the areas of Whole Number, Measurement and Geometry as addressed in state and/or national curriculum documents relevant to this unit.

Select from task 2a or 2b (50% weighting)

Assessment Task 2a

Individually write a literature review exploring themes, ideas and issues related to the learning and teaching of mathematics in the primary classroom or early learning context pertaining to a particular mathematics topic relevant to this unit and addressing relevant Learning Outcomes.

OR

Assessment Task 2b (50% weighting)

A weekly reflective journal that draws together understanding from the weekly lecture, tutorial activities and prescribed readings and observations from PCE experiences. These reflections must address each of the learning outcomes.

General comments

This unit is the second unit in the Mathematics suite of units and requires students to complete the EDMA163/EDMA103 Exploring Mathematics 1 unit as a prerequisite or co-requisite.

(c) EDMA369/EDMA309 Exploring Mathematics 2

In an increasingly technological society, a strong understanding of mathematics is a major asset to an individual seeking to participate fully and meaningfully in society. This unit, following on from Exploring Mathematics 1, uses a problem-solving approach and an emphasis on deep understanding of important mathematical content knowledge needed for teaching. In this case, the mathematical focus is on rational number (fractions, decimals, and percentages), proportional reasoning, probability and statistics, and algebraic thinking and reasoning. There is a particular emphasis in content and assessment on 'real-world' applications of mathematics. The kinds of approaches to teaching and learning advocated in Learning and Teaching Mathematics 1 and Learning and Teaching Mathematics 2 are modelled in this unit, where the desire is to increase the confidence and competence of students with mathematics.

Unit learning outcomes:

On successful completion of this unit, pre-service teachers should be able to:

- demonstrate a connected understanding of mathematical content, including rational number, proportional reasoning, probability and statistics, and algebraic thinking and reasoning
- describe the mathematics used in a variety of employment situations and/ or curriculum areas other than mathematics
- discuss the connections between different mathematical domains
- effectively use appropriate technologies in problem-solving in mathematics
- demonstrate how mathematics is a powerful tool in making sense of the world.

Topics include:

- Problem-solving and mathematical modelling
- Rational number (fractions, decimals, percentages)
- Proportional reasoning
- Probability
- Statistics
- Algebraic thinking and reasoning.
- Technology and mathematics
- Mathematics and numeracy in the workplace
- The use of mathematics in the media.

Assessment

Assessment Task 1 – (weighting is 30%)

Mathematics beyond the classroom. This may involve mathematics in the workplace, or in a second curriculum area. A report of findings will be made which may, for example, be an electronic presentation that provides a useful resource for their peers.

Assessment Task 2 – (weighting is 30%)

Problem-solving: Students will engage in a series of problem-solving tasks during the course. Formal assessment of this will occur though one or more of the following:

- the presentation of a group or individual problem-solving presentation,
- an oral presentation,
- a written report,
- the presentation of a folio

Assessment Task 3 – (weighting is 40%)

Written examination: Students will be required to demonstrate their understanding of key mathematical content and problem-solving skills in an examination, which will consist of a range of mathematical problems.

General comments

This unit is the third unit in the Mathematics suite of units and requires students to complete the EDMA163/EDMA103 Exploring Mathematics 1 unit as a prerequisite or co-requisite.

(d) EDMA 310/360 Mathematics: Learning and Teaching 2

NOTE: This extended unit outline is from ACU's School of Education, Strathfield Campus, NSW. This unit will be replaced in 2016.

This unit is designed to provide pre-service teachers with opportunities to experience and critically examine a range of different learning activities and teaching approaches in planning, implementing and monitoring learning experiences for school students in early childhood and primary mathematics. Pre-service teachers will explore the structure and content of the mathematics curriculum, in particular rational number, algebra, and chance and data will form the content basis of this unit. Pre-service teachers will examine a range of formal and informal assessment strategies with an emphasis on using these tools to inform reporting on student achievement. Underpinning explorations in the unit will be theories of children's mathematical learning such as constructivism, and socio-cognitive approaches to learning. Pre-service teachers will investigate the findings of reported research into mathematics education issues considered within this unit, and will discuss implications for the classroom.

The unit also states that students will be exposed to the current NSW Mathematics Curriculum (2002) with readings and learning material mainly focused on the new NSW Mathematical Syllabus for the Australian Curriculum.

Unit learning outcomes:

At completion of this unit, pre-service teachers will be able to:

- analyse a range of issues related to contemporary Mathematics teaching
- plan for the effective implementation of a range of learning activities and teaching approaches for learning Mathematics including the use of technology
- construct and analyse a variety of programming, assessment, evaluation and reporting techniques
- outline the content and processes of the *NSW Mathematics K–10 Syllabus for the Australian Curriculum* and associated documents
- critically discuss and demonstrate the implementation and implications of new technologies for learning Mathematics
- maximise opportunities for integrating mathematical content within different sub-strands of Mathematics and across other KLAs
- demonstrate personal confidence and competence in mathematical skills, concepts and processes relating to the teaching and learning of rational number (fractions and decimals), patterns & algebra, and chance and data (statistics and probability)
- explain the importance of a teacher of Mathematics having a concern for justice and the dignity of all, and the implications for the teaching and learning of Mathematics in the primary classroom.

Topics include:

- Catering for mixed achievement classes
- Open-ended questions in mathematics
- Resources in the teaching and learning of mathematics (eg the role and use of technology, issues in using print resources such as worksheets and texts)
- Assessment (eg developing and using rich assessment tasks, assessment informing instruction)
- Mathematics as an integrated subject: Helping students make connections
- Contexts for mathematics learning (eg use of children's literature in developing mathematical understanding, using real life contexts, games in the maths classroom, problem-solving and investigations)
- Program planning in primary mathematics
- Classroom organisational issues
- Mathematics education in relation to the wider community (eg communicating with parents)
- Effective teaching (eg research on effective teaching; effective teaching and learning strategies such as use of a range of representations and recordings, and varied grouping strategies)
- Affective aspects in mathematics learning
- Current national, state, and territory initiatives in mathematics education.

Assessment

Assessment Task 1 – (weighting is 30%)

Mathematics video and implementation report: Students are required to work in pairs to create a three-minute video on Rational Number for Stage 2 or Stage 3 that can be used as a teaching resource for a lesson. The video must highlight the technical mathematical language required for the particular stage. Students are encouraged to be creative, for example by using animation or acting. Students are also required to prepare an accompanying 800-word report describing the way in which the video will be implemented into lessons, including questions/ prompts that lead to mathematical investigations.

Assessment Task 2 – (weighting is 10%)

Leading reflection/discussion questions during allocated tutorial: Students are required to work in groups of three or four, and lead a 10-minute presentation on specific reflection/discussion questions on mathematics, teaching and student learning during a weekly class tutorial. Students are encouraged to use handouts or ICT to guide their discussion.

Assessment 3 – (weighting is 60%)

Gaining insights from research for classroom planning: This is a three part assessment where students are first required to prepare an 800-word literature review, based on at least five publications, on the learning pathway (birth to 12 years) of a Mathematics concept from the unit: either algebra, fractions and decimals, ratios/percentages, or probability. The literature review will cover key understanding, possible misconceptions, and issues that impact on children's learning. From the literature review, students are then required to discuss in 400 words, recommendations for effective pedagogies (Years 3 to 6) for developing the Mathematics concept. For this part, students are also required to critique the relevant curriculum documentation such as the Early Years Learning Framework and/or the BOSTES *NSW Mathematics K–10 Syllabus* in relation to the ideas presented in the literature review. Finally, the student is to prepare a unit plan of work that comprises of five sequential learning activities on the Mathematics concept for a grade level of their choice. The 1,100 unit plan must provide an overview of the teaching plan including learning activities, assessment and reporting strategies.

Common Assessment Task

Portfolio that includes a:

- literature review related to the learning pathway of a mathematical concept, including key understanding, possible misconceptions, and issues that impact on children's learning
- discussion of and recommendations for effective pedagogies for developing this concept
- series of effective learning activities for this concept, and related assessment and reporting strategies.

General comments

The unit has an extensive list of required and recommended texts and references including mathematics education apps for phones or tablets. The required readings include Bobis, J., Mulligan, J., & Lowrie, T. (2013), Mathematics for Children: Challenging children to think mathematically (4th edition), Frenchs Forest, Pearson Education Australia, the BOSTES NSW Syllabus for the Australian Curriculum, the COAG 2008 National Numeracy Review Report. A written examination that assesses students' understanding of the key ideas addressed in the unit, and ability to apply their knowledge in context may also be included as assessment for this unit.

3 Content – B. Ed (P)

(a) NMBR140 Introduction to Mathematical Thinking

In an increasingly technological society, an understanding of mathematics is a major asset to an individual seeking to participate fully and meaningfully. Mathematical content in this unit draws from the areas of Number, Algebraic Thinking, Geometry, Measurement, Probability, Statistics and the Application of Mathematics; and ways of mathematical thinking including reasoning, problem-solving and conceptual understanding. There is a particular emphasis in both content and assessment on real-world applications of mathematics.

Unit learning outcomes:

On successful completion of this unit, students should be able to:

- demonstrate understanding and application of some basic mathematical concepts
- solve a variety of mathematical tasks
- identify the structure inherent in various mathematical situations and undertake simple mathematical modelling
- demonstrate an understanding of the interconnectedness of different mathematical topics and their application to real world contexts using a range of resources
- communicate mathematical thinking and reasoning using mathematical language including spoken, written and visual representations.

Topics include:

- Numbers and Counting
  - Place value
  - Computational strategies including mental, estimation and use of calculators
  - Natural numbers, integers, fractions, factors, prime numbers, prime factorisation, divisibility tests
  - Proportional reasoning, ratio
  - Rational numbers and their representations as fractions and decimals, percentages, simple operations with fractions.
- Algebraic Thinking
  - Figural and numeral patterns leading to generalisation
  - Functions, variables and relationships
  - Foundations of Geometry
  - Classification of shapes in 2D and 3D
  - Angles and angle sums of polygons
  - Properties of figures and solids including symmetry
  - Transformations, tessellations
  - Constructions of shapes
  - Position
- Foundations of Measurement
  - Focusing on area, length, mass, volume and time
  - Estimating, recording and measuring and measurement error
  - Relationships between units
  - Metric and other measurement systems.
- Foundations of Probability
  - Sampling
  - Fairness
  - Single and multi-stage events
  - Use of tree diagrams
- Representation and interpretation of data
  - Population and samples
  - Distribution: comparing and contrasting using measures of centre, overall spread and variability within the spread of data
  - Summarising, analysing, presenting, interpreting data or results from empirical investigations
- Mathematical applications and modelling
  - Financial applications
  - Extrapolation and prediction
  - Rates of change

Embedded within each topic is the application of mathematical reasoning and problem-solving.

Assessment

Task 1 – (Weighting is 40%)

The first assessment task involves two investigative tasks, one of which must be a mathematical modelling task dealing with a real world context and the other a purely mathematical investigation with use of varied resources. An accompanying report requires a combination of written and oral multimedia forms of presentation and use of varied resources.

Task 2 – (Weighting is 20%)

Mid-Semester Test or Problem-solving Assignment.

Task 3 – (Weighting is 40%)

Final Written examination: demonstrating an understanding of key mathematical content and problem-solving skills undertaken in the unit.

General Comments

This is the first unit in the Mathematics suite of units.

(b) EDMA241 Mathematics Education 1: Curriculum, Pedagogy and Assessment

This unit provides an introduction to primary school mathematics education by investigating current directions in research, the Australian Curriculum: Mathematics and other relevant curriculum documents. The unit introduces theories of knowledge needed for teaching mathematics, learning mathematics and effective teaching and learning through the content strands of Number (restricted to Whole Number), Measurement and Geometry. Emphasis is placed on pre-service teachers' further personal development of the concepts, substance, and structure of the mathematical content as well as strategies for teaching mathematics, with a focus on approaches to learning and teaching mathematics that are effective and respectful of each student's background and culture. The role of a range of resources, including digital technologies that engage students in the learning of mathematics is a focus, alongside the role of self-esteem and a positive disposition toward mathematics. The role of assessment will be considered in identifying students' current mathematical understanding and its usefulness in informing teaching.

Unit learning outcomes:

On successful completion of this unit, pre-service teachers should be able to:

- explain why concerns for justice and for the dignity of all human beings are fundamental principles in mathematics education and the important role of self-esteem, high expectations, and positive attitudes to mathematics
- demonstrate an ability to critically reflect on and enhance their own personal mathematical knowledge needed for teaching, and demonstrate an understanding of the historical and cultural development of mathematical idea
- apply theories and research about primary aged student's development of mathematical concepts and proficiencies to create powerful learning experiences for students in Whole Number, Measurement and Geometry as required by Australian Curriculum: Mathematics and other relevant curriculum documents
- demonstrate an ability to critically reflect on the Australian Curriculum: Mathematics and the effectiveness of different approaches to teaching mathematics that cater for students across a full range of abilities, particularly the formative, summative and diagnostic uses of assessment data, and apply these approaches to support students' diverse learning needs
- use language, symbols, resources including ICT as tools to design learning sequences and lesson activities to support student's mathematical learning of Whole Number, Measurement and Geometry, as outlined in relevant documents
- critically reflect on the role of mathematics and numeracy education across the curriculum for full participation in community life, work and further education, including how mathematics is a powerful tool in making sense of the world.

Topics include:

- Models of the mathematical knowledge needed for teaching
- A focus on relevant content and proficiencies as detailed in the Australian Curriculum: Mathematics and other state and national documents
- Interviews and open-ended diagnostic tasks are prioritised approaches to assessment that inform the learning and teaching of mathematics and reflect the significant connections between validity, fairness, a concern for justice and for the dignity of all human beings
- Implications of various relevant theories of learning for the teaching of mathematics are explored, with emphasis on those that support conceptual understanding and the critical influence of the teacher on student learning
- Typical pathways/trajectories in young children's mathematical learning, from pre-school to later primary years are investigated and applied to the design of learning experiences that are appropriate to student needs
- Informed, critical uses of manipulatives, words and symbols, students' interests in creating contexts, and digital technology are expected in the design of learning experiences for students
- How to set up and manage mathematical learning experiences for individual, group and whole class teaching and learning.

Mathematics content basis for the teaching in this Unit will be Number (restricted to Whole Number), Measurement and Geometry as required in Primary School. This will include pre-service teacher reflection on and enhancement of their own personal knowledge.

Assessment

The first assessment task requires an interview of two students at different years of primary school, recording the responses of each student accurately in respect of the interview protocols, and interpreting the data about each student to form judgments about their mathematical development with reference to a theoretical framework or trajectory. A summary report on each is required along with the design of a follow-up lesson for each student that targets a need that was identified in the interview. The lesson outcomes are to be linked to the Australian Curriculum: Mathematics and other state and/or national curriculum documents and explicitly use materials, symbols and language to support the learning of each student.

The second task is a choice between two options.

Assessment Task 2a – CHOICE- *For the purposes of national moderation all campuses must select the same task (Equivalent to 2,000 words)*

Individually, write a literature review exploring themes, ideas and issues related to the learning, teaching and assessment of Whole Number (including calculation), Geometry or Measurement. Synthesise and critique ideas from a range of scholarly sources that reflect a balance of teacher and pure research publications. Present a coherent discussion and cite/reference appropriately to the discipline.

OR

Assessment Task 2b *(Equivalent to 2,000 words)*

A weekly reflective journal that draws together understanding from the weekly lecture, tutorial/workshop activities and prescribed readings and observations from professional experiences. The journal entries demonstrate critical reflection and growing understanding of (a) their own developing content knowledge for teaching, (b) application of theory and research to understanding how students learn, (c) teaching strategies to best support the learning of all students, (d) the varied use of assessment to use the data collected to focus future teaching, and (e) the application of pedagogical content knowledge though making connections between these.

NOTE: This task assumes participants have a one day a week placement or similar during the semester.

General comments

This unit is the second unit in the Mathematics suite of units and has *NMBR140 Introduction to Mathematical Thinking* as a prerequisite.

(c) EDMA342 Mathematics Education 2: Curriculum, Pedagogy and Assessment

This unit is designed to provide pre-service teachers with in-depth understanding of the underlying principles and concepts that enable teachers to critically evaluate strategies in planning, implementing, monitoring and assessing learning experiences for the Australian Curriculum: Mathematics primary. Pre-service teachers will develop and implement a culturally aware and responsive curriculum and pedagogy that demonstrates concern for justice and the dignity of all. Promoting critical thinking and judgement, this unit will explore theories of mathematical learning and research into mathematics education issues and their implications for learning and teaching. The structure and content of relevant primary education mathematics curriculum will be critically reviewed, with particular emphasis on rational number, algebraic thinking, and statistics and probability. This unit will promote cognitive skills to analyse, consolidate and synthesise a range of different learning activities and teaching

approaches. A range of formal and informal assessment strategies will be examined with an emphasis on using student data to inform and differentiate learning and teaching: report on student achievement and meet professional accountability requirements.

Unit learning outcomes:

On successful completion of this unit, pre-service teachers should be able to:

- evaluate teaching programs through analysis of the effectiveness of a range of different types of mathematics learning experiences that contribute to an inclusive mathematics pedagogy, including open-ended tasks, teacher questioning and learning experiences to enhance student learning outcomes
- implement strategies, including the ethical use of ICT, that cater for the diverse needs of learners, with appropriate assessment and moderation, constructive and timely feedback and reporting practices for shared understanding of progress with students and stakeholders
- use initiative and creativity to reflect upon and make informed judgements about the appropriateness of generally agreed principles of learning and teaching mathematics
- present a clear and coherent knowledge of research about pedagogical approaches, student understanding and dispositions in relation to rational number, algebraic thinking, and statistics and probability
- evaluate student learning needs, based on interpretation of student assessment data for analysis, moderation and consistent and comparable judgement to inform planning for mathematics teaching with reference to the Australian Curriculum: Mathematics and other relevant mathematics curriculum documents
- demonstrate personal competence and confidence in mathematical knowledge to a level appropriate for a graduate teacher, concepts and processes related to rational number, algebraic thinking, and statistics and probability.

Topics include:

- Researching informed approaches to successful mathematics learning that are responsive to the strengths and needs of students from diverse linguistic, cultural, religious and socio-economic backgrounds
- The role of mathematical investigation and open tasks for constructing mathematical knowledge and orchestrating mathematical discourse, reasoning, argumentation, and proof
- Effective resources that support and enhance the teaching and learning of mathematics (eg manipulatives, digital technologies, and visual representations)
- Assessment practices to guide learning teaching of mathematics: (eg informal and formal, including diagnostics approaches to formative and summative assessment of cognitive and affective learning)
- Strategies to provide accurate written and oral feedback for students in relationship to their numeracy development with exploration of any ethical issues regarding feedback and responses
- Assessment-related issues and the purposes, characteristics, and limitations of various types of assessments
- Interpreting assessment data and its links to planning and school based policies
- Reviewing national testing requirements and its impact on teaching and learning eg NAPLAN
- Moderation practices for comparing individual and group differences within classrooms, state and national levels
- Diagnosing and planning for support of learners to who are working beyond or below stage outcomes
- Approaches for different levels planning for mathematics teaching as identified in the Australian Curriculum: Mathematics
  - Incorporating the mathematical content and proficiencies
  - Integrating the mathematical content strands to facilitate connections across dimensions of mathematics
  - Effective contexts for mathematics learning (eg children's literature, real life contexts, games, problem-solving and investigations)
  - Identifying opportunities to use Numeracy across the curriculum
- Powerful pedagogical actions in mathematics (eg creating powerful learning environments, grouping practices, scaffolding learning, attending to literacy demands, promoting productive discourse and collaborative argumentation, questioning and prompting), selecting tasks and models that promote deep learning and knowing and using pedagogical knowledge
- Current national, state, and territory initiatives in mathematics education

The teaching of rational number, algebraic thinking, and probability and statistics as found within the Australian Curriculum: Mathematics will form the content basis of this unit.

Assessment

There are two assessment tasks in this unit made up of 40% and 60% in weightings respectively.

The first assessment task requires students to evaluate the effectiveness of two assessment strategies:

- a rational number interview – assess a student using the rational number interview and complete a record sheet, and
- using assessment rubrics for open tasks – design a one-page assessment rubric for the assigned open tasks. Produce a work sample that shows full understanding of the mathematics.

The second assessment task involves selecting from one of:

- developing a research informed learning pathway – choose one area of mathematical focus, review the literature to identify current research related to the children's learning of the chosen mathematical focus throughout primary school
- designing a research informed unit of work – write a critical review of literature relating to a particular content area and critically discuss the relevant curriculum documents in light of the identified literature and then plan a unit of work for the selected content area for a particular Year level
- planning inclusive tasks – Part 1: a mathematics stimulus lesson OR a photograph/video prompted investigation. Part 2: designing a research informed family information session and pamphlet.

General comments

This unit is the third unit in the Mathematics suite of units and has *EDMA241 Mathematics Education 1: Curriculum, Pedagogy and Assessment* as a prerequisite.

4 Content – MTeach

(a) EDMA504 Mathematics Curriculum 1 (accredited by jurisdiction)

The unit is designed to provide an introduction to primary school mathematics education by discussing and investigating current directions in mathematics education, including social justice issues, drawing on contemporary research, curriculum documents and initiatives.

Students will explore theories of learning mathematics and effective teaching and learning strategies that enhance children's understanding of mathematical concepts and skills. Emphasis will be placed on ways in which children's understanding of mathematics develops in number, measurement and space. Aspects of mathematical thinking and critical problem-solving and ways to develop positive attitudes towards mathematics will permeate the unit.

Unit learning outcomes:

At completion of this unit students will be expected to be able to:

- detail current directions in numeracy including social justice issues by drawing on research papers and curriculum documents and initiatives
- incorporate culturally responsive and socially critical perspectives in an analysis of mathematics curriculum, including Indigenous perspectives
- demonstrate skills and articulate understanding of key concepts in the K–6 Mathematics strands of Number, Measurement, Space and Geometry
- outline the features of the process strand of Working Mathematically
- evaluate and plan a range of mathematics learning experiences that contribute to an effective mathematics pedagogy
- explain the ways in which children's understanding of mathematics develops
- identify strategies that enhance children's learning of mathematical skills, concepts and understanding
- demonstrate positive attitudes towards mathematics learning and teaching.

Topics include:

- Contexts of curriculum: includes definitions of numeracy; states and international curriculum documents, social and cultural perspectives in mathematics
- Children and mathematical understanding: includes comparison and contrast of theories of children's mathematical learning; mathematical thinking and development of reasoning
- Mathematical pedagogy: includes strategies to enhance children's learning; use of manipulatives, language and digital technologies in representing mathematical ideas; strategies to promote self-esteem and positive attitudes to mathematics
- Mathematical content: includes understanding of key concepts in K–6 Mathematics in Number, Measurement, Space and Geometry; mental computation and estimation strategies; the role of informal and formal algorithms in written computation

Assessment

Assessment tasks will comprise a hurdle task to affirm students' knowledge, understanding and skills of the mathematics content covered in the unit and two major pieces:

- Folio, based on tutorial and online tasks, related to student learning in mathematics, drawing on relevant readings and curriculum documents. This assessment is designed to address aspects of learning outcomes.
- A case study of a student's mathematics learning drawing on field notes, clinical interviews, planned learning sequences supported by related research in the chosen mathematics domain. (weighting approximately 50%) This assessment is designed to address aspects of learning outcomes.

General comments

This is the first unit of Mathematics in this program.

(b) EDMA505 Mathematics Curriculum 2 (accredited by jurisdiction)

This unit is designed to provide students with opportunities to investigate current issues in primary school mathematics education. The findings and implications of contemporary research for classroom practice and the impact of curriculum documents are then carefully reviewed and evaluated within a social justice and equity framework.

Students will develop and apply advanced strategies for the explicit teaching of numeracy involving whole class, group and individual instruction, focusing on children's development of concepts, skills and understanding in mathematics. The teaching of rational number, algebra, and chance and data will form the content basis of this unit, along with mathematical thinking and critical problem-solving. Students will examine a range of formal and informal assessment strategies with an emphasis on using these tools to inform reporting on student achievement. Underpinning students' explorations in the unit will be theories of children's mathematical learning such as constructivism, and socio-cognitive approaches to learning.

Unit learning outcomes:

At completion of this unit students will be expected to be able to:

- explain the importance of a teacher of mathematics having a concern for justice and the dignity for all, and the implications for the teaching and learning of mathematics in the primary classroom
- incorporate culturally responsive and socially critical perspectives in an analysis of mathematics curriculum, including Indigenous perspectives
- demonstrate an understanding of generally agreed principles of learning and teaching mathematics
- demonstrate skills and articulate understanding of mathematical skills, concepts and
- processes relating to rational number, algebra, and chance and data
- evaluate and plan a range of mathematics learning experiences that contribute to an effective mathematics pedagogy
- critically examine assessment practices and how they inform mathematics teaching
- critically discuss the implementation and implications of digital technologies for learning mathematics
- critically discuss a range of issues related to contemporary mathematics teaching
- demonstrate positive attitudes towards mathematics learning and teaching.

Topics include:

- Diversity and socio-cultural issues: includes mathematics education in relation to socio-cultural issues in the community (eg communicating with parents, planning an inclusive mathematics school-based curriculum); catering for diversity within mathematics classes (eg ESL students, low and high attaining students); affective learning in mathematics; issues relating to contemporary mathematics teaching
- Developing students' mathematical understanding includes mathematical thinking and reasoning skills; understanding in rational number, algebra and chance and data
- Mathematics teaching: includes effective teaching strategies (eg grouping practices, open-ended questions, problem-solving); resources (eg the role and use of technology, manipulatives, issues in using print resources such as worksheets and texts); strategies for assessment; and program planning.

Assessment

Assessment tasks will comprise a hurdle task to affirm students' knowledge, understanding and skills of the mathematics content covered in the unit and two major pieces, chosen from the following:

- Research-based planning and teaching of a mathematics topic. This includes identifying the conceptual knowledge underpinning the learning of that concept and planning a unit of work (that includes teaching strategies and assessment practices) that supports the children learning of the topic. (weighting approximately 50%). This assessment is designed to address aspects of learning outcomes.
- Workshop folio of rich assessment tasks for a specific mathematics concept across a range of Year levels drawing on current research and reading. The folio should include reflections on the effectiveness of the tasks in gaining insights into student learning and how they link to mathematics curriculum document expectations following some trialling (weighting approximately 50%). This assessment is designed to address aspects of learning outcomes.
- Exploration of an issue relating to the teaching and learning of mathematics in the Primary school (eg catering for diversity in the mathematics classroom; contemporary mathematics teaching in the 21st century). This should include an investigation from both a theoretical and practical perspective and may include gathering information of key players – eg children, teachers, parents. The impact of the findings on classroom practice and relevant quality resources that are informative or useful for a primary teacher should also be included. (weighting approximately 50%). This assessment task is designed to address aspects of learning outcomes. It may address others depending on the issue chosen.

General comments

This is the second unit of Mathematics in this program.

(c) EDMA504 Mathematics Curriculum 1 (revised and subject to national accreditation)

The unit is designed to provide an introduction to primary school mathematics education by discussing and investigating current directions in mathematics education, including social justice issues, drawing on contemporary research, national and state curriculum documents and initiatives.

Pre-service teachers will explore theories of learning mathematics and effective teaching and learning strategies that enhance students' understanding of mathematical concepts and skills. Emphasis will be placed on ways to enhance the pre-service teacher's content knowledge in the areas of Number and Algebra, Measurement and Geometry and their understanding of how students' knowledge in these areas develops. Opportunities to advance problem-solving, reasoning, analytical thought and fluency will permeate the unit.

Pre-service teachers will explore ways to foster creativity, confidence and positive attitudes in mathematics.

Pre-service teachers must demonstrate appropriate numeracy standards or attend numeracy support sessions to help facilitate personal numeracy proficiency.

Unit learning outcomes:

On successful completion of this unit pre-service teachers should be able to:

- formulate an informed concept of current directions in mathematics and numeracy education including culturally responsive and socially critical perspectives by drawing on relevant research, the Australian Curriculum: Mathematics and other state and national curriculum documents
- apply theories and research about primary aged students' development of mathematical concepts and proficiencies to create powerful learning experiences, including the use of ICT, for students in Whole Number, Measurement and Geometry as required by Australian Curriculum: Mathematics and other relevant curriculum documents
- demonstrate an ability to critically reflect on the Australian Curriculum: Mathematics and the effectiveness of different theories and approaches to teaching mathematics that cater for students across a full range of abilities, particularly the formative, summative and diagnostic uses of assessment data, and apply these approaches to support students' diverse learning needs)
- use language, symbols, resources including ICT as tools to design learning sequences and organise lesson activities to support students' mathematical learning of Whole Number, Measurement and Geometry, as outlined in relevant documents
- provide evidence of numeracy at a level appropriate for the teaching profession or commitment to access additional support to build capability.

Topics include:

- Contexts of curriculum
  - state and national curriculum documents, social and cultural perspectives in mathematics.
- Students and mathematical understanding
  - theories of students' mathematical learning; and how they develop mathematical understanding, fluency, problem-solving and reasoning skills.
  - student misconceptions.
- Mathematical pedagogy
  - strategies to enhance all students' learning through the use of manipulatives, mathematical language and digital technologies in representing mathematical ideas
  - designing lesson sequences and mathematical learning activities for students of varying abilities
  - management and organisation of mathematical learning activities
  - strategies to promote self-esteem and positive attitudes to mathematics with due consideration of learners from non-English speaking backgrounds
  - purposes and approaches to formative and summative assessment.
- Mathematical content
  - content of Number and Algebra, Measurement and Geometry
  - instrumental and relational understanding in the strands of Number and Algebra, Measurement and Geometry.

Assessment

Assessment Task 1 – (weighting 30%)

Invigilated Examination on Australian Curriculum: Mathematics content and pedagogy knowledge.

Written examination: demonstrating an understanding of key mathematical content and problem-solving skills involving multiple-choice, short-answer and extended-answer items.

The content focus in the examination reflects the focus over the 12 week semester, that is, approximately 50% Number, 10% Algebraic Thinking, 25% Geometry and Measurement, and 15% other

Assessment Task 2 – (weighting 20%)

Reflective folio, based on lecture, tutorial, relevant readings and curriculum documents

A weekly reflective journal that draws together understanding from the weekly lecture, tutorial/workshop activities and prescribed readings and observations from professional experiences. The journal entries demonstrate critical reflection and growing understanding of:

(a) the pre-service teacher's own developing content knowledge for teaching

(b) application of theory and research to understanding how students learn

(c) teaching strategies to best support the learning of all students

(d) the varied use of assessment to use the data collected to focus future teaching, and

(e) the application of pedagogical content knowledge though making connections between these.

NOTE: This task aligns with the pre-service teacher's Professional Experience program of one day a week placement or similar during the semester.

Assessment Task 3 – (weighting 50%)

Assess student learning, interpret and report on student data and subsequently plan specifically targeted teaching.

A case study of students' mathematics learning drawing on field notes, clinical interviews, planned learning sequences supported by related research in the chosen mathematics domain.

Interview two students at different years of primary school, recording the responses of each student accurately in respect of the interview protocols. Interpret the data about each student to form judgments about their mathematical development with reference to a theoretical framework or trajectory. Summarise the data about each student in a summary report suitable for reading by another teacher, using professional language and presentation. Design a follow-up lesson setting goals for each student that targets a need that was identified in the interview. Link the lesson outcomes to Australian Curriculum: Mathematics and other state and/or national curriculum documents, with explicit use of materials, symbols and language to support the learning of each student.

Assessment task 4 – Hurdle requirement: a Pass grade only will be awarded

Assessment to validate each pre-service teacher's personal numeracy being broadly equivalent to those of the top 30% of the population. Each pre-service teacher is to submit a portfolio to demonstrate his or her proficiency in numeracy. If pre-service teachers are not able to provide such a portfolio they are required to undertake support sessions offered by Office of Student Success and provide a statement of completion.

General comments

The fourth assessment task requires students to validate their personal numeracy skills and must be passed to pass the unit.

(d) EDMA685 Mathematics Education 2 (revised and subject to national accreditation)

The unit is designed to provide opportunities to consider issues and strategies in planning, implementing and monitoring learning experiences for pre-service teachers in primary mathematics by discussing and investigating current directions in mathematics education, including social justice issues, drawing on contemporary research, national and state curriculum documents and initiatives.

Pre-service teachers will continue to explore theories of learning mathematics and effective teaching and learning strategies that enhance students' understanding of mathematical concepts and skills. This unit will promote cognitive skills to analyse, consolidate and synthesise a range of different learning activities and teaching approaches. A range of formal and informal assessment strategies will be examined with an emphasis on using student data to inform and differentiate learning and teaching: report on student achievement and meet professional accountability requirements.

Unit learning outcomes:

On successful completion of this unit, pre-service teachers should be able to:

- critically discuss a range of issues related to contemporary mathematics teaching and communicate this analysis effectively, drawing on relevant research, the Australian Curriculum: Mathematics and other state and national curriculum documents
- evaluate student learning and implement lesson sequences and teaching strategies, including the ethical use of ICT, that cater for the diverse needs of learners, with appropriate assessment and moderation, constructive and timely feedback and reporting practices for sharing understanding of progress with students and stakeholders
- critique through informed research, acquisition of mathematical understanding, fluency, problem-solving and reasoning in Number and Algebra, Statistics and Probability to inform planning for mathematics teaching with students of varying abilities, referenced to the Australian Curriculum: Mathematics and other relevant mathematics curriculum documents)
- model professional confidence and competence in mathematical skills, concepts and processes relating to Number and Algebra, Statistics and Probability to engage students in their learning and to evaluate the effectiveness of teaching programs.

Topics include:

- Researching informed approaches to successful mathematics learning that are responsive to the strengths and needs of students from diverse linguistic, cultural, religious and socio-economic backgrounds
- The role of mathematical investigation and open tasks for constructing mathematical knowledge and orchestrating mathematical discourse, reasoning, argumentation, and proof
- Effective resources that support and enhance the teaching and learning of mathematics (eg manipulatives, digital technologies, and visual representations)
- Assessment practices to guide learning teaching of mathematics: (eg informal and formal, including diagnostics approaches to formative and summative assessment of cognitive and affective learning).
- Recording and tracking of student learning – interpretation and analysis of student data; moderation of student learning outcomes against class, state and national norms
- Reporting of student learning outcomes to parents/carers and other stakeholders – types of reports; strategies for engaging parents
- Issues regarding National testing, eg NAPLAN
- Approaches for different levels planning for mathematics teaching
  - Incorporating the mathematical content and proficiencies
  - Integrating the mathematical content strands to facilitate connections across dimensions of mathematics

  - Effective contexts for mathematics learning (eg children's literature, real life contexts, games, problem-solving and investigations)
  - Identifying opportunities to use Numeracy across the curriculum
- Powerful pedagogical actions in mathematics (eg creating powerful learning environments, grouping practices, scaffolding learning, attending to literacy demands, promoting productive discourse and collaborative argumentation, questioning and prompting), selecting tasks and models that promote deep learning and knowing and using pedagogical knowledge.
- Current national, state, and territory initiatives in mathematics education

The teaching of rational number, algebraic thinking, and probability and statistics will form the content basis of this unit.

Assessments

Assessment Task 1:

Unit of work (Teaching program) (weighting 50%)

Write a critical review of literature relating to a particular content area (rational number – beyond fractions and decimal fractions ie proportion reasoning, ratio), statistics and probability, algebraic thinking). Evaluate the relevant curriculum documents in light of insights gleaned from the literature; and**,** plan a unit of work for the content area, for a particular Year level. The unit of work must include use of ICT, relevant assessment and moderation strategies, ways of providing feedback to students and parents/carers, recording and reporting processes, varied teaching strategies to differentiate learning.

Assessment Task 2 – CHOICE of assessment:
(For the purposes of national moderation all campuses must select the same task)

Invigilated examination on content and pedagogy knowledge

Written examination: demonstrating an understanding of key mathematical content and problem-solving skills involving multiple-choice, short-answer and extended-answer items.

OR

Researching and reporting an aspect of mathematics learning and teaching.

A choice from 2 items

(a) *Mathematics Video Stimulus Lesson(s)* (weighting 50%)

Create a three-minute video clip, focusing on rational number, algebraic thinking or statistics and probability, that highlights the mathematical language required for a particular age group, for use as a stimulus to introduce the learning in a lesson.

Provide a description of the way in which this video will be implemented into lessons, including prompts or questions that lead to mathematical investigations.

OR

(b) *Photograph/Video Prompted Investigation* (weighting 50%)

Take a series of three photographs or create a short video from the local area that enables students to explore the mathematics under focus (rational number, algebraic thinking or statistics and probability) and some prompts and questions that lead to mathematical investigation, based on the photo.

AVONDALE COLLEGE OF HIGHER EDUCATION

Avondale offers:

- **Bachelor of Arts/Bachelor of Teaching (Primary)**
- **Bachelor of Arts/Bachelor of Teaching (Primary) (Honours)**
- **Bachelor of Arts/Bachelor of Teaching (Birth to 12 years)**
- **Master of Teaching (Primary)**

Preparation to teach K–6 Mathematics

1 Approach

- Avondale provides three dedicated units of primary mathematics, two of which are common to each of the Bachelor of Arts/ Bachelor of Teaching (Primary), Bachelor of Arts/Bachelor of Teaching (Primary) (Honours) and the Master of Teaching (Primary) courses. The third mathematics unit is specific to the Bachelor of Arts/Bachelor of Teaching (Birth to 12 years) course.
- The units are delivered face-to-face, by distance and mixed/ blended formats. The units all have a common topics format focusing on pedagogy, mathematic teaching and learning, content and vocabulary, and curriculum planning.
- In addition, aspects of numeracy are incorporated within other units, such as BBUC11020 Literacy and Numeracy in an organisation (in the undergraduate programs) and other KLA units (for example through an assessment requiring strategies around numeracy).

2 Content

(a) BBUS11020 Literacy and Numeracy in an Organisational Context

This foundational unit for the undergraduate programs entails students exploring and extending their own ability and understanding of literacy and numeracy. It provides students with assessments to address their own competency. It addresses the link between research theory and practice and the associated research skills in the context of any organisation. The aims of the unit are to develop students who can identify literacy and numeracy in all of its forms and design programs to assist and improve individual abilities across contexts.

Unit learning outcomes:

Topics include:

1. Theories of literacy and numeracy
2. Stage development of literacy and numeracy practices
3. Pervasive nature of literacy and numeracy
4. Conditions of learning
5. Diverse learners and ability needs across literacy and numeracy.

   (Students requiring intensive assistance for either literacy or numeracy need to attend additional workshops beyond the standard two lectures/one tutorial per week).

Assessment

Assessments include sitting for a numeracy test (analyse results and design program to address weaknesses), keeping two week literacy and numeracy diary of everyday personal use (assess and evaluate numeracy demands), and an essay and text-based assignment requiring design of individual numeracy programs for two individuals to address their needs, including identifying relevant resources.

(b) EDUC14105 Curriculum Studies – Teaching Mathematics I

This unit explores various pedagogical, learning and assessment approaches for teaching mathematics to children in Foundational/Kindergarten to Year 2 classes. Engaging, challenging and enjoyable methods using ICT, hands-on activities and practical resources are integrated throughout this unit. The Australian Curriculum and the NSW syllabus documents are used to demonstrate how the development of students' mathematical concepts, skills and attitudes are considered, with associated implications for teaching, learning and assessment. The unit equips students to understand mathematical content and vocabulary, analyse mathematical learning and plan for Foundational/Kindergarten to Year 2 children's needs, abilities, interests and attitudes.

Unit learning outcomes:

- Demonstrate cognitive and technical skills to develop engaging mathematics materials appropriate to the knowledge, skills, needs, interests and attitudes of Foundational/Kindergarten to Year 2 learners
- Demonstrate knowledge about engaging and communicating clearly and coherently with parents and carers in the mathematics education process of Foundational/Kindergarten to Year 2 learners
- Exercise cognitive, creative and critical thinking skills to analyse and evaluate children's mathematics learning in conjunction with a broad and coherent knowledge of curriculum and syllabus documents appropriate for Foundational/Kindergarten to Year 2 learners
- Exhibit initiative and judgement, based on theories associated with developmental learning, meaning-making and emergent curriculum principles, to plan sequential learning experiences for Foundational/Kindergarten to Year 2 learners
- Demonstrate a broad and coherent body of knowledge, gained in contexts that require self-directed work and learning, of mathematical content and vocabulary appropriate to teaching Foundational/Kindergarten to Year 2 learners.

Topics include:

- Pedagogy
  - Teachers' and students' attitudes and experiences of mathematics
  - Articulation of personal and researched views about mathematics teaching
- Mathematic teaching and learning
  - The role of play and games in mathematics
  - Nature of mathematics and mathematics learning
  - Organising the mathematics classroom environment for optimised learning
  - Hands-on, practical mathematics activities using resources and manipulatives appropriate for Foundational/Kindergarten to Year 2 mathematics teaching and learning
  - Inquiry-based, project and negotiated mathematics for Foundational/Kindergarten to Year 2 learners
- Curriculum planning
  - Planning resources and learning experiences based on an analysis of students' abilities and needs
  - Australian Curriculum/NSW syllabus lesson planning
  - Designing learning and assessment tasks
- Content and Vocabulary – Knowledge of mathematics content and vocabulary for teaching and learning in a Foundational/Kindergarten to Year 2 context:
  - Number: number and place value; fractions and decimals; money and financial mathematics; patterns and algebra
  - Statistics and probability: chance; data representation and interpretation
  - Measurement and geometry: using units of measurement; shape; location and transformation

Assessment

Assessment in this unit includes two tasks of equal weighting –

- The first task requires students to create a learning kit that can be used in a school or home context to facilitate mathematics learning of children in Foundational/ Kindergarten to Year 2 classes.
- The second task is a planning portfolio that is based on observations of teaching situations in Foundational/Kindergarten to Year 2 classes where students are required to document and assess the learning activities and the way the children are making meaning of the lesson. Students are then required to develop follow-up lesson sequences which they present either on campus or online.

The assessment outlines provide very detailed descriptions of the tasks involved and clear marking criteria in the form of a rubric.

Participation in weekly contributions to online learning activities also contributes to the final mark for this unit and is assessed as either a Pass/Fail. (This is officially the third assessment task.)

To achieve a pass in this unit, students must obtain an assessment mark of 40% or greater in each of the assessment tasks, with an overall aggregate mark of at least 50%. Students must demonstrate regular contribution (more than 85%) to the online activities and attend 85% of online and/or online classes.

This unit is common across the Bachelor of Arts/Bachelor of Teaching (Primary), Bachelor of Arts/Bachelor of Teaching (Primary) (Honours) and Master of Teaching (Primary) courses.

General comments

There are three texts referenced as prescribed readings for this unit and include:

> Australian Curriculum Assessment and Reporting Authority. (2013) *Australian Curriculum: Mathematics*. Sydney, Australia: Author
>
> NSW Board of Studies NSW (2012). *NSW Syllabus for the Australian Curriculum: Mathematics K–10*. Sydney: Author, and
>
> Reys, R.E. et. al. (2012) *Helping children learning mathematics* (Australian ed.). Milton, Australia: Wiley and Son Australia.

There is an extensive three page list of recommended readings which include texts, web resources and selected journals. The unit is delivered face to face over a period of 13 weeks or online and/or in a blended format.

(c) EDUC24106 Curriculum Studies – Teaching Mathematics II

This unit explores various pedagogical, learning and assessment approaches for teaching mathematics to children in Years 3 to 6 classes. Engaging, challenging and enjoyable methods using ICT, hands-on activities and practical resources are integrated throughout this unit. The Australian Curriculum and the NSW syllabus documents are used to demonstrate how the development of students' mathematical concepts, skills and attitudes are facilitated through the design of sequential, motivating mathematics learning experiences. Several theories of learning considered, with associated implications for teaching, learning, and assessment. The unit equips students to understand mathematical content and vocabulary, analyse mathematical learning and plan for Years 3 to 6 children's needs, abilities, interests and attitudes.

Unit learning outcomes:

- Demonstrate cognitive and technical skills to select engaging mathematics materials appropriate to the knowledge, skills needs, interests and attitudes of Years 3 to 6 learners
- Demonstrate knowledge in creating and presenting an engaging series of sequential steps, to present a concept within mathematics education for Years 3 to 6 learners
- Exercise cognitive, creative and critical thinking skills to analyse and evaluate children' mathematics learning in conjunction with a broad and coherent knowledge of curriculum and syllabus documents appropriate for Years 3 to 6 learners.
- Exhibit initiative and judgement, based on theories associated with developmental learning, meaning-making and emergent curriculum principles, to plan sequential learning experiences for Years 3 to 6 learners.
- Demonstrate a broad and coherent body of knowledge, gained in contexts that require self-directed work and learning, of mathematical content and vocabulary appropriate to teaching Years 3 to 6 learners.

Topics include:

- Pedagogy
  - Teachers' and students' attitudes and experiences of mathematics
  - Articulation of personal and researched views about mathematics teaching
- Mathematic teaching and learning
  - The role of play and games in mathematics
  - Nature of mathematics and mathematics learning
  - Organising the mathematics classroom environment for optimised learning
  - Hands-on, practical mathematics activities using resources and manipulatives appropriate for Years 3 to 6 Mathematics teaching and learning
  - Inquiry-based, project and negotiated mathematics for Years 3 to 6 learners
- Curriculum planning
  - Planning resources and learning experiences based on an analysis of students' abilities and needs
  - Australian Curriculum/NSW syllabus lesson planning
  - Designing learning and assessment tasks
- Content and Vocabulary – knowledge of mathematics content and vocabulary for teaching and learning in a Years 3 to 6 context:
  - Number: number and place value; fractions and decimals; money and financial mathematics; patterns and algebra
  - Statistics and probability: chance; data representation and interpretation
  - Measurement and geometry: using units of measurement; shape; location and transformation.

Assessment

Assessment in this unit includes three tasks, the first being 40% worth of the final mark and the second being 50% worth of the final mark. The third task is defined as 'participation' (equivalent to 500 words via weekly online activities) and carries 10% of the final mark.

- The first task requires students to present two micro-lessons (equivalent to 2500 words) on two different syllabus learning outcomes or content descriptions for Years 3 to 6 learners of mathematics. These micro-lessons are followed up by a mini-report requiring students to demonstrate their ability to apply theoretical ideas to the selection of resources and to the sequential development of learning concepts.
- The second task requires students to construct an effective mathematics learning and teaching plan (equivalent to 3000 words) incorporating a range of numeracy and ICT teaching strategies relevant to Years 3 to 6 learners.

The assessment outlines provide very detailed descriptions of the tasks involved and clear marking criteria in the form of a rubric. A minimum of 50% is required across assessments tasks in order to pass the unit.

General comments

There are three texts referenced as prescribed readings for this unit and include:

> Australian Curriculum Assessment and Reporting Authority. (2013) *Australian Curriculum: Mathematics*. Sydney, Australia: Author
>
> Board of Studies NSW (2012). *NSW Syllabus for the Australian Curriculum: Mathematics K–10*. Sydney.
>
> Reys, R.E. et. al. (2012) *Helping children learning mathematics* (Australian ed.). Milton, Australia: Wiley and Son Australia.

There is an extensive two-and-a-half page list of recommended readings which include texts, web resources and selected journals. The unit is delivered face to face over a period of 13 weeks or online and/or in a blended format.

The unit learning outcomes, topics and prescribed readings are the same for each unit with a focus on Foundational/Kindergarten to Year 2 learners in the first unit and a focus on Years 3 to 6 learners in the second unit. This unit is common across the Bachelor of Arts/Bachelor of Teaching (Primary), Bachelor of Arts/Bachelor of Teaching (Primary) (Honours), Master of Teaching (Primary) and Bachelor of Arts/Bachelor of Teaching (Birth to 12 years) courses.

(d) EDUC11101 Curriculum Studies – Teaching Mathematics I & EC Numeracy

This unit explores various pedagogical, learning and assessment approaches for teaching mathematics to children aged 0 to 8 years of age. Engaging, challenging and enjoyable methods using ICT, hands-on activities and practical resources are integrated throughout this unit. The Australian Curriculum, the NSW syllabus documents and the Early Years Learning Framework documents are used to demonstrate how the development of students' mathematical concepts, skills and attitudes are facilitated through the design of sequential, motivating mathematics learning experiences. Several theories of learning considered, with associated implications for teaching, learning, and assessment. The unit equips students to understand mathematical content and vocabulary, analyse mathematical learning and plan for the needs, abilities, interests and attitudes of children aged 0 to 8 years of age.

Unit learning outcomes:

- Demonstrate cognitive and technical skills to select engaging mathematics materials appropriate to the knowledge, skills needs, interests and attitudes of children from 0 to 8 years age.
- Demonstrate pedagogies of relationships with parents and carers in the mathematics education process of children from 0 to 8 years of age.
- Exercise cognitive, creative and critical thinking skills to analyse and evaluate children' mathematics learning in conjunction with a broad and coherent knowledge of syllabus and framework documents appropriate for children from 0 to 8 years of age.
- Exhibit initiative and judgement, based on theories associated with developmental learning, meaning-making and emergent curriculum principles, to plan sequential learning experiences for children from 0 to 8 years of age.
- Demonstrate a broad and coherent body of knowledge, gained in contexts that require self-directed work and learning, of mathematical content and vocabulary appropriate to teaching children from 0 to 8 years of age.

Topics include:

- Pedagogy
  - Teachers' and students' attitudes and experiences of mathematics
  - Articulation of personal and researched views about mathematics teaching
- Mathematic teaching and learning
  - The role of play and games in mathematics
  - Nature of mathematics and mathematics learning
  - Organising the mathematics classroom environment for optimised learning
  - Hands-on, practical mathematics activities using resources and manipulatives appropriate for children 0 to 8 years of age
  - Inquiry-based, project and negotiated mathematics for children 0 to 8 years of age
- Curriculum planning
  - Planning resources and learning experiences based on an analysis of students' abilities and needs
  - Australian Curriculum/NSW syllabus/Early Years Learning Framework, experience and lesson planning
  - Designing learning and assessment tasks
- Content and Vocabulary – knowledge of mathematics content and vocabulary for teaching and learning children 0 to 8 years of age including outcomes that enable:
  - children to develop dispositions for learning such as curiosity, cooperation, confidence, creativity, commitment, enthusiasm, persistence, imagination and reflexivity

- children to develop a range of skills and processes such as problem-solving, enquiry, experimentation, hypothesising, researching and investigating
- children to transfer and adapt what they have learned from one context to another
- children to resource their own learning through connecting with people, place, technologies and natural and processed materials
- children to interact verbally and non-verbally with others for a range of purposes
- children to engage with a range of texts and gain meaning from these texts
- children to express ideas and make meaning using a range of media
- children to being to understand how symbols and pattern systems work
- children to use information and communication technologies to access information, investigate ideas and represent their thinking. [From the Early Years Learning Framework]

Assessment

Assessment in this unit includes two tasks of equal weighting.

- The first task requires students to create a learning kit that can be used in a school or home context to facilitate mathematics learning of children from 0 to 8 years of age.
- The second task is a planning portfolio that is based on observations of teaching situations (including children from 0 to 8 years of age) where students are required to document and assess the learning activities and the way that children are making meaning of the lesson. Students are then required to develop follow-up sequence experience which they present either on campus or online.

The assessment outlines provide very detailed descriptions of the tasks involved and clear marking criteria in the form of a rubric.

Participation in weekly quizzes also contributes to the final mark for this unit and is assessed as either a Pass/Fail.

To achieve a pass in this unit, students must obtain an assessment mark of 40% or greater in each of the assessment tasks, with an overall aggregate mark of at least 50%. Students must demonstrate regular contribution (more than 85%) to the online activities and attend 85% of online and/or online classes.

General comments

There are four texts referenced as prescribed readings for this unit and include:

> Australian Curriculum Assessment and Reporting Authority. (2013) *Australian Curriculum: Mathematics.* Sydney, Australia: Author
>
> Australian Government Department of Education, Employment and Workplace Relations for the Council of Australian Governments. (2009). *Belonging, being and becoming: The Early Years Learning Framework for Australia.*
>
> Board of Studies NSW (2012). *NSW Syllabus for the Australian Curriculum: Mathematics 10.* Sydney: Author, and
>
> Reys, R.E. et. al. (2012) *Helping children learning mathematics* (Australian ed.). Milton, Australia: Wiley and Son Australia.

There is an extensive two page list of recommended readings which include texts, web resources and selected journals. The unit is delivered face to face over a period of 13 weeks or online and/or in a blended format.

The unit learning outcomes, topics and prescribed readings are based on the units EDUC14105 and EDUC24106, however catering for children aged 0- to 8. This unit is only offered in the Bachelor of Arts/Bachelor of Teaching (Birth to 12 years) course.

CHARLES STURT UNIVERSITY

Charles Sturt University (CSU) offers:

- **Master of Teaching (Primary)**
- **Bachelor of Teaching (Primary) (Graduate Entry)**
- **Bachelor of Education (Early Childhood and Primary)**
- **Bachelor of Education (K–12)**

Preparation to teach K – 6 Mathematics

1 Approach

- CSU provides two dedicated units of primary mathematics common to each of the Master of Teaching (Primary), Bachelor of Teaching (Primary) (GE), Bachelor of Education (Early Childhood and Primary) and Bachelor of Education (K–12). These units are EMM209 Mathematics: Content and Pedagogy and EMM 410 Mathematics in the Primary Years.
- The units are delivered online and blended with classes for on campus delivery and focus on central mathematics concepts, modes of enquiry and content, based on the Board of Studies *NSW Mathematics K–6 Syllabus* and K–12 Mathematics Continuum. They emphasise differentiation and models of pedagogical practice, and integration of mathematics across KLAs.
- The MTeach (P) and BTeach (P) (GE) are delivered by distance education and are identical for the purposes of mathematics preparation and contain these two units.
- The B.Ed. (EC and P) is a 4.75 equivalent full-time length program and contains two foundational mathematics units from the School of Mathematics (MTH100 Foundation Mathematics and MTH110 The Evolution of Mathematics as per website list of units), the two common units as above, and an additional unit EMM106 Mathematical and Scientific Learning in the Early Years.
- The B.Ed. (K–12) program (equivalent 4.6 to 5-year program, depending on specialisation) contains the two common units covering the primary years, with additional secondary content units and teaching method for those specialising as secondary mathematics teachers. In relation to primary preparation the content is identical to the Master's course and the BTeach (P).

2 Content

(a) EMM209 Mathematics: Content and Pedagogy

This unit builds on central concepts, modes of enquiry and structure of the content of mathematics. Students explore principles and practices underpinning the teaching of mathematics and develop a deep understanding of current syllabus documents that will inform and guide their pedagogical practice. This unit also reinforces the function of mathematics as numerate and literate practice and the role and value of Information and Communication Technologies (ICT) as a pedagogical tool. It reviews theories of learning that are relevant to mathematics as well as mathematics content.

Unit learning outcomes:

Students should be able to:

- understand the function of mathematics as a numerate and literate practice that enables students to meet social, aesthetic and cultural needs
- demonstrate a developed knowledge base that is informed by the principles and practices of teaching and learning mathematics
- plan, implement and evaluate a problem-based task that is differentiated to meet diverse learning needs
- be aware of a range of strategies for teaching primary mathematics
- demonstrate a broad and critical understanding of current syllabus documents
- become aware of how to use Information and Communication Technologies (ICT) as a pedagogical tool.

Topics include:

- The nature and role of mathematics as a numerate and literate practice
- Principles and practices of teaching and learning mathematics including planning engaging lessons
- Software, the internet and technology for supporting mathematics pedagogy
- Mathematical concepts and processes such as:
  - thinking and working mathematically (planning, conducting and communicating)
  - number (such as Hindu–Arabic numeration) systems, fractions, decimals, and operations
  - statistics and probability
  - patterns and algebra
  - introduction to measurement and geometry
- Choosing and using mathematics: mathematical thinking and problem-solving techniques
- Central ideas in mathematics and numeracy and common student misconceptions.

Assessment

Assessment in this unit includes two tasks:

- The first task focuses on the development of an investigative lesson comprising a draft lesson plan for which peer feedback is given, a final lesson plan, a description of resources required to support the final lesson plan and an essay (letter or report) that justifies the lesson design.
- The second task is an examination.

Marking criteria for each of the assessment tasks is provided in the form of a rubric.

General comments

This unit is delivered online with a mix of pre-recorded and synchronous lectures. There are three documents referenced as 'literature' for this unit and include:

Siemon, D. et al. (2011) *Teaching mathematics: Foundations to Middle Years*. South Melbourne: Oxford University Press.

Board of Studies NSW (2012) *Mathematics K–10*. Sydney.

Victorian Curriculum and Assessment Authority (2012). *The AusVELS curriculum*. Melbourne.

All lessons have additional online readings and video clips relevant to the topic. Students are given a list of videos and video sites, websites, journals, conferences, Teacher Association sites, and teaching resources. The unit is considered a core unit of the course with no prerequisites.

(b) EMM410 Mathematics in the Primary Years

This unit consolidates central concepts, modes of enquiry and structure of the content of mathematics and explicitly connects these ideas to the models of pedagogy for teaching and assessing mathematics. There is strong emphasis on ways of differentiating curriculum to meet the diverse needs of learners in the mathematics classroom. The role and value of mathematics in the broader school curriculum and the relationship between mathematics, numeracy and literacy is also addressed.

Unit learning outcomes

Students should be able to:

- critically evaluate models of pedagogy for teaching and assessing mathematics
- design and differentiate a sequence of lessons (unit of work) to meet the diverse needs of leaners in the mathematics classroom
- have reflected critically on, and improve, practice with reference to professional standards framework
- make explicit their understanding of the role of the value of mathematics in the broader school curriculum and the relationship between mathematics, numeracy and literacy
- have demonstrated a broad and critical knowledge of Board of Studies syllabus and assessment requirements for primary mathematics
- explain and interpret the place of primary mathematics in the K–12 continuum of learning.

Topics include:

- Differentiating a mathematics curriculum for diverse learners
- A closer look at measurement and geometry and planning for these areas of teaching
- Models of pedagogy for teaching and assessing mathematics
- Exploring relationships between mathematics, numeracy and literacy
- Integrating mathematics across key learning areas
- What constitutes an effective pedagogical framework in mathematics
- Board of Studies syllabus and assessment requirements for primary mathematics
- Identifying the place of mathematics in a K–12 continuum of learning.

Assessment

Assessment in this unit includes two tasks.

- The first task is a report explaining how mathematics should be taught in order to cater for diversity in student experiences. The report should review the current literature for each of the learner groups identified in the classroom context provided and show that you have an understanding of the diverse needs of each of these learner groups. It should also include appropriate teaching strategies and a practical task that would be beneficial in promoting the successful achievement of mathematical learning outcomes for each of these learner groups.
- The second task is to design a unit of work outlining 8 learning experiences that will address the development of this outcome in a class of diverse learners. You will also design a summative assessment task that could be used at the conclusion (lesson 8) of your unit of work. In line with your summative assessment, develop a marking rubric based on the NSW Board of Studies A to E grading system.

Marking criteria for each of the assessment tasks is provided in the form of a rubric.

General comments

Differentiating the curriculum is informed by mathematics education research on Indigenous students; students with additional languages and cultures; the importance of social justice and diversity; and catering for diversity through problem-solving, inquiry collaborative learning. This subjects specifically considers geometry and measurement education bringing together pedagogical principles for planning and assessing.

Recommended Texts:

Siemon, D. et al. (2011) *Teaching mathematics: Foundations to Middle Years*. South Melbourne: Oxford University Press

Board of Studies NSW (2012) *Mathematics K–10*. Sydney.

Victorian Curriculum and Assessment Authority (2012). *The AusVELS curriculum*. Melbourne.

Recommended readings and video material are provided for each topic. Further websites, journals, conference proceedings, Teacher Association and other websites are recommended. The unit is delivered online and blended with classes for internal students. It is considered a core unit of the course with no prerequisites.

(c) EMM106 Mathematical and Scientific Learning in the Early Years

In this subject, students will learn about the development of mathematical and scientific understanding from birth to eight years of age. The subject will focus on foundation mathematical and scientific concepts and processes, and students will explore how these understanding are developed through children's everyday activities, play, and investigations, across the birth to eight spectrum. The subject will explore what mathematics and science looks like in these different settings, and the pedagogical approaches for recognising, supporting and extending mathematical and scientific development in each of these settings. Students will learn how to observe, record and analyse children's mathematical and scientific activity in early childhood settings.

Unit learning outcomes

Students should:

- possess knowledge of the foundation mathematical and scientific concepts and processes developed during the early childhood years
- be able to identify children's engagement with these concepts and processes through their everyday activities, play, and investigations
- be able to demonstrate understanding of the role of the early childhood mathematics and science teacher by observing, recording and analysing children's play in relation to the children's developing understanding of mathematical and scientific concepts and processes
- be able to effectively use pedagogies of play, language, modelling, and questioning to facilitate opportunities for mathematical and scientific learning and develop children's emerging understanding of mathematics and science
- be able to demonstrate an ability to use learning stories to communicate children's mathematics and science learning to colleagues, families, and the children themselves
- be able to demonstrate an ability to use children's drawings and narratives as a starting point for planning future mathematics and science learning experiences
- be able to demonstrate skills in planning effective mathematics and science learning experiences which respond to the prior experiences and understanding of children.

Topics include:

- Mathematical and scientific learning in early childhood: Learning mathematics and science in early years settings and powerful processes in early mathematics and science
- Foundation scientific concepts and processes in early childhood: Biological and earth sciences, physical and chemical sciences and environments and sustainability
- Foundation mathematical concepts and processes in early childhood: Number and counting, pattern, shape and space
- Recognising and supporting mathematical and scientific development: 0–2 years
- Supporting and extending mathematical and scientific development: 3–5 years
- Extending and formalising mathematical and scientific development: 5–8 years.

Assessment

- Students will critique a book suitable for 0 to 8 years in terms of its value for mathematical and scientific learning and prepare opportunities for activities related to the concepts and processes incorporated in the book.
- Students will observe children playing, investigating and/or drawing, focusing on one child, interpret their observations and children's products in terms of scientific, mathematical, engineering, and technological understanding. They will prepare a learning story that takes account of the Early Years Learning Framework and incorporates recommendations for further learning.

Marking criteria for each of the assessment items is in the form of a rubric.

General comments

This unit combines with the two common units and two foundational mathematical units to provide a suite of five units in this degree covering early years through to Year 6 in primary.

(d) MTH110 Evolution of Mathematics

This subject is designed to develop an understanding and an appreciation of the importance of Mathematics in Society. This will be developed by following the evolution of some mathematical concepts throughout history, how these concepts have aided in communication and interpretation of the world around us. These concepts will also be studied formally to develop the student's mathematical skills further. Topics to be included are, but not limited to, measurement systems, algebra, geometry, and statistics.

Unit learning outcomes:

Students should be able to:

- examine and describe historical mathematical concepts and processes and discuss their impact on modern society
- define the geometric concepts of shape and measurement and apply them in practice to different contexts
- demonstrate models and patterns through the use of algebraic equations and apply these to everyday practice
- collate, analyse and interpret data and communicate and make recommendations from the resulting information
- represent data to communicate information in an appropriate cultural format.

Topics include:

- Measurement systems, including the history and development of Babylonian and Hindu–Arabic number systems
- Algebra, including solving linear and quadratic equations, sequences and series.
- Geometry, including coordinate geometry, geometrical shapes, transformations, similarity and congruence.
- Statistics, including descriptive statistics and the normal distribution.

EXCELSIA COLLEGE

Excelsia College (formerly Wesley Institute) offers:

- **Master of Teaching (Primary)**

Preparation to teach K–6 Mathematics

1 Approach

- The degree includes two units on Numeracy and Mathematics to be completed sequentially in the first and second semester of second Year, with satisfactory completion of the first unit (Numeracy) a prerequisite for the second.
- A focus on research is embedded within each unit in week 8 (Teacher as Researcher, prescribed readings relating to Mathematics teaching, plus an assessment task requiring evaluation of the readings in relation to aspects of curriculum design, development and evaluation). In addition students have the option of doing a mathematics-based research project in their final semester of candidature as part of their third Professional Experience.
- The unit of study outlines lists those APST Standard Descriptors which are addressed by the units.
- The units are online units with explicit teaching during the first 8 or 6 weeks respectively. Assessments are undertaken in the remainder of the Numeracy unit, and assessments and professional experience is undertaken in weeks 7–13 in the Mathematics unit.

2 Content

EDPC502 Numeracy

In this unit, teacher education students will acquire a working knowledge in applying current pedagogical theories to the teaching and learning of mathematics including specific knowledge and skills, including literacy skills, which facilitate the active learning of numeracy. They will also acquire the necessary knowledge and understanding of relevant curriculum documentation, and will become aware of a range of teaching resources (including calculators and Information and Communication Technology) that can enhance the teaching and learning of numeracy skills, concepts and processes.

Unit learning outcomes:

- Appreciate and value the development of children's numeracy skills
- Demonstrate an understanding of current theories and research findings, and their applications to the ways in which students think, learn and construct numeracy concepts and processes
- Make appropriate use of curriculum documents related to numeracy (including national, state, and school-based documents) in consultation with colleagues
- Design and implement appropriate teaching, learning, assessment and evaluation experiences for primary students in numeracy, recognising the individual learning needs of students including Aboriginal and Torres Strait Islander students, students leaning English as an additional language or dialect and special needs students

- Design and implement appropriate teaching, learning, assessment and evaluation experiences for Working Mathematically, Number and Algebra, Measurement and Geometry, Statistics and Probability
- Evaluate and appropriately use teaching materials, including calculators and ICT resources, for the development of numeracy skills in primary school.

Topics include:

- The place of Numeracy in the curriculum
- Developing numeracy concepts and skills
- Overcoming difficulties in developing numeracy skills
- Computational skills
- Problem-solving and mathematical thinking
- Teaching fractions and decimals and chance
- Assessment
- Standardised testing in Numeracy
- The teacher as researcher
- Integration of theory and practice.

Assessment

Preliminary basic assessments include satisfactory engagement in workshops in practical numerical processes (four hours) and a discussion forum in week 3.

- Journal tasks (1000–1500 words) (20%): focused on developing understanding of numeracy and associated mathematical concepts, and reflections on relevant pedagogical approaches for developing children's numeracy skills.
- Teaching computational strategies (3000 words) (30%):a sequence of lessons addressing specific syllabus outcomes in particular computational processes.
- Essay (2000 words) (45%).

Assessments 2 and 3 require students to focus on particular NSW maths syllabus outcomes across the Primary K–6 stages. Interactive lesson, with worksheets and rationale derived from research-based material (week 8) focused on specific mathematical processes.

General comments

All course work is completed from weeks 1 to 8 of the semester. Students work on assessment 2 and 3 for the remainder of the semester. The NSW Mathematics syllabus is listed as prescribed reading from week 4. Students also work through Bobis' and Westwood's texts as prescribed reading over the semester. A comprehensive list of (15) other texts are listed as recommended reading.

The Australian Curriculum content on the Numeracy general capability and the APST are also prescribed reading.

EDPC505 Mathematics

This unit builds on the Numeracy unit by assisting teacher education students to develop their knowledge and understanding of how current pedagogical theories relate to teaching and learning mathematical concepts and processes. They will acquire further knowledge and skills that will facilitate the active learning of mathematics, gain a greater knowledge and understanding of relevant curriculum documents (including links between Stages 3 and 4 documents), and develop an awareness of a wide range of teaching resources (including ICT resources) that enhance the teaching and learning of mathematical skills and concepts.

Unit learning outcomes:

- Appreciate more fully, and value the development of, children's mathematical abilities
- Demonstrate a well-rounded understanding of current theories, research findings, and their applications to the ways in which students think about, learn and construct mathematical knowledge
- Demonstrate a thorough knowledge of, and make appropriate use of, curriculum documents in Mathematics – national, state and school-based – including the links between Stage 3 and Stage 4 Mathematics within the K-12 continuum of learning
- Design and implement appropriate teaching, learning, assessment and evaluation experiences in Mathematics for primary students, recognising the individual learning needs of students including Aboriginal and Torres Strait Islander students, students learning English as an additional language or dialect and special needs students
- Evaluate and appropriately use Mathematics teaching resources, including ICT resources

Topics include:

- The place of Mathematics in the Australian curriculum (overview of K–10 Mathematics documents, including strands, sub-strands, elements, support materials and sample units of work); time allocation and relevance of world views to mathematics..
- Thinking and working mathematically across the strands, including pedagogical strategies for problem-solving.
- Student learning needs and curriculum differentiation
- Planning, programming and assessment (scope and sequence, unit development, assessment strategies)
- Teaching resources and ICT
- The teacher as researcher (Week 6 readings)
- Integration of theory and practice

Assessment

(including participation in a discussion forum)

- Journal tasks (1000-1500 words) (25%): focused on developing mathematical understanding and reflection on pedagogical approaches.
- Programming a unit of work (3000 words) (45%): overview of a 10 week Year 4/Stage 2 unit with detailed programs for three topics from the different strands (referenced to Week 6 readings, syllabus documents and resources).
- Essay (2000 words) (30%): three ICT resource evaluations across the stages

General comments

Course work is completed over weeks 1–6 of the semester. Students spend weeks 7 through 15 doing a practicum and assessments 2 and 3.

The NSW maths syllabus documentation is listed as prescribed weekly readings from week 1 of this unit. A comprehensive list of (19) other texts are listed as recommended reading.

The Master of Teaching (Primary) is delivered via online learning. Students have online access to the courses, resources, discussion forums and a digital drop box for assignments which are submitted electronically. Compulsory on-campus orientation is run at the beginning of the course for a week and mid-course for an additional week. Students participate in hands-on numeracy workshops with practising primary mathematics teachers.

Students undertake Professional Experience practicum units in Semesters 1, 2 and 4.

MACQUARIE UNIVERSITY

Macquarie University (MQ) offers:

- **Bachelor of Education (Early Childhood Education) (Birth to 12)**
- **Bachelor of Arts/Bachelor of Education (Primary)**
- **Bachelor of Arts Psychology/ Bachelor of Education (Primary)**
- **Bachelor of Education (Primary) – Graduate Entry**

Preparation to teach K – 6 Mathematics

1 Approach

- MQ provides initial teacher education programs that are of four years duration (three double degrees) plus a two-year graduate-entry B.Ed., which include compulsory units common across the degrees addressing the BOSTES Mathematics K–6 syllabus, and integrating it with a variety of pedagogy studies and professional teaching experience.
- Student teachers are introduced to maths teaching from their second year onwards. Except for the unit Mathematics in Schools, the other compulsory units that address mathematics teaching also combine it with English teaching studies.
- MQ requires student teachers to complete two discipline-based units in their other Bachelor stream to give their students stronger academic grounding. If a student did not complete 2 units of HSC General Mathematics at Band 4, they must also complete the unit, MATH106 A view of mathematics, which is principally designed for students intending to teach in primary schools.
- The Bachelor of Education (Early Childhood Education) (Birth to 12) is offered through the University's Institute of Early Childhood. Its approach to mathematics teaching preparation is set out in (d) to (f) below. The program requires three units that focus on mathematics (and science/technology), there is an elective science and technology unit (one of 4 KLA electives of which 2 must be chosen) and there are aspects of numeracy and mathematics syllabus included in a Curriculum and Pedagogy unit (specifically in an assessment task) as well as within the third and fourth professional experience placements.

2 Content

(a) EDUC258 Mathematics in Schools

This unit is compulsory for all primary teacher students (as well as secondary mathematics teacher students). Students attend two lectures and a tutorial each week, or for external (off-campus) students, lectures are viewed online and attendance is a two day on-campus block session during the middle of the semester. The first lectures in each week focuses on research perspectives applied to primary mathematics classrooms, and the second lectures examine current research about how children learn basic mathematical concepts and consider theories of learning and teaching mathematics.

Unit learning outcomes:

- Demonstrate knowledge and understanding of research into how students learn certain fundamental mathematical ideas and the implications for teaching
- Demonstrate knowledge and understanding of strategies for differentiating teaching to meet the specific learning needs of students across the full range of abilities
- Demonstrate understanding of the concepts, substance and structure of the content and teaching strategies of mathematics
- Know and understand numeracy teaching strategies and their application in teaching areas
- Demonstrate understanding of the content covered in lectures and tutorials.

Topics include:

- Understanding children's development of mathematical concepts
- The nature of mathematics learning (different views of mathematics and learning theories)
- Promoting meaningful early numeracy (development of quantitative literacy and problem-solving in the real world)
- Theories of teaching mathematics (inclusive pedagogical approaches)
- Teaching and learning addition and subtraction concepts and processes
- Developing number sense and numeracy (importance of students investing and applying their own methods before learning more formal algorithms)
- Teaching and learning multiplication and division concepts and processes
- Multiplicative reasoning (early development, real situations for use, proportional reasoning, place value)
- Teaching and learning fractions (incl misconceptions and curriculum expectations)
- Learning about rational numbers
- Patterns and structure in mathematics learning
- Learning about patterns and algebra (early acquisition of key concepts, links between number and algebra)
- Approaches to teaching and learning measurement (incl relationships between length, area, volume and capacity and mass)
- Learning about measurement (the importance of measurement contexts in the development of children's understanding of fractions and decimals, estimation and approximation)
- Early development of spatial and geometric thinking (research background to early development, a range of spatial processes)
- Development of spatial and geometric understanding (research findings, approaches incl van Hiele as guide to understanding development of geometrical thinking)
- Development of statistical reasoning and data exploration in the primary school, including graphing
- Statistics and probability in the middle Years
- Development of chance and probability in the primary school
- Working Mathematically (NSW K–10 syllabus; Australian Curriculum), integration into mathematics teaching and learning
- Technological tools: the impact on mathematics learning and teaching
- Teaching by problem-solving (critically examining constructivist and transmissionist teaching)

Assessments

The first assessment, weighted at 20 percent, is an online multiple-choice quiz in week 4 based on content taught in the first three weeks of the unit. The second assessment, weighted at 35 percent, is a numeracy interview report with a school student on their views to mathematical concepts and processes where they demonstrate understanding and difficulty, and how this relates to the prescribed reading on multiplication and division that is assigned to the assessment. The final assessment, weighted at 45 percent, is a two-hour exam covering topics selected from the unit. No detail is provided on what the exam type will be (eg multiple-choice, short answers, essay, etc). For external students, there is an additional pass/fail assessment consisting of photocopies from their Student Manual on certain topics that are not covered during their two day on-campus block session.

General comments

The main readings for the unit are the BOSTES K–6 Mathematics syllabus and the EDUC258Unit Reader, a collation of select readings. In the course outline, each week of the semester outlines a topic which is directly linked to a specific reading that covers a certain aspect of primary mathematics and teaching children. Readings for each week are assigned drawn from key texts such as *Mathematics for Children* (2013) by J Bobis, J Mulligan and T Towrie., and journal articles. Explicit assessment rubrics are provided.

(b) EDTE251 Curriculum & Teaching in the Primary School 1 (English/ Mathematics)

This unit introduces general pedagogical aspects of teaching and learning in primary school, based on the NSW English and Mathematics syllabi (2012) and builds on pre-existing knowledge from previous subjects including the Mathematics in Schools unit. Undertaking professional experience is also required for the unit. The unit is structured through alternating weekly lectures in English and mathematics, with weekly workshops in each.

Unit learning outcomes:

- Developing knowledge of content, the structural organisation and scope and sequence of content, as prescribed by syllabus documents for Mathematics and English
- The ability to design and implement lessons in Mathematics and English that are engaging and motivating for K–6 students and are linked to appropriate learning outcomes
- Developing understanding of the strategies needed to cater for the diversity of learners
- The ability to think critically about the potential of information and communication technologies (ICT) to enhance the quality of learning and teaching.

Topics include (English topics covered in the unit are excluded below):

- Mathematics in the Primary School: An introduction (examination of the structure, content and process strands of the BOSTES K–6 Mathematics syllabus and the Australian Mathematics Curriculum
- Strategies for teaching whole number and working mathematically, including ICT use
- Using games in the Maths classroom: Addition and subtraction and working mathematically
- Number: The use of mental computation and calculator-based strategies in teaching and learning estimation, computation and problem-solving
- Number: Multiplication, division and working mathematically (including group designed lesson plan)
- Number: Fractions and decimals and working mathematically
- Mathematics: Integrating numeracy and literacy through children's literature
- Working mathematically through measurement (length, area, volume and capacity, mass; differentiation and management of group activities)
- Working mathematically through good questions in the maths classroom (strategies, evaluations)
- Working mathematically through patterns and algebra (all stages, links with other strands, devising activities for explicit Stages 1 and 2 instruction)
- Mathematics: Differentiating mathematics learning for individual differences (learner characteristics, policies, strategies, resources, examples)
- Differentiation in practice (group design of lesson, discussion and analysis)
- Pedagogies for using technologies in the English and Maths classroom
- Working mathematically through space and geometry (strategies, with focus on developing lessons, classroom/student management, reflection of effectiveness)
- Working mathematically through statistics and probability (strategies for data exploration, real life examples and links with other KLAs, resources).

Assessments

Student participation in the workshops is assessed throughout the semester, weighted at 5 percent. The first major assessment for the unit is a diagnostic task (10%). The student teacher is required to write a 200-word piece on a designated area of workshop and lecture discussion demonstrating their ability to present a logical, well-reasoned and grammatically sound argument through their developing content knowledge. The second assessment is an in class presentation (30%), in which the student teacher is required to pair up with another student teacher and design and demonstrate a creative English and Mathematics game that is suitable for developing knowledge and skill in the primary classroom. As part of the assessment, each student teacher is to individually write a 500-word lesson plan to accompany one of the games, demonstrating their understanding and originality of the lesson planning process, and at the conclusion of their presentations, write a 100-word individual reflection on their presentation and any areas for improvement. The third assessment (30%) is the development of four lesson plans/learning experiences in English and Mathematics, based on two videos selected by the course, to demonstrate the student teacher's understanding of pedagogical content and teaching strategies. A critical evaluation of the videos is required. The final assessment is a two-hour mixed mode exam (30%). The modes are not described in the course outline, except that one component will require students to demonstrate their ability to write (printing and cursive styles).

General comments

There are three pages of recommended readings for teaching mathematics and English. The unit's required mathematics text is Siemon, D., Beswick, K., Brady, K., Clark, J., Faragher, R. & Warren, E. (2011). *Teaching Mathematics Foundations to Middle Years*. South Melbourne: Oxford University Press. Additionally, the unit lists syllabus documents and support materials, such as the BOSTES Mathematics K–6 syllabus and the Australian Curriculum, and select journals on primary mathematics. In the course outline, each week of the semester include specific readings that is relevant to the topic, a section from the BOSTES K–6 Mathematics syllabus, and the relevant APST standards that are addressed.

(c) EDTE354 Curriculum and Teaching in the Primary School 4 (English/Mathematics)

This unit further builds on student teachers' pedagogical content knowledge of the NSW English and Mathematics syllabi (2012). The unit aims to develop strategies for fundamental design and delivery of learning experiences and differentiating for learning within the regular classroom. In particular, it addresses the national priority areas of Literacy and Numeracy, and Aboriginal and Torres Strait Islanders, classroom management, information & communication technologies, and students with special education needs.

Unit learning outcomes:

- Demonstrate knowledge of subject content across English and Mathematics in planning and practice
- Demonstrate an understanding of the processes of learning, teaching and assessing
- Develop pedagogical skills for effective use of the interactive whiteboard
- Use their research-based knowledge of curriculum and pedagogies to assess and evaluate a variety of teaching strategies
- Develop further skills in reflective practice and show an understanding of the professional role of the teacher and the ethics of teaching
- Apply their understanding of developments in the Australian Curriculum to the classroom, particularly in relation to Mathematics and English
- Demonstrate ability to plan, program and assess teaching and learning experiences that differentiate for learners
- Develop ways of teaching higher-order thinking skills to students
- Demonstrate strategies for teaching students how to work collaboratively.

Topics include
(English topics from this unit are excluded below):

- Quality mathematics teaching (examines the NSW Quality Teaching Model within the context of Mathematics teaching and syllabus requirements)
- Integrated learning and assessment of mathematics
- Planning, scaffolding and assessing for quality mathematics teaching and learning (consideration of assessment programs and strategies, eg Best Start, NAPLAN standardised tests/ACER, CMiT, differentiated assessments)
- Planning, programming, assessing and reporting in mathematics
- Mathematics in practice for the graduate teacher (casual or permanent). Strategies, differentiation, mini-units for casual teaching, and requirements for graduates to meet teaching standards, including in Mathematics as new teachers, are addressed.

Assessments

The first assessment, weighted at 35 percent is an English assessment task of designing a literacy plan. The second assessment, weighted at 35 percent, is the development of a mathematics unit of work. The student teacher must design four mathematical learning experiences (eg one week's program of mathematics) for a classroom that is based on the BOSTES K–6 Mathematics syllabus. The final assessment is a two-hour mixed mode exam, weighted at 30 percent. The modes are not described in the course outline, except that one component will require students to demonstrate their ability to write (printing and cursive styles).

General comments

The set text for this unit is Siemon, D., Beswick, K., Kathy Brady, K., Clark, J., Faragher, R. & Warren, E. (2011), *Teaching Mathematics Foundations to Middle Years*. South Melbourne: Oxford University Press. Additionally, there is a page of other recommended mathematics-related readings for the unit, including syllabus documents and support materials from the BOSTES Mathematics K–6 syllabus (2012) and the Australian Curriculum, and journals on teaching mathematics. Overall, readings for the unit consist of four pages covering mathematics, English, and pedagogy, including specific issues addressing learning difficulties. Like previous units, the course outline links a specific reading to each week of the semester and the relevant topic that is taught.

(d) ECH 232Teaching and Learning Mathematics, Science and Technology 1

This is the first of the three B.Ed. (ECE) (Birth to 12) program. It introduces each strand of the Maths and Science syllabuses, emphasising in mathematics the Number and Algebra strand, and addressing teaching and learning, planning and assessment practices in K–2 settings.

Unit learning outcomes:

- Demonstrating fundamental understanding of major theoretical developments in early childhood mathematics, science and technology
- Developing skills in designing, implementing and evaluating lesson sequences using knowledge of the EYLF, BOSTES syllabuses and other curriculum requirements of the Education Act
- Demonstrating relevant knowledge of the central concepts, modes of enquiry and structure in the discipline of mathematics, science and technology
- Beginning to evaluate mathematics, science and technology resources in light of experience as a teacher of young children
- Demonstrating research-based knowledge of the models of pedagogy for teaching and assessing mathematics, science and technology
- Developing skills in integrating ICTs within effective teaching and learning strategies to expand opportunities for students in mathematics and science learning
- Explore, adapt and shape understanding and skills and demonstrating safe, responsible and legal use of ICT in planning and teaching.

Topics include
(there are three modules – mathematics, science, technology – of three weeks each through which students rotate, following a common module 1).

- Module 1 introduction to philosophy, pedagogy and practice in the three areas (MST); key learning theories; common processes of observing, communicating, classifying, inferring, measuring, experimenting and introduction to syllabus documents
- Module 1 planning and assessment in MST: observation and assessment as basis for learning; making observations and links to EYLF and BOSTES syllabus documents; learning across KLAs (STEM and STEAM); formal and informal assessments as component of teaching/learning; Best Start and SENA.

Mathematics module

- Maths learning in context: syllabus documents 0–5 and K–12; models of instruction, resources, role of teacher; learning trajectories; Working Mathematically processes; role of skills and content in both areas; maths across strands and sub-strands foundational concepts in number: visualising, grouping and categorising, counting, estimating, patterning, base 10, place-value and arithmetic strategies, grouping, combining and partitioning, part/whole thinking; CMIT and SENA.
- Maths learning in Number and Algebra, applying number learning across measurement: part and whole number (fractions and decimals) 0–5 and K–12 strategies for use; working with whole numbers (addition/subtraction/division/multiplication) and strategies for use; numerical reasoning in measurement (length, area, mass, time); numerical reasoning in geometry (2D, 3D space and position); numerical reasoning in chance and data; assessment, student misconceptions; working mathematically in number.
- Mathematics learning in Number and Algebra: patterning(repeating, growing, special and geometric patterns, number patterns); structure of patterns and awareness of unit of repeat; representation, abstraction and generalisation of patterns; early algebraic thinking and algebraic reasoning; building number relationships and numeric patterns; developing algebraic thinking and reasoning with older children, linking geometric and number patterns; functional thinking; integrating patterns and algebra across other strands and other KLAs; different approaches to learning; differentiating curriculum in prior to school and K–6 settings; working mathematically through patterns and algebra; acknowledging children's interest and prior learning; strategies to assess children's learning-linking to teaching experiences and outcomes.

Assessment

There are three assessment tasks with the third focused on science. There are weekly quizzes, totalling 30% addressing the weekly key theoretical content (short online tasks such as quiz, short-answer response of online blog posting). The maths assessment task focuses on assessing a child's numeracy skills and then planning and reporting based on the assessment. SENA is used for a K–2 child.

General comments

This unit also includes three week modules in each of science and technology. The Learning Framework in Number is used to report on student solution strategies and make recommendations for follow up. A series of tasks are to be devised and implemented with clear learning outcomes to develop the child's number problem-solving strategies, with the outcomes assessed and reflected in a report to the teacher that could also inform the parents.

Texts are Bobis et al (2013, 5th edition), the BOSTES syllabus and Charles worth and Lind (2012, 7th edition) *Maths and Science for Young Children.* A set of required readings are included with a set of further readings.

(e) ECHE234 Teaching and Learning Mathematics, Science and Technology

This unit builds on ECHE232 and follows the same pattern of an initial common module followed by three week modules in each of mathematics, science and technology taken in rotation. The unit aims to deepen subject content knowledge with a focus on Statistics and Probability, Measurement and Geometry and Number Strategies for K–6 students, as well as the science and technology syllabus strands.

Unit learning outcomes:

The Learning Outcomes of this unit reflect the Learning Outcomes for the previous unit, applied to the mathematical concepts and processes in the area of number and algebra, statistics and probability and space and geometry. There is a focus on extending knowledge and understanding of the syllabus requirements, relevant learning frameworks, research- based pedagogies, and use of ICTs. There are further outcomes relating to science and technology.

Topics include:

Module one Catering for diverse learning needs: developing pedagogy and practice in MST moving from 0–5 to K–6 contexts; key theories to support learners including differentiation to support and extend learning; catering for Aboriginal children and children from diverse language backgrounds; syllabus/ frameworks revision. Planning for effective learning in STEM and cross-curriculum integration: observation and assessment in learning, role of key questions to support investigation and learning; cross-curriculum strategies including linking literacy and the arts with STEM.

Mathematics module

- Number K–6: revision of strands (content and process), transitions to school in maths learning; transitions into Stage 4; place value and multi-digit computational strategies and tools; moving beyond concrete materials to abstract manipulation of number, setting groundwork/ selecting strategies; simple and complex strategies for working with the number strand (from concrete to symbolic and abstract representation); mental and written computational strategies for Stage 4 students; linking literacy and numeracy, role of literature in mathematics learning to provoke problem-solving and engage learners
- Measurement and Geometry: investigating length, area, volume and capacity, mass and time; investigating 2D and 3D shapes. Angles and position; position, location and movement, recognising, visualising and drawing; Mathematical language relating to shapes, space and position; describing features and properties; static and dynamic representations, orientation, direction and perspective; theories of measurement and geometry, Piaget. Sequence of spatial development; Van Haile's Levels of Geometric Thinking; Clements and Sarema/Learning Trajectories: technology and transformation, exploring spatial ideas through the use of appropriate software; assessment and student misconceptions in Space and Geometry; differentiating curriculum in 0–5/K–6 settings; Working Mathematically through Space and Geometry
- Statistics and Probability: investigating chance in 0–5/K–6 settings; chance and probability in learning; chance and links to fractions and decimal understanding; mathematical language related to chance; data exploring simple to complex representations; accurate data representations/ importance of real world data collection; technology and transformation, exploring data collection through online tools, google forms and excel; assessment and student misconceptions in Data and Chance; differentiating curriculum 0–5/K–6 settings; Working Mathematically through statistics and probability.

Assessment

There are weekly quizzes and online tasks as in the previous unit, with the major maths assessment task focused on maths across the curriculum/ using literacy as a tool in planning learning based on Stage 2/Stage 3 mathematical learning, a pamphlet related to a book is to be designed, with text, graphics and pictures relevant to embedded mathematical concepts and processes. Five experiences from across the strands are to be developed (described, referenced to syllabus outcomes, linked to other curriculum areas, and designed with diverse learners in mind).

General comments

The texts include Bobis et al; Scamp, K. (2012). *Teaching primary science constructively* (4th Ed); the BOSTES syllabuses with further required readings and optional readings.

(f) ECH431 Teaching and Learning Mathematics and Technology

This online unit (with 12 hours on campus) builds on two previous units ECH232 and ECH234 to further develop subject content knowledge across the Mathematics KLA in planning and practice. It also focuses on using technology to support learning and differentiating curriculum, integrating mathematics into other areas and deeper engagement with STEM.

Unit learning outcomes:

- Developing further understanding of the major theoretical and research directions and current issues in mathematics education
- Designing lesson sequences that enhance the growth of children's mathematical thinking, reflect current issues in research and integrate other curriculum areas
- Demonstrating knowledge of mathematical processes and content in number and algebra, statistics and probability, measurement and geometry, working mathematically
- Demonstrating research-based knowledge of teaching and learning approaches to differentiating the curriculum to meet diverse needs of learners in the mathematics curriculum
- Demonstrating effective mathematics teaching and learning strategies for meeting the needs of indigenous students
- Demonstrating the capacity to use appropriate software for student profiling and reporting, lesson preparation and general administrative tasks
- Developing an awareness of the range of application and adaptive technologies available to support students with special needs.

Topics include:

Module 1

- (revising earlier units) Philosophy, pedagogy and practice; Framework and syllabus documents; concepts/processes in number, patterns and algebra, space and geometry; strategies for teaching assessing; place of maths in K–12 learning continuum; enhancing students learning through technologies including mobile and tablet tools, web-based resources, software, interactive media and tools; learning across KLAs linking literacy and the arts to STEM and STEAM.

Module 2 Meeting diverse learners' needs in mathematics

- Maths/Indigenous perspective: assumptions underpinning teaching practice; current research re indigenous children's mathematical skills (spatial patterning/counting skills) assessing appropriateness of resources for use in indigenous contexts/ culturally inclusive practices re maths curriculum, teaching, assessment; providing appropriate maths education for indigenous students; CMiT Indigenous; establishing partnerships with the community and utilising members of the community and elders for maths teaching and learning; maths in Aboriginal culture/catering for specific cultural needs; examining Aboriginal perspectives embedded in syllabus documents and develop strategies for the inclusion of Indigenous learners in maths education.
- Mathematics learning in context, diverse learning trajectories: individual needs, interests and abilities in planning programs; curriculum-based assessment to identify starting points and reasonable adjustments required to enable students to meet syllabus/curriculum outcomes; using assessment and monitoring procedures to make instructional decisions; individualising content and instruction; meeting specific needs through inclusive education practices; establishing Learning Centres; using Learning Frameworks to meet needs of diverse learners; applications and adaptive technologies to support students with special needs; strategies for the gifted and talented.
- Mathematics learning in context, diverse learning backgrounds and languages other than English: teaching/learning strategies for teaching second language learners; using assessment and monitoring procedures to make instructional decisions; individualising content and instruction; meeting specific needs through inclusive practices; identifying and evaluating support materials to facilitate learning for children from diverse language backgrounds.

Module 3 mathematics in context: strategies for teaching and learning

- Working Mathematically: mathematical thinking and problem-solving techniques; Process (communicating, problem-solving, reasoning, understanding and fluency) creation of model eliciting activities; mathematical literacy; open ended questions; problem posing and problem-solving; numeracy; assessment; different approaches to learning.
- Numeracy and Mathematical Literacy: distinguishing development in mathematics and mathematical literacy; critical factors in promoting maths learning for EC and primary teachers; process of mathematical literacy (representation, manipulation, reasoning, problem-solving); framework to assist professional development

(modelling, scaffolding, coaching, articulation, reflection and exploration); contextual play and development of numeracy skills; using working mathematically outcomes and approaches to develop mathematical literacy; analyse student work samples to identify areas of literacy need.

- Mathematics through Literature and Mathematical Literacy: investigating and analysing the literacy skills required to completing mathematical tasks and implications for teaching and learning; storybooks and mathematical development; mathematical literacy; using literature (mathematical wonder, exploration and problem-solving) developing maths games based on children's literature; using children's literature to differentiate maths instruction.
- Mathematics learning through connected outcomes groups and KLA integration: rich tasks for diverse learners; role of STEM and STEAM re engaging activities for maths across KLAs; examining rich tasks – risks for mathematics and benefits for learners; investigating/ analysing maths skills required for completing STEM tasks and implications for teaching and learning; interactive design as tool for reflection on learning and rich engagement mathematical processes
- Role of mathematical processes in KLA integration; assessment for learning through children's reflection and revision in rich tasks.

Module 4 Technologies to support mathematics learning

- Using technology for assessment: identifying and creating assessments tasks using interactive media such as screen casting, web 2.0 tools and google forms; designing ICT-based assessment tasks (marking criteria linked to syllabus outcomes); selecting, developing and using rich assessment tasks that integrate literacy and numeracy in digital environments; mapping digital assessment tools to syllabus/ curriculum outcomes; using technology for assessment; developing digital portfolios, using software for student profiling, reporting and administration; managing digital images and creating digital sequences for teaching, learning and assessment.
- Technology for mathematics learning: identifying web-based maths resources and software to promote mathematical thinking and problem-solving for diverse learners; evaluating, retrieving, manipulating and managing information sources; using communicative technologies, such as twitter, social media, skype, chats, forums, and other online tools and evaluating these for 0–5/K–6 use; examining the mathematical potential of simple robotics and techno toys to develop and enhance mathematical learning; technologies to support diverse learning needs.

Assessment and General comments

Texts are as for the previous unit, along with other readings. Assessment tasks include weekly reflective posts (discussion points and reflections relating to set readings, along with peer assessments/responses to posts), a two part task involving a researched essay on the needs of a designated group of diverse learners, and presentation to peers along with strategies and resources for the group's learning needs, and lastly a task based on three misconceptions typical of Stage 2/3 children preparing parent guides for each including review of research literature, with rationale outlining concepts and links with syllabus outcomes.

SOUTHERN CROSS UNIVERSITY

Southern Cross University (SCU) offers:

- **Bachelor of Arts/Bachelor of Education (Primary)**
- **Bachelor of Arts/Bachelor of Education (Early Childhood and Primary)**
- **Bachelor of Arts/Bachelor of Education (Primary/Secondary)**

Preparation to teach K – 6 Mathematics

1 Approach

- SCU's three primary education programs provide 11 core units, in which three of the compulsory units cover Mathematics.
- Students are introduced to basic mathematics in society in their first year and it is in the second and third years where they undertake curriculum and pedagogy mathematic units that address the BOSTES Mathematics syllabus, as well as additional national and Queensland curriculum requirements.

2 Content

(a) MAT10002 Mathematics and Numeracy

Provides students with an introduction to mathematics in society, opportunities to build personal numeracy, as well as the skills and confidence to effectively engage with units in their course and future professional settings that require numeracy skills or applications of mathematics; includes ICT applications.

Unit learning outcomes:

- Be able to discuss the history and role of mathematics in society
- Demonstrate personal competence in mathematics to a level of appropriate for their intended tertiary study and later professional settings
- Demonstrate the mathematical understanding and capabilities that enable the integration of numeracy into professional and societal use
- Plan for, collect, analyse, represent and apply data for individual and professional use in a variety of settings in ethical and appropriate ways including applications to probability
- Employ a range of appropriate technology applications for mathematics and numeracy, in everyday and professional settings.

Topics include:

- Critical Thinking – problem-solving (Numeracy for adults; financial mathematics; computer applications)
- Systems of Numeration (Mathematics in Society)
- Number theory
- Real Numbers
- Introduction to Algebra (including symbols, patterns, basic skills and using ICT tools)
- Algebra: Graphs and Functions (higher-level mathematics; understanding the place of other mathematics)
- Measurement
- Geometry
- Probability; theoretical and experimental understanding
- Descriptive Statistics (Data analysis (types, uses, representations, ICT tools)
- (history, uses, ICT in mathematics).

Assessment

Assessment of the unit includes online test – calculations (multiple choices) scheduled in the fourth, eighth and thirteenth week during the course and weighted 10 percent each; submission of a digital workbook on tutorial topics, tasks, personal research and reflection that is weighted 20 percent; and a final exam comprising of problem-solving, short answers and calculations that is weighted 50 percent. In order to achieve a passing grade in this unit, all assessment tasks must be completed. Students must obtain a minimum score of 50% in the final examination and a score of at least 50% of the total assessment marks for the unit.

General comments

The unit includes a half page list of learning resources. Unspecified prescribed set readings are said to be provided to students via Linguine accessible through the Miscue internet platform. There are six recommended textbooks that cover basic mathematics.

(b) EDU20009 Mathematics Education: Curriculum and Pedagogy

This intermediate level unit focuses on mathematic topics found in the Early Years Learning Framework, the NSW syllabus for Mathematics K–10, the Australian Curriculum for Mathematics F–10 (Number and Algebra, Measurement and Geometry, Statistics and Probability) and Queensland documentation supporting the Australian Curriculum. Teaching practices in the unit are said to address APST Standards 1 (Know students and how they learn), 2 (Know the content and how to teach it) and 3 (Plan for and implement effective teaching and learning), the BOSTES Priority Area Elaborations in Literacy and Numeracy, and ICT, and the Curriculum Specifications 2 (Education and curriculum studies), 3 (Early childhood pedagogies) and 5 (History and philosophy of early childhood) required by ACECQA.

Unit learning outcomes:

- Demonstrate a sound knowledge of relevant national and state syllabuses and early childhood curriculum requirements
- Analyse contemporary pedagogical approaches to teaching mathematics in early childhood and primary contexts, and employ appropriate curriculum documents in planning mathematics teaching
- Design teaching and learning strategies that may employ ICTs to maximise student engagement and inclusivity
- Incorporate both formative and summative assessment as specified in the relevant Maths syllabuses and frameworks
- Meaningfully integrate mathematics across other KLAs and across key transition points (early childhood/primary/secondary).

Topics include:

- Teaching strategies (underlying knowledge base, pedagogical models, range of strategies, overview of curriculum documents)
- Numbers and Algebra (approaches to teaching, basic concepts/processes, current approaches to sub-strands, student difficulties/misconceptions)
- Measurement and Geometry (basic concepts/processes, current approaches to teaching space, difficulties and misconceptions)
- Statistics and Probability basic concepts/processes, current teaching approaches, working with data, difficulties/misconceptions)
- Working mathematically (basic terms and concepts, processes and strategies for the components of Working Mathematically
- Planning for teaching in the mathematics classroom (teaching resources, technological tools, program builder, professional development resources, and assessment).

Assessment

Assessment in the unit involves two equally weighted tasks. The first requires the student to build a digital workbook focused on designing an outline of a sequence of five mathematics lessons for one of the topic areas. The second task is a final exam with a quiz, based on *The New Primary Mathematics Handbook* and written response questions.

General comments

The unit includes a one page list of references that includes various textbooks on early learning mathematics, as well as the BOSTES K–10 Mathematics syllabus, Australian Curriculum v2, NSW DET support material, and the Qld Studies Authority's curriculum materials for mathematics.

(c) EDU30005 Mathematics Education: Issues

This advanced level unit focuses on current issues in teaching and assessment of mathematics and numeracy in early childhood settings and primary classrooms. Particular emphasis is on developing differentiated strategies for diverse classrooms and effective use of ICTs in mathematics education. Teaching practices in the unit are said to address APST Standards 1 (Know students and how they learn), 2 (Know the content and how to teach it), 3 (Plan for and implement effective teaching and learning), 4 (Create and maintain supportive and safe learning environments), 5 (Assess, provide feedback and report on student learning), and 7 (Engage professionally with colleagues, parents/carers and the community), the BOSTES Priority Area Elaborations in Literacy and Numeracy, Aboriginal and Torres Strait Islander education, and ICT, the NSW Mandatory Area of Teaching Students from NESB, and the Curriculum Specifications 1 (Psychology and child development), 2 (Education and curriculum studies), 3 (Early childhood pedagogies), 4 (Family and community contexts) and 5 (History and philosophy of early childhood) required by ACECQA.

Unit learning outcomes:

- Analyse a wide range of current issues in teaching and learning mathematics and numeracy in early childhood and the primary school curriculum, and in assessing student performance in these areas
- Design differentiated teaching and learning strategies to meet the needs of diverse classrooms/early childhood settings and to empower learners across key transition points
- Design formative and summative assessment tasks with feedback, moderation and reporting
- Analyse contemporary approaches to addressing the needs of low attaining students in mathematics and numeracy
- Demonstrate effective use of ICTs for teaching and learning of mathematics in diverse classrooms/early childhood settings.

Topics include:

- Mathematics and difference
  - Equity and diversity in mathematics education
  - Inclusive mathematics in teaching strategies
  - Mathematics and Aboriginal and Torres Strait Islander student education.
  - Mathematics and EAL/D students; mainstream classroom strategies, systemic and community resources
  - Mathematics and gifted and talented students and differentiation of instruction
  - Learning difficulties and learning disabilities, inclusive practices, adapted curriculum
  - The learning framework in number; approaches to targeted intervention
  - Personalised learning plans
- Mathematics and assessment
  - Approaches to assessment in early childhood settings and the primary classroom
  - Trends in assessment
  - Interview-based assessment; SENA testing, Newman's analysis
  - Principles and practices of reporting, including standardised reporting and reporting software
  - Alternative assessment models
  - Basic skills testing, including NAPLAN and Best Start
  - International comparison studies
  - including the understanding that mathematical learning begins at birth
  - The roles of formal algorithms and calculators
  - Using and applying mathematics in problem-solving, mathematical modelling, word problems
  - Resources and information and communications technology and the teaching of mathematics.

Assessment

Assessment of the unit involves two tasks of equal weighting syllabus outcomes and indicators

- Issues in teaching mathematics
  - Role and value of mathematics in the broader school curriculum including cross-curriculum priorities and general capabilities with a focus on literacy and numeracy
  - Place of primary mathematics in the continuum of learning, EC–K, and in K–12, including a particular understanding of the links between Stage 3 and Stage 4
  - Mathematics K–10 syllabus, Support Documents and, Early Years Learning Framework
  - Theories of mathematics learning and instruction
  - Productive pedagogies, quality teaching in the teaching of mathematics

Issues in teaching number, number sense and mental computation. The first is a 2000-word essay and production of a SENA classroom test kit. The second task is the development of individual mathematics learning plans based on a student case study. The student is also required to contribute to a blog identifying websites and a critique of it that are useful for the learning plan.

General comments

The unit lists two prescribed textbooks on mathematics teaching and the government reports, *National Numeracy Review Report* by COAG and the Queensland Department of Education's report, *Towards a 10-year plan for Science Technology Engineering and Mathematics (STEM) Education and Skills in Queensland*. The NAPLAN website is listed under Other Resources along with unspecified readings available from the my Readings attached to the Unit.

UNIVERSITY OF NEWCASTLE

University of Newcastle (UON) offers:

- **Bachelor of Teaching (Early Childhood and Primary) (Honours)**
- **Bachelor of Teaching (Primary) (Honours)**
- **Master of Teaching (Primary)**

Preparation to teach K – 6 Mathematics

1 Approach

- Nine core units are common across the two Bachelor degrees of which two relate to Mathematics/ Numeracy (a discipline unit Math1900 and EDUC2749 K–6 Numeracy). Each undergraduate program contains one further relevant unit.
- There are two units in the Master of Teaching, with identical (Advanced Numeracy Studies) or near identical (K–6 Numeracy/K–6 Mathematics) titles though with different code numbers, to two undergraduate units.

2 Content

(a) Math1900 Elementary Mathematics

A core unit in both Bachelor programs. Exposes the student to a broad range of elementary but important topics in mathematics that are especially relevant for intending early childhood and primary teachers. Topics include number concepts, elementary geometry, measurement, probability and basic statistics.

Unit learning outcomes:

- To develop students' understanding of elementary algebra, geometry, number concepts, probability and problem-solving
- To introduce students to number theory and statistics
- To encourage students to think mathematically and to increase students' confidence in their mathematical ability.

Topics include:

- Problem-solving
- Number concepts
- Number theory
- Algebra
- Geometry
- Measurement
- Probability
- Graphical representation
- Statistics

Assessment and General comments

Assessment is described as Examination – Formal and Quiz – Class. This unit appears to be offered from the Mathematics Department of the University. There are no texts, reading lists or resources given, nor further detail on assessments of content topics.

(b) EDUC2749: K–6 Numeracy

This unit introduces teaching and learning in Mathematics in K–6 contexts. Students explore the NSW Mathematics K–6 syllabus incorporating the Australian Curriculum and the role and value of mathematics in the broader school curriculum. This unit is common to the two undergraduate programs.

Unit learning outcomes:

- Understanding the development of children's' mathematical knowledge, skills and understanding in Number and Algebra, Space and Measurement and Geometry, and Statistics and Data Probability
- Understanding processes children use in Working Mathematically
- Consideration of children's home and community numeracy practices as a foundation for learning in K–6 contexts
- Appreciation of the role and value of Mathematics in the broader school community
- Understanding and use of the NSW Mathematics K–6 syllabus incorporating the Australian Curriculum to plan for learning and teaching in all aspects of numeracy.

Topics include:

- Theory, concepts and key stages related to the acquisition of knowledge and skills in Number and Algebra, Measurement and Geometry, and Statistics and Probability
- Theoretical perspectives on teaching/learning mathematics; Learning as Changing Behaviour, Changing Thinking, Changing Participation, Changing Brain Structure
- Conceptual understanding as an individual activity and as social practice
- The language of mathematics
- The impact of home and community numeracy practices (non-school contexts and parental/carer attitudes)
- Interrelationship between children's literacy and numeracy development/role of children's literature in scaffolding skill acquisition
- Difference between numeracy and mathematics
- Rich problem-solving opportunities in authentic contexts represented through literature
- Principles and practices of teaching and learning of Number, Algebra, Measurement and geometry, and Statistics and probability (thinking and working mathematically, planning and programming, instructional approaches, strategies and resources for informed decision making and problem-solving, collaborative inquiry
- Differentiation for a diversity of learners
- Strategies for assessing and reporting aspects of numeracy (prior assessment, formative and summative assessment, reporting)
- *NSW Mathematics K–10 Syllabus* (Working Mathematically, Number and Algebra, Measurement and Geometry, Statistics and Probability).

Assessment

There are two assessments of equal worth, firstly development of a written series of sequential lessons from the syllabus, selecting resources and planning for effective learning, and secondly a class examination.

General comments

The required texts are the *NSW Mathematics K–10 Syllabus for the Australian Curriculum* and Siemon, D et al (2011) *Teaching Mathematics: Foundations to Middle Years,* Melbourne and Oxford. Further texts, articles and websites are listed. *The unit is common to the undergraduate and graduate programs.*

(c) EDCU3055: Pedagogies of Numeracy from Birth to 12 Years.

This unit is part of the core studies in the B.Ed. (Early Childhood and Primary). It aims to deepen understanding of the principles and practices of teaching and learning numeracy from birth to 12 years. It addresses foundational numeracy concepts within early childhood settings, continuity with primary curriculum KLAs, and knowledge of the Australian Curriculum numeracy, science and technology language and literacy standards.

Unit learning outcomes:

- Describing how children (0–5) become numerate within early childhood environments, using contemporary theories
- Identifying powerful mathematical ideas represented in children's play environments to plan further learning
- Connecting foundations of literacy within EYLF to Primary curriculum
- Integrating knowledge of Australian Curriculum numeracy, science and technology language and literacy standards to plan the development of numeracy knowledge.

Topics include:

- Contemporary theoretical knowledge of how young people become numerate (within social and cultural learning contexts, through everyday experiences and interactions, and through social interactions with others and under adult guidance)
- Introduction of the powerful mathematical ideas forming the foundation for mathematical understanding in early childhood (eight key ideas presented, applying the key ideas to pedagogical practices, viewing children as competent and capable of developing and using mathematical thinking in social learning contexts, emergent mathematical thinking and play)
- Holistic approach to teaching numeracy in learning environments through connection to other areas of learning and development (integrating with other curriculum areas, planning for incorporating numerical practices throughout the day, connecting children's everyday experiences and prior knowledge)
- Integration of Australian Curriculum numeracy, science and technology language and literacy (develop relevant curricula, integrating teaching approaches and methodologies reflecting holistic curriculum, respond to aims and goals of the Australian Curriculum).

Assessment

There are two assessment tasks. The first requires a written investigation of how children 0–5 become numerate within early childhood environments drawing from and synthesising specialised and contemporary theoretical knowledge, and include a analyse a play scenario in terms of key mathematical ideas and pedagogical theories.. Students must also present to peers an account of suitable teaching strategies and experiences for extending children's mathematical understanding.

The second assessment is a written assignment designing a numeracy program for teaching and assessing children within the foundational stage. ELTF and Australian Curriculum standards are to be holistically applied to integrate numeracy.

General Comments

Resources and texts include K–6 syllabus documents, the Early Years Learning framework and Macmillan, A. (2009) Numeracy in early childhood. Shared texts for teaching and learning. Victoria and Oxford. Included is a short list of further texts and articles.

(d) EDUC 4749: K–6 Advanced Numeracy Studies

This unit within the B.Ed. (Primary) aims to deepen students' understanding of the principles and practices of teaching and learning mathematics in primary schools. It addresses interpretation of school-based and system-wide numeracy data to inform decisions about student numeracy. This course provides highly professional skill development in the analysis and interpretation of numeracy data. Students undertake a research project to compare and contrast global issues in numeracy pedagogy using international data sources.

Unit learning outcomes:

- Interpretation of school-based and system-wide numeracy data in order to make informed decisions about student numeracy needs
- Analysis and interpretation of systemic numeracy data
- Research into effective numeracy practice
- Report on research to a professional audience.

Topics include:

- Interpretation of school-based and system-wide numeracy data. Knowledge and skills of numeracy data analysis. Interpretation and evaluation of school-based and system-wide numeracy data.
- Class, stage and school-based numeracy planning (identifying numeracy directions for school, class and individuals using mandatory syllabus documents and the Australian Curriculum)
- Frameworks for investigating and evaluating numeracy data and practices (Numeracy frameworks such as 3 Tiered Framework, Justas DEC K–10 Numeracy continuum, US NCTM; mathematical know-how, numeracy for knowledge; contextual know-how numeracy for practical purposes, interpreting society and personal organisation eg Butcher et al. (2008)
- Development of research skills to analyse comparative international data (sourcing then selecting relevant, useful and practical numeracy data; comparing, contrasting and critically evaluating numeracy data ie validity and reliability)
- Research into effectiveness of pedagogies of numeracy (critical numeracy, transformative pedagogy, conceptual understanding, adaptive reasoning, problem-solving, strategic competence, procedural fluency, productive disposition)
- Presentation of reports to professional audiences (ICT, verbal and written reports).

Assessment

The first assessment involves a case study analysing a data set to identify learning directions for class, school and individuals. Curriculum documents and learning strategies are applied in the analysis of data and development of learning directions. The second assessment is the research report into international data sets on numeracy, including samples of global numeracy pedagogies and assessment for local application.

General comments

Required texts and reading material includes various formal BOSTES and ACARA syllabus and curriculum documents, and Siemen et al. (2011) *Teaching Mathematics: Foundations to Middle Years* Melbourne and Oxford. There is an extensive list of further reading materials.

(e) EDUC6739: K–6 Mathematics

The unit addresses the requirements of the *NSW Mathematics K–10 Syllabus* Volume 1 and Stage 4 from Volume 2, as well as the related Australian Curriculum documents. It focuses on strategies and resources for programming, teaching and assessing primary mathematics, differentiation for diverse learners, and role of mathematics within the broader curriculum as well as teaching for equity and social justice.

Unit learning outcomes:

- Demonstrate knowledge of the principles and practices of teaching and learning mathematics K–6 (including strategies for programming, teaching and assessment)
- Examining K–6 Mathematics syllabus and Australian Curriculum: Mathematics
- Identifying the role of language in maths' learning and investigating implications of how language is used in mathematical settings
- Navigating the content of the NSW K–10 syllabus Vole 1 Mathematics Curriculum
- Differentiate curriculum for diverse learners, including Aboriginal and Torres Strait Islander students
- Utilise instructional approaches relevant to the strands of NSW syllabus/Australian Curriculum documents
- Examine perspectives of mathematical skill development incorporating EAL and Aboriginal learners
- Explore pedagogies that have the capacity to promote equity and social justice for diverse learners.

Topics include:

- Principles and practices of teaching and learning mathematics in K06 settings (including strategies for programming, teaching and assessing mathematics)
- Syllabus analysis, teachers' toolkit, research base for maths' education unit planning ES1–Stage 3, assessment and analysis of work samples
- Role and value of mathematics in broader school curriculum (pupil diversity, links between Stages 3 and 4, Numeracy continuum K–10)
- Content and structure of BOSTES K–10 Mathematics syllabus and Australian Curriculum: Mathematics (links and analysis)
- Strategies for differentiating mathematics curriculum to meet diverse learners' needs including EAL/D students including ATSI students
- Studies relating to Aboriginal and Torres Strait Islander students and cultures, including connections between representations of number and pattern, time place relationship and measurement concepts, application and evaluation of statistical data
- Syllabus studies in Data, Space, Measurement, Patterns and Algebra, Number and Working Mathematically and beyond
- Direct explicit instruction, problem-solving toolbox for mathematics, group work, practical experiences, iPads and other ICT links for maths teaching
- Examining perspectives of mathematical skill development incorporating EAL and Aboriginal learners (valuing and incorporating cultural knowledge and perspectives of students)
- Exploring pedagogies with capacity to promote equity and social justice for diverse learners
- Exploring Revised Blooms' taxonomy in planning units of work for diverse learners.

Assessment

There are two assessment tasks. The first is a series of lesson plans, including assessments and resources, using a variety of strategies including student grouping strategies and using ICT, based on the syllabus. The second is a unit plan based on one sub-strand of the syllabus, associated working mathematically outcomes and an accompanying rationale (critically analyses, reflects on and synthesizes complex concepts, problems and theories).

General comments

The text is Siemon, D. et al (2011) and the *NSW Mathematics K–10 Syllabus* and a range of other texts and websites are specified.

(f) EDUC6749: Advanced Numeracy Studies

The unit seeks to deepen understanding of the impact of the principles and practices of teaching primary mathematics (numeracy demands in all KLAs). It addresses interpretation of school and system numeracy data to inform decision making. With a focus on 'working mathematically' the unit addresses instructional strategies and educational technologies for teaching and assessing the foundational mathematical concepts of number and algebra, measurement and geometry, statistics and probability.

Unit learning outcomes:

- Identify the numeracy demands of all Primary Curriculum KLAs
- Identify the numeracy demands of everyday life
- Interpret school-based and system-based numeracy data in order to make informed decisions about student numeracy needs
- Design instruction that assists students to 'work mathematically'
- Select appropriate instructional strategies and educational technologies for teaching and assessing the foundational mathematical concepts of quantity, measurement, spatial representation, and generalisation.

Topics include:

- Numeracy demands of all KLAs (identify mathematical competencies, knowledge, concepts, and skills required to engage effectively with these KLAs; make explicit the mathematical links; effective development of competencies; use embedded mathematical competencies in other KLAs to enrich engagement with mathematics as a discipline)
- Numeracy in everyday life (as social practice, in school and home environment, making meaning of mathematical concepts in diverse cultural and social environments, diversity and differentiation, inclusivity and equity in relation to perspectives and practices of numeracy)
- School-based and system-wide numeracy data (analysing NAPLAN reports, results and sample, Best Start samples and other data; reporting on the sample in terms of literacy requirements, communication – visual and textual – procedures, fluency, adaptive reasoning and problem-solving procedures)
- Working mathematically (strategies for promoting each of the five mathematical actions; linkages between each action, lesson planning to enhance adaptive reasoning and problem-solving)
- Institutional strategies and educational technologies for teaching and assessing the foundational mathematical concepts of number and algebra, measurement and geometry, statistics and probability (a range of pedagogies: transformative, strengths-based, student centred, those to support individual adaptive reasoning and problem-solving generally; demonstration and reporting; practical activities; concrete materials; using interactive ICT and ICT resources).

Assessment and general comments

The first assessment is a written task involving case studies/data analysis including the designing, implementing and evaluating an individual learning plan for a small group of students with specific learning needs. Students must critically analyse, reflect on and synthesise the complex concepts, problems and theories used to interpret and evaluate systemic school-based numeracy data and apply advanced, specialised knowledge and skills in teaching numeracy across the curriculum, including collaborative leadership skills. The second task is a capstone research project focused on existing research evidence and knowledge in pedagogies of practice for numeracy in primary schools (report to include research questions and aims, methodology, analysis of findings and discussion). No particular text is indicated; however, there is a range of recommended reading materials provided.

UNIVERSITY OF NEW ENGLAND

The University of New England (UNE) offers:

- **Bachelor of Education (Primary)**
- **Bachelor of Education (Early Childhood and Primary)**
- **Bachelor of Education (K–12 Teaching)**
- **Bachelor of Special Education (Primary)/Bachelor of Disability Studies**
- **Master of Teaching (Primary)**

Preparation to teach K – 6 Mathematics

1 Approach

- The units Primary Mathematics 2A: Space, Measurement and Number and Primary Mathematics 2B: Statistics, Algebra and Number are common to all degrees (including under and post grad). They are distinguished by different unit of study codes but are otherwise identical in content, structure and assessment.
- Delivery modes for these degrees are a combination of face-to-face/internal and distance/external learning (except the Bachelor of Special Education (Primary)/Bachelor of Disability Studies which is delivered entirely by distance)
- The following information on delivery mode and time is provided for all units:
  - On-campus mode: lectures, workshops, online discussion forums. Weekly schedule: 1hr lecture, 2hr workshop, 9.5 hrs independent study
  - Off-campus mode: online forums, discussions, access to teaching materials, podcasts and activities. Weekly schedule: 12.5hrs independent study

2 Content

EDME145 Primary Mathematics 1: Numeracy

The unit covers the mathematics content appropriate to teachers of primary school students in the five strands of the NSW syllabus – Data, Measurement, Patterns and Algebra, Space and Geometry and Number. Students will be able to demonstrate their personal content knowledge in these strands, recognise the developmental nature of mathematics learning, be familiar with the distinctive contents and structures of the mathematics K–6 curriculum and exhibit basic proficiency in the use of ICT.

Unit learning outcomes:

- demonstrate an understanding of the mathematics content relevant and necessary for teaching primary school students;
- demonstrate the ability to perform an assessment of a student's current mathematical understanding; and
- identify and plan a course of action relevant to a student's needs, applying skills that reflect real-life work practices.

Topics include:

- Number: early counting, mental computation, place value, Count Me in Too and Best Start (weeks 1–3)
- Measurement: measurement framework, using measurement concepts in other KLAs (week 4–5)
- Geometry: geometry framework, common misconceptions – week 5–6
- Chance and Data: chance and data framework – week 7
- Algebra: algebra framework – week 8

Assessment

- a 2000-word scenario report (50%)
- a two-hour final exam in week 12 (50%)

General comments

The NSW K–6 maths syllabus documentation and Reys et al 'Helping Children Learn Mathematics' are listed as prescribed reading. Additional readings are listed including the Count Me in Too: professional development package.

Supplementary tutorial videos and mathematical content tasks for the relevant material are assigned each week.

There are no prerequisites for this unit.

EDME258 (UG)/EDME358 (PG) – Primary Mathematics 2A: Space, Measurement and Number

This unit is common to both the undergraduate and MTeach programs. It is distinguished by different unit of study codes but is otherwise identical in content, structure and assessment.

The unit introduces students to (a) philosophical and theoretical underpinnings of primary mathematics as a continuum into secondary mathematics; (b) developmental teaching theories and psychology of learning mathematics within the curriculum strands of space and geometry measurement, and number; (c) design of learning sequences to promote constructivist teaching and learning; (d) development of investigative activities including use of tools to promote problem-solving and communicating mathematically; (e) strategies to effectively implement lesson plans, promote classroom discourse and manage classroom environments; (f) development of assessment tasks to inform the teaching–learning cycle and to ensure students' needs are met; and (g) integration of innovative strategies as part of ongoing curricular and professional development. The content is drawn from relevant Mathematics syllabuses. The relevant Graduate Teacher Standards are linked to the learning outcomes in the unit of study outline.

Unit learning outcomes:

- Demonstrate an in-depth understanding of the models of pedagogy of the primary Mathematics syllabus, including Early Stage 1, 2, 3, and 4, including a K–12 perspective
- Develop teaching sequences and lesson plans consistent with a constructivist approach within the content strands of space and geometry, measurement and early number
- Design and implement investigative activities that promote problem-solving, working and communicating mathematically
- Plan a suite of 'assessment for learning' and 'assessment of learning' tasks to inform further development of teaching and learning activities to meet the needs of a diverse range of learners
- Design and implement lessons which orchestrate classroom discourse, manage the classroom environment effectively, and flexibly assess for learning; and
- Incorporate a wide range of tools, resources, and innovative strategies in learning and teaching activities.

Topics include:

- Module one: The constructivist approach to teaching mathematics: measurement curriculum focus. Assessment for learning techniques; syllabus components (focus on measurement in K–6 syllabus and K–10 continuum); lesson structures and measurement lesson design; measurement framework; using interactive software and PBL in groups.
- Module two: Developmental models: space and geometry curriculum focus. Van Hiele theory of geometry development and pedagogy, and teaching phases; familiarisation with Space and geometry strand, Early Stage 1–Stage 4; van Hiele Teaching Phases and using ICT as teaching tool; tasks using dynamic geometry software (GSP and GeoGebra);geometric constructions (using rhombus properties); PBL and designing lesson sequences; student understanding of 3D figures and properties; geometry through play.
- Module three Early Number: Constructing early number concepts and relationships; Number strands Early Stage 1–Stage 4; Count Me in Too Learning Framework in Number: Introduction to SENA Kit: SOLO model for assessment and activity design; computation – formal vs mental strategies: additional readings in number and technology, and presentation of support structures for mathematics teaching (associations and journals).

Assessment

- Lesson design and justification, incorporating developmental stages within the Measurement and Number strands. It is a mandatory requirement for on-campus students to attend workshops. (2000 words (50%)
- Design a sequence of activities using a developmental teaching framework that uses ICT as a teaching tool in the Space and Geometry strand. It is a mandatory requirement for on-campus students to attend workshops. (2000 words) (50%)

General comments

A prerequisite of EDME145 Primary Mathematics 1: Numeracy applies to B.Ed. (Primary) students, but not for the other undergraduate degrees. There are no prerequisite units for MTeach students completing this unit (coded as EDME358 for PG).

Serow et al 'Primary Mathematics: Capitalising on ICT for Today and Tomorrow', and the *NSW Mathematics K–6 Syllabus* are prescribed readings. A comprehensive list of further reading is also provided. There is a detailed weekly course schedule provides, as well as assessment task criteria.

EDME369 (UG)/EDME569 (PG) – Primary Mathematics 2B: Statistics, Algebra and Number

This unit is common to both the undergraduate and MTeach programs. It is distinguished by different unit of study codes but is otherwise identical in content, structure and assessment.

The unit covers the content and pedagogy appropriate to teaching primary school students in the strands of Data, Chance, Patterns and Algebra and later Number (numeracy). Students will be able to demonstrate their personal content knowledge in these strands, discuss associated teaching strategies, and use the understanding to create developmental learning sequences.

Unit learning outcomes:

- Use appropriate curriculum materials to plan and prepare outcomes-based mathematics programs for Years K–6
- Based on relevant theories, pedagogical frameworks and methodologies, demonstrate approaches to mathematics teaching that provide children with opportunities to build on their existing mathematical understanding
- Explain the importance of and incorporate concrete materials and technology in learning and teaching mathematics
- Analyse and discuss children's mathematical work in order to plan effective teaching experiences
- Recognise stages in the development of children's mathematical understanding and discuss the implications of these in devising effective teaching experiences; and
- Demonstrate personal content knowledge of the mathematics in Data, Chance, Algebra and Number, necessary for teaching primary school students.

Assessment

- Essay (related to statistics (2000 words) (50%)
- Essay (related to number) (2000 words) (50%)

General comments

Prerequisite: EDME145 Primary Mathematics 1: Numeracy (B.Ed. Primary students) or EDME358 Primary Mathematics 2A (MTeach candidates).

Serow et al 'Primary Mathematics: Capitalising on ICT for Today and Tomorrow' and the *NSW Mathematics K–6 Syllabus* are prescribed reading. A comprehensive list of further reading is also provided. Assessment criteria provided.

EDME340 Mathematics for the Inclusive Classroom

This unit is unique to the Bachelor of Special Education (Primary)/Bachelor of Disability Studies and is delivered online. Students also undertake EDME 258 Primary Mathematics 2A and EDME 369 Primary Mathematics 2B.

This unit will take a developmental view of mathematics learning, in which a variety of learning trajectories may be accommodated, catering for individual differences. The emphasis will be on providing age-appropriate learning opportunities in mathematics, based on identified cognitive development, drawing on current research across all areas of the mathematics curriculum. There will be a particular emphasis on essential numeracy skills required to be a functional member of society.

Unit learning outcomes:

- Develop and use a range of assessment strategies to identify the mathematical development of students with special needs
- Plan and program for individuals with specific needs in the mainstream classroom, including the development of Individual Education Plans in mathematics
- Based on relevant theories, concepts and methods develop pedagogical approaches suitable for teaching students who have different learning trajectories and developmental pathways
- Apply coherent knowledge to address the mathematical needs of primary, adolescent and young adult students with significant developmental delays; and
- Demonstrate theoretical and technical knowledge and skills to address the mathematical needs of students with physical difficulties, such as blindness, deafness or limited manipulative capabilities.

Topics include:

- Developmental aspects of learning
- Developmental trajectories as explicated in the NSW syllabus and other curricula
- Assessment frameworks for number, space and measurement content areas (content, assessment and pedagogical approaches)
- Pedagogy and research-based knowledge in establishing diverse learning experiences for the inclusive maths classroom Adapting content and teaching strategies, including computer-based software and associated technologies.

Assessment

- Essay: assess students' mathematical development and prepare a plan to address specific mathematical and numeracy needs. (2000wd) (50%)
- A sequence of lesson plans to accommodate the needs of students in an inclusive classroom environment. (2000wd) (50%)

General comments

Prerequisites: EDME258 Primary Mathematics 2A: Space, Measurement and Number and EDME369 Primary Mathematics 2B: Statistics, Algebra and Number.

There are 2 prescribed readings: Reys et al 'Helping Children Learn Mathematics and the *NSW Mathematics K–6 Syllabus*) as well as a list of recommended readings and online resources for diverse students including Indigenous students and students with a disability.

EDEC354 Young Children as Mathematicians

This unit is unique to the Bachelor of Education (Early Childhood–Primary) and is delivered online and on-campus.

This unit focuses on young children's (birth to eight years) problem-solving from their exploration of their everyday world. Students will develop an appreciation of children's' transitions into mathematical understanding in their everyday life and across the curriculum by recognising and appropriately addressing the range of mathematical thinking in young children. Combining research and theoretical perspectives with experience will assist and consolidate student understanding. Students will implement appropriate learning strategies with reference to relevant National authorities' policy and curriculum documents.

Unit learning outcomes:

- Identify and demonstrate how theory, research and practice can lead to a better comprehension of children's problem-solving skills
- Plan for young children's mathematical thinking across a variety of environments and contexts
- Support children's problem-solving and mathematical learning using a play-based integrated curriculum focus and using available technology
- Plan, implement and evaluate relevant curriculum and guidelines and demonstrate autonomy and judgement to professional standards of communication, modelling skills applicable in a professional career.

Topics include:

- Developmental aspects of learning
- Developmental trajectories as explicated in the NSW syllabus and other curricula
- Pedagogy and research-based knowledge appropriate to young learners.
- collect evidence of play-based mathematics events in a preschool
- analyse mathematics play events and interactions, critique the interactions and plan for further learning
- view videos of children completing the SENA1 and learn to place students on the CMIT continuum
- plan for young children's (K–2) learning, based on the SENA1 results
- apply the five mathematics strands to the learning needs of young children.

Assessment

- Participation in online discussions. Students are required to actively participate in online activities to pass the unit. (500-word equivalent) (10%)
- Essay: assess the mathematical experiences of 3 to 5 year-old children and prepare a plan to address specific mathematical and numeracy needs. (1500 words) (40%)
- Scenario report for 5 to 8 year-old children (2000 words) (50%)

General comments

Prerequisites: candidature in Bachelor of Education (Early Childhood Primary)

There are two prescribed readings: Knaus 'Maths is All Around You: Developing Mathematical Concepts in the Early Years' and the *NSW Mathematics K–6 Syllabus.* There is also a list of recommended readings and online resources.

UNIVERSITY OF NOTRE DAME AUSTRALIA – SYDNEY CAMPUS

University of Notre Dame Australia – Sydney Campus (UNDA) offers:

- **Bachelor of Education (Birth – Twelve Years)**
- **Bachelor of Primary Education**
- **Bachelor of Primary Education (Religious Education)**

Preparation to teach K – 6 Mathematics

1 Approach

- UNDA provides four dedicated units of primary mathematics common to each of the Bachelor of Ed (birth to twelve years), Bachelor of Primary Ed and the Bachelor of Primary Ed (Religious Ed)
- The units focus on the foundations of the teaching and learning of numeracy in the early years including theoretical perspectives, the Australian Curriculum, the Early Years Learning Framework, the planning and creation of developmentally appropriate tasks, resources and units of work. There is also a focus on incorporating differentiation for students with special needs (at both ends of the spectrum with a particular emphasis on gifted students), Questioning as an essential pedagogical tool and a significant focus on building information and communication technologies into the teaching of Mathematics.

2 Content

(a) ED1008 Mathematics 1 In the early years

This unit presents concepts that are foundational to the teaching and learning of numeracy and mathematics in the early years. The unit investigates pedagogy that is developmentally appropriate for the early learning of numeracy and mathematics and is supported by appropriate resources. Further, the unit aims to enhance general understanding, attitudes, values and skills within the Mathematics Key Learning Area. There is focus on curricula including the Early Years Learning Framework, the Australian Curriculum and the NSW Board of Studies syllabus documents.

Unit learning outcomes:

- Demonstrate knowledge of the principles, content, teaching and assessment methodologies of Mathematics and approved mathematics curricula in the early years
- Communicate and critique theoretical perspectives relating to the early acquisition of mathematical concepts and numeracy skills
- Apply these developing understanding through appropriate teaching methodologies that recognise children's individual development and learning in order to broaden the deepen children's knowledge, and develop their skills and dispositions in a positive manner
- Demonstrate an increasing standard of competence in explaining mathematical concepts.

Topics include:

- Children's Development in Mathematics
- Numeracy and Literature (including frameworks, number sense and prior to school expectations)
- Application of Theory to Your Own Practice
- Ways of Thinking about Numeracy (including frameworks and pedagogical approaches/models)
- Learning Materials in Mathematics (preparatory for Assignment 2, building and using material resources, applying learning principles, concepts and skills to number development)
- SENA – Assessing young children
- Observe Numeracy Learning (with links to theories)
- Mathematics strands – Number, Space, Measurement, Chance, Probability, Data
- Assessment Leads to Planning (online, with task with child, and analysis of interactions)
- Mathematics Across the Curriculum (exploring different teaching strategies)
- Patterning
- Informal learning (deconstructing play, links to formal learning)
- Parents as Partners

Assessment

Assessment in this unit includes three tasks:

- the first task focuses on literacy linked to numeracy – choosing an item of children's literature and devising numeracy activities for it (Years 3 to 8 focus).
- the second task focuses on a numeracy learning activity – developing a structured teaching resource for mathematics including a learning activity sequence with a partner, tutorial presentation of resource with analysis.
- the third task is an examination.

General comments

This introductory unit on Mathematics includes a three page list of essential and recommended readings from various text books, websites and online journals. There is no set text for this unit, rather there is a 'reader' which includes journals and book chapters from a variety of sources, and specific readings are set for each topic. The assessment outlines include detailed description of the tasks, with detailed assessment rubric for each task.

(b) ED2009 Mathematics 2

This unit complements the knowledge developed in Mathematics 1 in the Early Years. It explores the strands of the Australian Curriculum: Working Mathematically, Number and Algebra, Measurement and Geometry, Statistics and Probability. This exposure to the curriculum is underpinned by recognition of the need to plan developmentally appropriate tasks. Students learn a range of strategies to plan for stage appropriate challenging and engaging experiences for all learners of Mathematics in the primary school classroom which will contribute to developing their confidence to teach mathematics in their professional experience block. Students are challenged to recognise and develop their own skill and confidence in mathematics through deliberate focus on, as well as an assessment of, their mathematical content knowledge. There is an emphasis on the recognition of the students' current level of mathematical Content Knowledge and Pedagogical Content Knowledge and development of these via a variety of literature and technology-based tools. Students have the opportunity to demonstrate their mathematical understanding through explanation and questioning techniques in their lesson planning. It also allows students to continue to develop their personal literacy and numeracy after completing the unit. There is also an emphasis on using Interactive White boards in the classroom to enhance student learning.

Unit learning outcomes:

- Demonstrate competence in their own mathematical ability
- Display an awareness of a clearly developmental approach to teaching mathematics that will underpin implementation of the Curriculum
- Demonstrate appropriate mathematical knowledge through explanation and questioning techniques
- Demonstrate an ability to plan stage/grade appropriate, challenging and engaging mathematics lessons.

Topics include:

- The nature of mathematics and mathematics teaching and learning
- Teaching theoretical framework: Constructivism and Mathematics Learning Theory
- Australian curriculum content strand Number & Algebra – Number and Place Value
- Australian curriculum content strand Number & Algebra – Fractions and Decimals
- Australian curriculum content strand Number & Algebra – Money and Financial Mathematics
- Australian curriculum content strand Number & Algebra – Patterns and Algebra
- Differentiation, catering for differing abilities in a diverse classroom, using technology
- Australian curriculum content strand Statistics & Probability – Chance
- Australian curriculum content strand Statistics & Probability – Data Representation and Interpretation
- Advanced Questioning Skills in the Classroom
- Assessment for Learning
- Australian Curriculum – General capabilities and cross-curriculum priorities
- An emphasis on authentic maths tasks incorporating numeracy through problem-solving.

Assessment

Assessment in this unit includes three tasks:

- The first task is a mini diagnostic test of strand content knowledge. This is a test which is initially done diagnostically early in the semester and then summatively late in the semester.
- The second task focuses on developing a mathematical resource (in this case writing and illustrating their own children's picture book with mathematical themes and activities) with clear and direct reference to the *NSW Mathematics K–6 Syllabus* (F–6 Australian Curriculum) appropriate to a NSW stage and class
- The third task is an examination.

General comments

This unit builds on the previous unit with a focus on Australian Curriculum content. The set textbook is Bobis, J et al. (2012) Mathematics for children – Challenging children to think mathematically (4th ed.), Sydney, Australia: Pearson. There is also a course reader which includes journal articles and book chapters. There is reference to learning theories, assessment and differentiation for diverse learners. Specific readings are set for each topic. The assessment tasks are detailed, with explicit assessment rubrics.

(c) ED2011 Mathematics 3

This unit continues exposure to the Mathematics Key Learning Area building on the work done in the Mathematics 1 and Mathematics 2 units. In this unit students are guided through a deeper exploration of the Mathematics Curriculum and syllabus documents with a focus on application of the syllabus content into real world, engaging activities for children. Specific attention is paid to the creation of Mathematics resources and the development of unit work. Students will focus on the Australian Curriculum strands of Working Mathematically, Number & Algebra, Measurement & Geometry and Statistics & Probability. Students learn strategies teaching in the primary school classroom, incorporating differentiation for special needs. This unit builds on two professional experience blocks (totalling 11 weeks) which the students have already completed.

Unit Learning Outcomes:

- Present mathematical learning experiences in a classroom situation to enable children to access all aspects of the Mathematics curriculum
- Design differentiated mathematical learning experiences in a classroom situation to enable children of all ability levels to engage with mathematical concepts successfully
- Create stage appropriate mathematical resources which will develop the mathematical skills and content knowledge understanding of primary students
- Demonstrate the ability to develop a cohesive and sequential collaborative unit of work with partners, on a specific primary syllabus-based topic.

Topics include:

- Students' and Teachers' Attitudes towards Maths
- Australian Curriculum F–6 Measurement & Geometry Strand: Using units of measurement
- Australian Curriculum F–6 Measurement & Geometry Strand: Shape
- Australian Curriculum F–6 Measurement & Geometry Strand: Location and Transformation
- Australian Curriculum F–6 Measurement & Geometry Strand: Geometric reasoning, Van Hiele's levels
- F–6 Theoretical Teaching Frameworks: Information graphics
- Cooperative Learning in Mathematics
- Australian Curriculum F–6 Statistics and Probability Strand: Chance Planning Units of Work
- Australian Curriculum F–6 Statistics and Probability Strand: Data Representation and Interpretation
- Cognition in Mathematics Education
- Diversity of Learners: Students whose language background is other than English (LBOTE), students with special needs and Aboriginal and Torres Strait Islander students. Differentiation
- Achievement Standards and Cross-curriculum Priorities.

Assessment

Assessment in this unit includes three tasks:

- The first tasks is a student investigative project comprising of three steps – the first step involves designing a rich learning experience for a single lesson, the second step involves selecting a student from K–6 to complete the lesson designed, and the third step involves writing a 1000-word report describing the entire process.
- The second task focuses on working in groups of three to develop a unit of work made up of a three lesson sequence.
- the third task is an examination.

General comments

This unit continues to build on the previous two units with further focus on the Australian Curriculum and the creation of stage appropriate resources, lessons and units of work. There is also focus on differentiation for diverse learners. There is a page and a half of essential and other recommended reading. This unit adopts the same textbook as the previous unit (Bobis et al) as well as a course reader which includes journal articles and book chapters, with set readings for each topic. There is also reference to BOSTES syllabus support documents and sample units of work. Assessment tasks are extensively detailed, with an explicit assessment rubric provided.

(d) ED3005 Mathematics 4

This unit complements the work done in Mathematics 1, 2 and 3 with a specific emphasis on digital technology and information and communication technologies (ICTs) can be built into the teaching of Mathematics. In this unit students are exposed to a 'roadshow' of classroom- based digital technologies which will support and complement their teaching of Mathematics in the primary classroom. Students are provided with opportunities to apply their developing digital technology skills in the creation of lesson resources with specific focus on the themes of assessing prior knowledge, engagement, catering for diversity and assessment. Students also are given the opportunity to develop their teaching skills through the presentation of the digital technology lesson they prepare. It also allows students to continue to develop their personal literacy and numeracy after completing the unit. This unit builds on three professional experience blocks (totalling 21 weeks) which the students have already completed.

Unit learning outcomes:

- Display development of the skills required to create learning tools based on digital technologies
- Demonstrate an ability to teach a micro lesson to peers based on the development of digital technology resources
- Demonstrate the ability to collegially develop Mathematics classroom teaching resources utilising digital technologies with clear evidence of links to syllabus documents
- Demonstrate a clearly articulated theoretical understanding of the valuable use of digital technologies in the primary Mathematics classroom.

Topics include:

- Issues integrating technology, content and pedagogy in the mathematics classroom – the TePack model
- Overview of main learning theories
- Mobile learning in mathematics education
- Numeracy apps across the curriculum
- National curriculum maths proficiency strands
- Performance of Australian students in maths nationally internationally
- Current trends in Mathematics Education
- Multimodal ICT Applications in the F–6 in the Number strand
- Multimodal ICT Applications in the F–6 in the Algebra strand
- Multimodal ICT Applications in the F–6 in the Measurement strand
- Multimodal ICT Applications in the F–6 in the Geometry strand
- Multimodal ICT Applications in the F–6 in the Statistics and Probability strand
- Lifelong Professional Learning – affiliation to professional organisations (AAMT, MANSW, MERGA). Research mathematical centres Australia. Professional journals and magazines.

Assessment

Assessment in this unit includes three tasks:

- The first tasks is to create an ICT-based lesson plan with a partner, including explicit differentiation for cognitive abilities
- The second task then requires students to teach the lesson prepared in the first task
- The third task is an examination.

General comments

This unit complements the previous three units with a specific focus on digital technology. This unit also adopts the same textbook as the previous unit as well as a course reader which includes journal articles and book chapters. There is a page and a half of essential and recommended readings comprising of links to relevant research and assessment. There is reference to current trends in Mathematics, professional learning and organisations and a model for integrating technology, content and pedagogy in the mathematics classroom. The assessment tasks are detailed, with an assessment rubric included.

UNIVERSITY OF SYDNEY

University of Sydney (USYD) offers:

- **Bachelor of Education (Primary)**
- **Master of Teaching (Primary)**

Preparation to teach K – 6 Mathematics

1 Approach

- The units on Primary Mathematics at USYD are different in the Bachelor and Master degrees.
- The B.Ed. (Primary) program incorporates four units in Mathematics (including Numeracy) with one unit studied in each year of the four-year degree.
- The first unit, EDUP1003 Mathematics and Numeracy has a content focus, with the three Mathematics Education units focusing on curriculum and pedagogy in Mathematics K–6.
- The program documentation provides an overview of the four units and maps the content of the units to the individual elements of the BOSTES Subject Content Requirements for Primary Mathematics KLA addressing each element of the Content and Teaching Strategies categories of the requirements. The elements are addressed variously through unit outcomes, content topics or specific assessments.
- Mathematics, as a national priority area, is explicitly addressed through the units, particularly the first unit on a weekly basis.
- The MTeach (Primary) provides two units on mathematics content and pedagogy.

2 Content – B.Ed. (Primary)

(a) EDUP1003 Mathematics and Numeracy

The aim of this unit is for students to develop a more holistic understanding and appreciation of mathematics and numeracy, and themselves as learners of mathematics through explorations of mathematical systems, patterns, relationships and reasoning. Through practical and collaborative workshops designed to cater for a range of learning styles, students develop deeper understanding of fundamental mathematical concepts and processes through an inquiry learning approach. To promote an appreciation for the origins, evolution and purposes of mathematics, the content is situated in historical and cultural contexts, including Indigenous and non-English speaking perspectives. Students are expected to reflect upon the meanings and roles of numeracy in their own lives and in modern society, including in educational contexts.

Unit learning outcomes:

- Appreciate the nature of mathematical thought and recognise the roles of inductive and deductive reasoning
- Demonstrate increased knowledge and understanding of concepts in measurement, probability, statistics, geometry and number
- Conduct investigations of patterns and relationships in geometry, number and statistics
- Demonstrate an appreciation of the structure inherent in various mathematical systems and an appreciation of the origins and evolution of mathematics from both social and cultural perspectives
- Reflect upon their own Numeracy development and the roles of Numeracy in society
- Apply research and inquiry, and information literacy skills to develop approaches for further independent learning in mathematics, including ICT use.

Topics include:

The content of the unit draws from a range of mathematical systems that underlie typical primary and secondary school mathematics curricula. It explores the theme of 'teacher as a learner' of mathematics and the impact a teacher's knowledge can have on their students' perspectives of mathematics.

- Number: numeration systems (ancient and modern), cultural contexts including Aboriginal perspectives
- Geometries: origins, Euclidean, Topology, Transformational, Projective
- Measurement: historical, systems (covering surface area, volume, mass, capacity and density)
- Reasoning: pattern and algebra, problem-solving and investigation (including inductive and deductive reasoning)
- Statistics and Probability: statistical analysis using ICT and statistical literacy (including historical background, data handling and graphical representations)
- Assessing numeracy and interpreting student assessment data on a class and school level

Assessment

There are four assessment tasks, all with detailed specifications and guidelines. First, five sets of mathematical/numerical tasks completed in weekly tutorials are submitted and assessed, secondly a reflection on the first 7 weeks of learning is submitted, and thirdly pairs of students research the historical and mathematical aspects of a chosen mathematical concept or development, and fourthly a statistical investigation comparing data sets, presentation and display of data. There are detailed outlines of the assessment requirements, and assessment criteria.

General comments

The text is Haylock, D (2014) Mathematics explained for primary teachers (5th edition. London: sage Publications. There is a two page list of other texts, articles, websites and resources.

(b) EDUP2005 Mathematics Education 1: Early Number

This unit introduces students to Mathematics pedagogy and curriculum in schools, with the Numeracy Continuum (NSWDEC) being a main focus of study content. Students are required to assess a child from K–2 grades using an interview schedule and to use the results to plan activities that demonstrate knowledge of worthwhile mathematical tasks. The strands of the K–6 Mathematics syllabus for the first three years of school are studied in this foundational unit. The development of children's mathematical thinking strategies are explored through a research-based framework of number, with the syllabus and curriculum documents introduced through the learning framework

Unit learning outcomes:

- Demonstrate familiarity with current educational theory, research and curriculum documents as they relate to the teaching and learning of mathematics
- Explore a child's understanding of early number by undertaking a diagnostic interview and analysing the results using a developmentally based learning framework
- Design a sequence of lesson ideas based on the results of an assessment of a child and using knowledge of the NSW syllabus and support documents
- Discuss research-based knowledge of quality pedagogies associated with the teaching of mathematics
- Reflect critically upon personal beliefs, experiences, attitudes and learning style toward mathematics and considered how this may impact on an individual's teaching of mathematics
- Explain the role mathematics plays in developing numeracy
- Use technology appropriately to enhance a child's mathematical thinking
- Demonstrate increased content knowledge of mathematics.

Topics include:

- Number and Algebra (including rational counting, addition & subtraction, early multiplication & division, pattern & number relations, fraction sense) – over five weeks throughout the unit
- Introduction to the Learning Framework in Number, Numeracy Continuum and the *NSW Mathematics K–6 Syllabus*
- Assessing early number – using SENA interviews, interpreting children's responses and providing appropriate feedback
- Place value and working mathematically
- Chance and data
- Problem-solving and investigation
- Issues in mathematics education.

Assessment

The first assessment of the unit, weighted at 40 percent, requires students to make online reflections for 4 selected weeks that demonstrate their own learning and ability to relate with the set readings. Students self-assess their reflections, based on a provided reflection level criteria sheet, with the final mark calculated as an average of all four weeks' contributions. The final assessment, weighted at 60 percent, requires the student to assess and analyse early number strategies for a child about to start school or in Years K–1. The assessment comprises of a recorded interview (SENA 1) with the child and assessing and analysing their results using the Numeracy Continuum (NSWDEC). From this, the student is required to design three lesson ideas/activities to address the needs of the child. The assessment requires a concise description of the activities and not the preparation of full lesson plans.

General comments

The text is Bobis, J., Mulligan, J., & Lowrie, T. (2013) *Mathematics for children: Challenging children to think mathematically* (4th ed.) and the BOSTES *NSW Mathematics K–10 Syllabus* (2012). Further readings for each weekly topic are provided online to students. The specifications and rubrics for the assessments are detailed.

(c) EDUP3004 Mathematics Education 2

This unit teaches the mathematical content areas of measurement (length, area, mass, volume & capacity, time) and space and geometry, while integrating the process strand of Working Mathematically. The unit continues development of understanding of how children learn mathematics, the content and the pedagogical content knowledge needed to effectively teach these strands and the significant issues associated with these areas. The unit involves an in-school component over three weeks with required collaborative planning.

Unit learning outcomes:

- Demonstrate deeper understanding of mathematical concepts and processes in the areas of measurement, space and geometry
- Extend their knowledge of mathematics syllabus content strands, Working Mathematically strand and support documents
- Extend their research-based knowledge of children's cognitive development and apply this knowledge to how they learn concepts of measurement and space and geometry
- Demonstrate the application of content and syllabus knowledge, including Working Mathematically, by planning and implementing a sequence of teaching sessions with a small group of primary-aged students
- Use technology appropriately to enhance a child's mathematical thinking and content knowledge
- Assess children's learning during practical-based learning activities and to use this knowledge to inform the students, their teachers and to critically reflect on their own teaching practices.

Topics include:

- Learning frameworks and developmental sequences for Measurement, Space and Geometry, Working Mathematically
- Investigating the properties of 3D objects with a focus on prisms and pyramids, Space 2D (including Lines & Angles, investigating the properties of 2D shapes, symmetry and transformational geometry)
- Measurement (including volume and capacity, length and area, time and temperature, mass including confusion with volume) –taught over four weeks of the unit
- In school preparation planning for teaching
- Assessment in Mathematics
- Unit evaluation, with reflection on teaching and sharing of practical issues/ideas for teaching volume and capacity.

Assessment

The first assessment for the unit, weighted at 40 percent, is the development of a digital resource for teaching a specific mathematics topic from the Space and Geometry or Measurement strand of the BOSTES syllabus. Examples of what the digital resource form could be include a PowerPoint presentation, video clip or website. A written component must also be submitted that addresses the context, rationale and potential strategies for integrating the digital resource into a school lesson. The final assessment, weighted at 60 percent, is the development of a mini program of three to four lessons, based on content from the Measurement strand of the BOSTES Mathematics syllabus, and taught to a small group of primary school children during tutorials. This component of the assessment is to be done in a group. The assessment also includes an individual written component where the student reflects on their professional learning and how they address the APST using evidence and examples.

General comments

The text is Bobis, J., Mulligan, J., & Lowrie, T. (2013) *Mathematics for children: Challenging children to think mathematically* (4th ed.) and the BOSTES *NSW Mathematics K–10 Syllabus* (2012). There is also a page of other references including resources from the NSW Department of Education such as teaching measurement. In the course outline's schedule, there are set readings that are designated to complement the content taught for each week. The assessment tasks include detailed specifications and rubrics.

(d) EDUP4074 Mathematics Education 3

This unit builds on the content taught in the previous mathematics education units, and explores how children's mathematical thinking strategies develop via research-based frameworks of number. It reflects growing international emphasis on the development of efficient mental computational strategies to enhance numeracy levels in Australia, and incorporates the strands of Number and Algebra within the learning framework. It focuses on Stages 2 and 3 children. Content includes learning frameworks and developmental sequences for multiplicative thinking, proportional reasoning (fractions, ratio and proportion) probabilistic thinking (chance), data handling knowledge and skills, and algebraic thinking (patterns and algebra).

Unit learning outcomes:

- Use a diagnostic interview to assess a child's level of mathematical thinking and analyse the results in relation to a research-based framework of number development
- Demonstrate the ability to work collaboratively with peers in the design and implementation of the mini-program that is based on the outcomes of the initial assessment
- Utilise appropriate ICT to further their own knowledge in mathematics education
- Develop the ability to choose, provide and use appropriate mathematical activities that promote risk taking, foster efficient learning strategies, develop positive attitudes, promote enjoyment and provide opportunities for children to create for themselves mathematical thinking skills
- Demonstrate their understanding of a variety of assessment strategies (clinical interviewing, observation & work sample analysis), evaluation, recording and reporting of a child's developing mathematical needs
- Demonstrate, through the choice of activities and assessment methods, the integration of theory and practice
- Build on their own personal philosophy of how children learn mathematics based on readings, reflections and practical experience.

Topics include:

- Theoretical and practical components focused on the mathematical development of Stages 2 and 3 children.
- Fractions framework, assessing fractions, concepts and skills
- Multiplicative thinking (and fraction notation, equivalence, operations with fractions, calculators)
- Place value with whole numbers and fractions (and decimal fractions; using digital resources)
- Advanced computation –number sense, mental strategies, estimation and approximation (and developing addition and subtraction algorithms; concrete to abstract transitions)
- Designing assessment-based programs – curriculum differentiation
- Problem-solving and working mathematically (developing written computation for multiplication and division)
- Algebraic thinking and working mathematically (investigations – promoting reasoning and communications)
- Chance framework – Probabilistic thinking (3 probability perspectives, social context, role of language
- Data handling knowledge and skills – statistical thinking (organising and displaying data, graphs, teaching strategies to enhance intellectual quality, computers)
- Continuing professional learning
- Aboriginal and multicultural perspectives
- Language needs

Assessment

The first assessment, weighted at 60 percent, is designed in three parts, where students develop and demonstrate their ability to design and implement a task-based assessment interview protocol for Stage 2/3 Fractions, then plan appropriate learning experiences to cater for the differing needs of a class. The first part involves groups of four students to collaborate on the design of a diagnostic assessment. The second part requires individual students to interview a child from Years 4–6 using the group-designed diagnostic assessment, and write a profile. This student profile will detail information gained about the child's progress in understanding fractions in relation to the NSW Numeracy Continuum and the NSW syllabus. The final part of this assessment involves the students returning to their four person group to review their student profiles and plan a sequence of four tasks that address the identified key strengths and learning needs of the children. The final assessment, weighted at 40 percent, is a presentation in pairs, at the end of the semester, where students will carefully explain a mathematical concept or skill relevant to the content of the unit, aimed at clarifying the mathematics for their fellow pre-service teachers. The presentation must use digital media such as PowerPoint, a movie, interactive whiteboard tools or an animation. A written summary of the presentation is also required to be submitted.

General comments

Under the course outline's heading, *References and readings*, there is a downloadable document containing two pages of references. In the course outline's schedule, there are also set readings next to each week's content. The texts for the unit are Bobis, J., Mulligan, J., & Lowrie, T. (2013) *Mathematics for children: Challenging children to think mathematically* (4th ed.), the BOSTES *NSW Mathematics K–10 Syllabus* (2012) and the Numeracy Continuum.

3 Content – MTeach (Primary)

The overview of the two Mathematics units within the degree expressly maps the various aspects of the units to each of the elements of the BOSTES Subject Content Requirements for Primary Mathematics, as well as the elements of the Numeracy strand of the National Priority Areas.

(e) EDMT5532 Primary Mathematics 1

This unit covers the Number and Algebra, and Working Mathematically strands of the NSW Mathematics K–6 Syllabus and the Australian Curriculum, with particular focus on the first three to four years of school. It explores how children's mathematical thinking strategies develop via a research-based framework of number and introduces the important connection between assessment and planning for instruction. Students are introduced to suitable assessment instruments for Early Stage 1, Stage 1 & 2 (Foundation/K-K–3) children including clinical interviewing (eg SENA), observation and work sample analysis. There is a three-week in-school/teaching component conducted during regular tutorial times that is focused on the development of mathematical thinking in ES1–Stage 2 children that underpins the assessment work.

Unit learning outcomes:

- Understand current educational theory, issues and research pertaining to early number learning, mathematics content and relevant syllabus requirements
- Use a diagnostic interview to help assess a child's level of mathematical thinking and analyse the results in relation to a research-based framework of number development
- Demonstrate the ability to work collaboratively with peers in the design and implementation of a sequence of lessons based on the mathematical strengths and needs of a small group of children
- Utilise appropriate teaching strategies and resources, including ICT, to actively engage students in meaningful mathematical learning experiences
- Plan appropriate learning experiences that reflect knowledge of current educational theory, research, effective pedagogy and curriculum documents/resources
- Develop the ability to choose, provide and use appropriate mathematical experiences that promote risk taking, foster efficient learning strategies, develop positive attitudes, promote enjoyment and provide opportunities for children to create for themselves mathematical thinking skills
- Demonstrate your understanding of a variety of assessment strategies (clinical interviewing, observation & work sample analysis), evaluation, recording and reporting of a child's developing mathematical needs
- Demonstrate increased knowledge and understanding of mathematics content, of how children learn mathematics and effective pedagogy
- Critically reflect on their beliefs, experiences and attitudes toward mathematics and how this impacts on their teaching of mathematics.

Topics include:

- The nature of mathematics & how children learn it (including introduction to the NSW Mathematics K–6 syllabus and the Australian Curriculum)
- The development of early number
- Early Addition & Subtraction: Counting to non-counting strategies including CMIT
- Early Multiplication & Division: Forming groups to basic facts (including SENA)
- Place Value: Mental strategies for addition and subtraction of 2-digit by 2-digit numbers
- Working with place value and number sense to explore the introduction of algorithms for addition and subtraction (including diagnostic testing of a child)
- Algebraic thinking: Patterns and Algebra
- Fractions (and lesson planning)
- Preparation for in-school: Rehearsal of teaching some key concepts during tutorials to peers
- Weeks 10–12: teaching and assessing in schools.

Assessment

The first assessment of the unit, weighted at 30 percent, requires students to make regular online reflections every couple of weeks that demonstrate their own learning and ability to relate with the set readings. Students self-assess their reflections, based on a provided reflection level criteria sheet/pro forma. The format of this assessment is similar to the first assessment for the undergraduate unit EDUP2005 Mathematics Education 1: Early Number. The second assessment, weighted at 40 percent, is a diagnostic interview with a child (SENA 1 and/or 2) that is conducted with a partner, although the analysis report must be individually prepared and submitted. The final assessment, weighted at 30 percent, is the development and teaching of a mini program of three to four lessons, the content of which is determined by the results of the diagnostic interview. This component of the assessment is conducted in a group. The assessment also includes an individual written component where the students reflect on their professional learning and how they address the APST using evidence and examples. The format of this assessment is similar to the final assessment for the undergraduate unit EDUP3004 Mathematics Education 2, but with a focus on early number content.

There are detailed assessment task specifications and rubrics.

General comments

The text is Bobis, J., Mulligan, J., & Lowrie, T. (2013) *Mathematics for children: Challenging children to think mathematically* (4th ed.). Additionally, there is a page and a half list of recommended references and readings, including the Australian Curriculum, the BOSTES Mathematics K–6 syllabus, and the Department of Education's Developing Efficient Numeracy Strategies for Early Stage 1, and Stages 1 and 2. There are specific readings and other resources assigned for each weekly topic.

(f) EDMT6532 Primary Mathematics 2

This unit draws on all strands of the NSW syllabus. It focuses on the development of concepts and processes from the Statistics and Probability, and Measurement and Geometry strands from the NSW Mathematics syllabus and Australian Curriculum. It explores children's understanding of measurement concepts, chance and data handling, and investigates the teaching of concepts from multiple syllabus strands in an integrated way. The unit also builds on the content and processes taught in the previous unit by focusing on Stages 2 and 3 of the Number and Algebra strand, integrating the syllabus strands Working Mathematically and use of ICT throughout all content areas.

Unit learning outcomes:

- Demonstrate their developing understanding of measurement, space and geometry, chance and data, and number and algebra concepts and processes through their participation in a range of practically based tutorial activities
- Demonstrate their understanding of teaching/learning and assessment strategies that are applicable to their own classroom teaching, eg collaborative learning, subject integration, small group discussion, integration of technologies, peer assessment, problem-solving and inquiry-based learning
- Critically reflect on developmental learning frameworks of measurement, the supporting research findings and their applications concerning ways in which children think, learn and construct mathematical knowledge
- Demonstrate a familiarity and understanding of teaching strategies for developing more sophisticated levels of mathematical thinking through the processes of Working Mathematically and the provision of mathematically rich investigations
- Demonstrate a familiarity and understanding of the aims, outcomes and mathematical content of the *NSW Mathematics K–10 Syllabus for the Australian Curriculum*, support documents, national and international curriculum documents
- Assess and produce a variety of practical teaching resources, both digital and non-digital, that correspond to Syllabus outcomes and theoretical frameworks of mathematical development.

Topics include:

- Development of geometric thinking, and mathematical resources and games/activities/ task design
- Space and Geometry concepts (including 2D, 3D Space, tessellations, angles, symmetry, etc); locating/selecting appropriate digital resources and using technology to increase cognitive challenge, strategies for working mathematically (2 weeks)
- Measurement of Length, Area, Volume/Capacity, Time and Mass Including concepts and skills, measurement framework and misconceptions)
- Chance and probability
- Data handling
- Number Content with a focus on Stages 2 and 3 (including operations for addition, subtraction, multiplication, division, fractions and decimals); developing written algorithms, assessment strategies.
- Algebraic thinking (development of and systemic strategies and pattern finding)
- Designing appropriate teaching and learning experiences
- Integration of Working Mathematically to all content strands
- Integration of content from various mathematics strand and other KLAs
- Digital resources – analysis of quality and effective pedagogy.

Assessment

Each of the three assessment tasks is graded as either 'Satisfactory' ('S') or 'Unsatisfactory' ('U'). The first assessment is weighted 50% and requires students to design a motivating structured teaching resources kit (ie Four 'basic' games or one 'rich' game for a group of children) that matches specific mathematical learning objectives. Students are encouraged to design the teaching resources in pairs. The teaching resource kit is presented in class, is peer-critiqued and accompanied by lecturer moderation to determine ultimate satisfaction of criteria. There is a written component to this assessment where students explain the details of the kit, how it links to the NSW Mathematics syllabus and how it will facilitate learning. The second assessment (weighted 40%) is a report analysing a Mathematics K–6 syllabus 'narrow-focus' topic and two different digital resources aligned with learning the topic's mathematics concepts and skills. The second component of the assessment is describing a lesson design that exemplifies effective use of one of the analysed digital resources. The purpose of this component is for the student to explain the justification of the teaching–learning design. The final assessment (weighted 10%) is contributing to a tutorial-group blog that reflects their mathematics teaching experiences during their professional experience placement in Weeks 9 to 12 of the semester. There are detailed assessment task specifications and rubrics.

General comments

The texts are Bobis, J., Mulligan, J., & Lowrie, T. (2013) *Mathematics for children: Challenging children to think mathematically* (4th ed.) and the BOSTES *NSW Mathematics K–10 Syllabus* (2012). There are also two pages of other references including resources from the NSW Department of Education such as teaching measurement. In the course outline's schedule, there is also reference to specific chapters from the set textbook and 'web resources' for each week.

UNIVERSITY OF TECHNOLOGY, SYDNEY

University of Technology, Sydney (UTS) offers:

- **Bachelor of Arts/Bachelor of Education (Primary) or (K–12)**
- **Bachelor of Arts/Bachelor of Education (Honours) (Primary)**
- **Bachelor of Education/Bachelor of Arts in International Studies (Primary)**

Preparation to teach K – 6 Mathematics

1 Approach

- UTS provides three dedicated units of primary mathematics common to both the Bachelor of Arts/ Bachelor of Education (Primary) and the Bachelor of Arts/Bachelor of Education (Honours) (Primary).
- The Bachelor of Arts/Bachelor of Education (K–12) and the Bachelor of Education/Bachelor of Arts in International Studies (Primary) only requires two of the primary mathematics units to be completed. Students choosing to undertake a K–12 STEM major will also choose two mathematics/ science electives.
- Each of the three units have a common learning outcomes approach with some subject content specific objectives in each. The content and assessments in each of the units follow a similar structure each culminating in an exam which covers mathematics content and pedagogy from the entire unit.

2 Content

(a) 028239 – Mathematics Education 1

This unit develops students' understanding of how to work mathematically in the teaching and learning of aspects of the NSW Mathematics K–6 syllabus. Students use current approaches to develop their own understanding of number, statistics and probability concepts and to develop strategies and techniques for teaching these concepts in the primary school. Participative and collaborative learning approaches are employed and the use of reflection and documentation of learning through portfolios is continued. The subject assists students to develop critical thought about and reflection on, the teaching of mathematics in the primary school.

Unit learning outcomes:

- Explain the primacy of working mathematically in the teaching and learning of mathematics
- Describe the principles of teaching and learning elementary numeration and number concepts
- Evaluate learning experiences in number, probability and statistics planned and implemented by the student
- Analyse critical issues and trends in Indigenous mathematics education
- Communicate mathematical ideas using appropriate mathematical terms and clear and explicit language.

Topics include:

- Exposure to and knowledge of mathematical concepts and the discipline of mathematics, including:
  - The meaning and language of mathematical operations
  - Mathematical laws and number facts
  - Computation and estimation the understanding and processing of algorithms
  - The use of calculators
  - The development of early numeration concepts
  - An examination of the basic ideas in probability and statistics
  - Concepts and applications of chance, modelling, simulation
  - Collection, organisation, representation and interpretation of data
  - Elementary concepts of statistical inference; Indigenous ways of doing mathematics.
- Exposure to, knowledge of and experience in planning and implementing lesson sequences with reference to the new *NSW Mathematics K–6 Syllabus* including:
  - Lesson planning
  - Topic analysis
  - Classroom organisation
  - Use of a thematic approach
  - Making numeracy–literacy connections explicit
  - Using working mathematically processes.

Assessment

Assessment in this unit includes three tasks of variable weighting:

- The first task requires students to develop learning resources in number that will support children's development of number concepts and is worth 25% of the overall assessment for this unit.
- The second task requires students to assume they are a statistician who has been asked to investigate a local issue for which they collect data and write a report for the community. This task is worth 30% of the overall assessment for this unit.
- The third task is an examination worth 45% of the overall assessment.

The assessment outlines provide descriptions of the tasks involved and clear marking criteria. To achieve a pass in this unit, students must obtain an overall assessment mark of 50% or greater and a minimum of 45% in the final examination. Although not part of the overall assessment students who attend less than 80% of classes are refused to have their final assessment marked.

General comments

There are two texts referenced as required readings for this unit and include:

> Jorgenson, R., & Dole, S. (2011). *Teaching Mathematics in Primary Schools* (2nd edn). Sydney: Allen & Unwin.
>
> NSW Board of Studies NSW (2012). *NSW Syllabus for the Australian Curriculum: Mathematics K–10*. Sydney.

There is a half-page list of recommended readings. The unit is delivered in a combination of face to face and online modes over a period of 9 weeks.

(b) 028240 – Mathematics Education 2

This subject examines the construction of, and builds students' understanding in, sound methodological principles for the development of concepts in rational number, measurement, graphing, and mental arithmetic. Students are introduced to ways of teaching and learning concepts in measurement and rational number. The study of mathematical concepts in this subject involves the modelling of participative and collaborative learning approaches. Students will be encouraged to reflect on their learning about, and teaching of, the NSW Mathematics K–6 syllabus. The link with the school-based field component of the corresponding professional experience subject will enable students to apply and reflect upon mathematics teaching and learning episodes.

Unit learning outcomes:

- Explain the primacy of working mathematically in the teaching and learning of mathematics
- Demonstrate an understanding of a variety of assessment procedures suitable in mathematics education
- Describe the principles of teaching and learning of measurement concepts
- Evaluate learning experiences in rational number, measurement, graphing and mental arithmetic planned and implemented by the student
- Analyse critical issues and trends in Indigenous mathematics education.

Topics include:

- Exposure to and knowledge about mathematics and the mathematics discipline, including:
  - Concepts and processes in the measurement of length, area, volume and capacity, mass and time
  - Development of awareness that measurement is a process of approximation
  - Fraction concepts, including application ratio and proportions, basic operations for common and decimal fractions, and the relationship amongst them
  - Percentages and their applications
  - Elementary concepts of graphing
  - Mental arithmetic concepts.
- Exposure to the NSW Mathematics K–6 syllabus, the new Australian Curriculum and to relevant pedagogies, including:
  - Approaches used in teaching measurement concepts, including questioning techniques to support student learning, listening to students and engaging them in discussion
  - Assessment in the primary school classroom of understanding of measurement and rational number concepts
  - Integration of the teaching of measurement concepts with other subject areas such as science
  - Development of understanding and strategies for teaching common, decimal and percentage fractions and their applications
  - Theories of learning in mathematics education, including cooperative learning and working mathematically
  - Use of computer technology to investigate the topics of rational number, measurement, graphing and mental arithmetic
  - An introduction to the teaching of mathematics using inquiry techniques, the calculator and appropriate language and mathematical terms.

Assessment

Assessment in this unit includes three tasks of variable weighting –

- The first task requires students to develop learning resources in measurement that will support children's development of measurement concepts and is worth 25% of the overall assessment for this unit.
- The second task requires students to conduct an interview of a primary aged student to assess their understanding of fraction concepts. After the interview students are required to write a report detailing the areas they investigated during the interview. This task is worth 30% of the overall assessment for this unit.
- The third task is an examination worth 45% of the overall assessment.

The assessment outlines provide descriptions of the tasks involved and clear marking criteria.

To achieve a pass in this unit, students must obtain an overall assessment mark of 50% or greater and a minimum of 45% in the final examination. Although not part of the overall assessment students who attend less than 80% of classes are refused to have their final assessment marked

General comments

There are two texts referenced as required readings for this unit and include:

> Jorgenson, R., & Dole, S. (2011). Teaching Mathematics in Primary Schools (2nd edn). Sydney: Allen & Unwin.
>
> NSW Board of Studies NSW (2012). NSW Syllabus for the Australian Curriculum: Mathematics K–10. Sydney: Author.

There is a half-page list of recommended readings. The unit is delivered in a combination of face to face and online modes over a period of 9 weeks.

(c) 028241 – Teaching Mathematics Education 3

This unit allows students to further develop their philosophy of teaching and learning mathematics. It examines the construction of, and builds students' understanding in, sound methodological principles for the development of concepts in introductory algebra, geometry and the number plane, and problem-solving, including assessment in mathematics. The subject also identifies and analyses some of the issues in teaching students whose first language is not English, and develops an awareness of their implications for student learning. Students will be encouraged to reflect on their own learning about, and teaching of, the NSW Mathematics K–6 syllabus.

Unit learning outcomes:

- Describe sound methodological principles for the teaching and learning of concepts in introductory algebra, geometry and the number plane, and problem-solving
- Analyse issues in teaching mathematics to students whose first language is not English
- Evaluate learning experiences in geometry, patterns and algebra, the number plane and problem-solving planned and implemented by the student
- Develop a variety of strategies for assessment and evaluation appropriate to the mathematical topics under consideration
- Identify and analyse some of the critical issues and trends in Indigenous mathematics education
- Communicate mathematical ideas using appropriate mathematical terms and clear and explicit language.

Topics include:

This unit addresses the following main areas, with particular emphasis on patterns and algebra, geometry, the number plane and problem-solving.

- Exposure to and knowledge of central concepts of mathematics and the discipline of mathematics including:
  - Informal and formal development of introductory algebraic concepts through the study of patterns and concrete representations, as well as equations and their application to problem-solving
  - Language and processes of geometry, including position, shape, classification, modelling, plane and space geometry, symmetry, tessellations, and the van Hiele levels
  - Number plane in four quadrants.
- Exposure to and knowledge about mathematics pedagogies, including:
  - Investigation of the use of technologies to develop concepts in the above areas
  - An introduction to the teaching of mathematics through problem-solving, including use of investigation techniques, the calculator and language in problem-solving
  - Using working mathematically processes.
- Exposure to, knowledge of and experience in implementing lesson sequences with reference to the NSW K-6 Mathematics K–6 syllabus, including:
  - Understanding the connections between Stage 3 and Stage 4.

Assessment

Assessment in this unit includes three tasks of variable weighting:

- The first task requires students to develop learning resources in geometry that will support children's development of geometry concepts and is worth 25% of the overall assessment for this unit.
- The second task requires students to create a unit of work comprising three to five lessons. This task is worth 30% of the overall assessment for this unit.
- The third task is an examination worth 45% of the overall assessment.

The assessment outlines provide descriptions of the tasks involved and clear marking criteria. To achieve a pass in this unit, students must obtain an overall assessment mark of 50% or greater and a minimum of 45% in the final examination. Although not part of the overall assessment students who attend less than 80% of classes are refused to have their final assessment marked.

General comments

There are two texts referenced as required readings for this unit and include:

> Zevenbergen, Dole & Wright (2004). *Teaching Mathematics in Primary Schools* (2nd edn). Sydney: Allen & Unwin.
>
> NSW Board of Studies NSW (2012). ˆ Sydney: Author.

There is a half-page list of recommended readings. The unit is delivered in a combination of face to face and online modes over a period of 9 weeks.

UNIVERSITY OF WOLLONGONG

The University of Wollongong offers:

- **Bachelor of Primary Education**
- **Bachelor of Primary Education (Deans' Scholar)**
- **Bachelor of Primary Education (Honours)**
- **Bachelor of Primary Education (Deans' Scholar) (Honours)**
- **Master of Teaching (Primary)**

Preparation to teach K – 6 Mathematics

1 Approach

- UoW provides 3 maths units in the Bachelor of Primary Education degrees dedicated to the NSW K–6 maths syllabus
- Students complete a further 3 units of study in Language and Literacy
- Student learning outcomes for each unit are linked to the relevant APST

2 Content

EDMM101 Mathematics Foundations

This subject focuses on the essential fundamental knowledge of mathematics content and associated skills needed by pre-service primary teachers. This subject develops pre-service teachers competencies in mathematical concepts necessary for the effective teaching of Stages 1–4 (Year K–8) in the NSW Mathematics K–10 syllabus.

Unit learning outcomes:

- Demonstrate knowledge of foundational mathematical concepts and skills
- Solve problems utilising a range of problem-solving skills in relationship to the mathematics covered
- Identify problem-solving strategies and developing plans of action when confronted with problems they need to solve
- Communicate their mathematical understanding verbally, in writing and utilising technology using appropriate mathematical language.

Topics include:

- Problem-solving
- Number and Algebra (weeks 2–8; numeration systems, structure of Base 10 number system, whole numbers and operations, fractions, decimals and percentages, with reviews of content mastery)
- Statistics and Probability (weeks 9 and 10; collecting, graphing, describing and analysing data; single and multistage experiments)
- Measurement and Geometry (weeks 11 and 12; plane figures, polygons, tessellations, 3D figures, measurement systems and measurable attributes).

Assessment

- 5 x 10-minute quizzes, based on readings and exercises (15%)
- 2 x short in-session mastery exams (30%)
- a five-minute group presentation of a mathematical topic to support children's understanding (10%)
- a three-hour final exam (45%).

General comments

This unit is undertaken in Semester 1 of first year. There are 2 prescribed texts and 4 texts listed as additional reading, with assigned reading from the Bennett et al text (2012).

EDKM102 Mathematics Content and Pedagogy 1

EDKM102 focuses on developing pre-service teachers' understanding of how children best learn mathematics; research-based quality mathematics teaching; planning and programming for effective mathematics learning experiences; assessing students' understanding to inform future teaching; and developing their own specialised content knowledge across all strands of mathematics.

This subject builds on the mathematics foundations developed in EDMM101 and explores the mathematics syllabus (Board of Studies NSW, 2012).

While major theories of learning and teaching are incorporated within these topics, the link between professional practice and students' learning outcomes, in relation to K–6 mathematics, is guided by the National Professional Teaching Standards (AITSL, 2011), the NSW Model of Pedagogy (NSWDET, 2003a; 2003b; 2004) and the AAMT Standards (2006).

Unit learning outcomes:

- Demonstrate fundamental knowledge of quality mathematics teaching and learning in the NSW quality teaching framework and the AAMT
- Demonstrate fundamental knowledge about the teaching, learning and assessing of the content and learning processes addressed in the mathematics K–6 syllabus
- Demonstrate fundamental knowledge of research based best practice in teaching mathematics and make connections to theories of how children best learn mathematics
- Identify and utilise teaching resources and technologies for the effective use in teaching K–6 mathematics
- Prepare learning experiences in mathematics that show a substantial understanding for individual student's learning needs
- Satisfactorily perform mathematical computations, demonstrate mathematical knowledge and skills, construct conceptual models/representations and provide explanations appropriate for teaching mathematics to K–6 students.
- Support professional teaching decisions using research in teaching, learning and assessment in K–6 mathematics in K–6 mathematics in a scholarly, critical and engaging manner.

Topics include:

- NSW syllabus strands: Working Mathematically, Number and Algebra, Measurement and Geometry (focusing on Length, Area, Volume and Capacity and Mass)
- Theories which underpin quality teaching in maths education
- The development of number concepts and mental strategies (including the utilisation of the Numeracy Continuum)
- Written algorithms, fraction and percentage concepts
- Patterns and Algebra

Assessment

- A five-minute group presentation (based on utilising the Numeracy Continuum) (10%)
- A contextualised learning experience for Stage 2 or Stage 3, which includes developing a lesson plan (20%) and evaluating it with reference to the Quality Teaching Model, the NSW syllabus and relevant research (20%) – total (40%)
- A minimum grade of 45% in the exam is required to pass the unit. The exam is weighted at 50% of the final mark for the course. Questions are based on a selection provided each week in the lecture schedule, plus 2 unseen questions.

General comments

This unit is undertaken in Semester 2 of first year. The 3 prescribed texts for this course include the NSW maths syllabus, with the main text being Booker et al. 2014 *Teaching Primary Mathematics*. A comprehensive list of recommended readings is also provided. Specific readings are assigned to topics and there are detailed outlines of assessment tasks.

EDKM301 Mathematics Content and Pedagogy 2

EDKM301 focuses on consolidating pre-service teachers' understanding and utilisation of the following in their teaching: how children best learn mathematics; research-based quality mathematics teaching; planning and programming for effective mathematics learning experiences; assessing students' understanding to inform future teaching; developing their own specialised content knowledge across all strands of mathematics.

This subject adds to, and extends, core ideas that were developed in EDMM101 and EDKM102 with a continued focus on developing a deep understanding of the mathematics syllabus (Board of Studies NSW, 2012) and relevant mathematical knowledge and skills.

While major theories of learning and teaching are incorporated within these topics, the link between professional practice and students' learning outcomes, in relation to K–6 mathematics, is guided by the National Professional Teaching Standards (AITSL, 2011), the NSW Model of Pedagogy (NSWDET, 2003a; 2003b; 2004) and the AAMT Standards (2006).

Unit learning outcomes:

- Demonstrate substantial understanding of quality mathematics teaching and learning in the NSW quality teaching framework and the AAMT standards
- Demonstrate substantial knowledge about the teaching, learning and assessing of the content and learning processes addressed in the mathematics K–6 syllabus
- Demonstrate substantial knowledge of research base best practice in teaching mathematics and make connections to theories of how children best learn mathematics
- Identify and utilise a variety of teaching resources and technologies for the effective use in teaching K–6 mathematics.
- Assess students' mathematical understanding and learning needs.
- Prepare learning experiences in mathematics that show a substantial understanding for individual students' learning styles
- Satisfactorily perform mathematical computations, demonstrate mathematical knowledge and skills, construct conceptual models/representations and provide explanations appropriate for teaching mathematics to K–6 students.

Topics include:

- Revision of the syllabus (week 1)
- Number and Algebra (working with fractions, number development and algebraic reasoning) (week 2–3)
- Statistics and Probability (teaching chance and data, measures of data) (week 4)
- Rich assessment) (week 4)
- Measurement and Geometry (focusing on 3D Space, 2D Space, Angles, Position, Time, Length, Area, Volume and Capacity and Mass) (weeks 5–8).

Assessment

- Group investigation including developing a problem-solving activity and annotating associated work samples (800 words, 25%)
- Report on future directions – individual learning experience developed, with analytical report, based on assessment 1 (800 words, 25%)
- A two-hour in-session exam focused on pedagogy (30%) and a take home exam on mathematical concepts (20%) based on a selection provided each week in the lecture schedule, and a possible 3 unseen questions.

General comments

This unit is undertaken in third year. Students in the Dean's Scholar programs are required to maintain a minimum weighted average mark of 80% from second year onwards. The 3 prescribed texts for this course include the NSW maths syllabus, with Booker et al (2014) the main text. An extensive list of recommended readings is also provided. There are detailed descriptions on content related to assessment tasks for each topic.

The unit is currently a 10-week subject with Week 9 focused on revision and Week 10 an in-session exam. The subject is related to 3rd Year PEX and may move to 12 weeks with the possible change in the timing of PEX.

(d) EDMP911 Numeracy and Mathematics I

The unit focuses on how children best learn mathematics; research-based quality mathematics teaching; planning and programming for effective mathematics learning experiences; assessing children's understanding to inform future teaching and developing specialised content knowledge and appropriate mathematical metalanguage in the Number and Algebra strand.

The unit explores the mathematics syllabus (Board of Studies NSW, 2012), introducing the Working Mathematically components and focusing on the mathematical content of the Number and Algebra strand.

Major theories of learning and research-based best practice are incorporated within these topics. Links between professional practice and students' learning outcomes, In relation to K–6 mathematics, will be guided by the National professional teaching Standards (AITSL, 2011), the NSW Model of Pedagogy (NSWDET, 2003a; 2003b; 2004) and the AAMT Standards (2006).

Unit learning outcomes:

- Demonstrating fundamental knowledge of quality mathematics teaching and learning in NSW (NSWDET and AAMT frameworks), theories of how children best learn mathematics and research-based mathematics education literature
- Demonstrating fundamental knowledge about the teaching, learning and assessing of the content and learning processes addressed in the K–6 syllabus (Board of Studies NSW, 2012)
- Demonstrate fundamental knowledge of research base best practice in teaching mathematics and make connections to theories of how children best learn mathematics
- Identifying and utilising teaching resources and technologies for the effective use in teaching K–6 mathematics
- Prepare learning experiences in mathematics that show a substantial understanding for individual student's learning needs
- Supporting professional teaching decisions using analysis of student learning needs and research into teaching, learning and assessment in K–6 mathematics in a scholarly, critical and engaging manner
- Satisfactorily performing mathematical computations, demonstrating mathematical knowledge and skills, constructing conceptual models/representations and providing explanations appropriate for teaching mathematics in K–6 students in the mathematical topics covered.

Topics include:

- Introduction to subject; overview of assessment; mathematics and numeracy
- Introduction to the quality teaching of K–6 mathematics and the underpinning theories
- Syllabus introduction; Working Mathematically; programming and planning
- Number and Algebra
- Introduction to the number system
- Development of number concepts
- Addition and subtraction; development of mental strategies; written algorithms
- Multiplication and division; development of mental strategies; written algorithms
- Teaching fractions; developing fraction concepts and representations; developing decimal fraction and percentage concepts
- Fraction operations and representations.

Assessment

Assessment tasks include one exam (50%), and a PEX-based task (50%) focused on the characteristics of the students in a class and a report on the organisation of the maths curriculum, teaching and assessment for the class, followed by a lesson plan with accompanying rationale and justification in terms of these class arrangements, literature and the quality teaching model. There is a detailed specification of the requirements for this lesson which must integrate with the English KLA.

General comments

Texts are the Mathematics syllabus (Board of Studies NSW, 2012), Booker et al (2014) and De Klerk and Marasco *Pearson's Illustrated Maths Dictionary* (2013). Other recommended readings relate to the DET quality teaching framework, the AAMT Standards (2006) and other articles and resources. Detailed specifications of readings are provided for each week.

(e) EDMP913 Numeracy and Mathematics II

This unit builds on the previous unit and adopts the same general description by way of outline, applied to Number and Algebra strand (Patterns and Algebra sub-strand); Measurement and Geometry strand and Statistics and Probability strand.

Unit learning outcomes:

- Demonstrating substantial knowledge of quality mathematics teaching and learning in NSW (NSW DET and AAMT frameworks), theories of how children best learn mathematics and research-based mathematics education literature
- Demonstrating substantial knowledge about the teaching, learning and assessing of the content and learning processes addressed in the K–6 syllabus (Board of Studies NSW, 2012)
- Identifying and utilising teaching resources and technologies for the effective use in teaching K–6 mathematics
- Assessing students mathematical understanding and learning needs
- Prepare learning experiences in mathematics that show a substantial understanding for individual students' learning needs.
- Satisfactorily performing mathematical computations, demonstrating mathematical knowledge and skills, constructing conceptual models/representations and providing explanations appropriate for teaching mathematics in K–6 students in the mathematical topics covered
- Supporting professional teaching decisions using analysis of student learning needs and research into teaching, learning and assessment in K–6 mathematics in a scholarly, critical and engaging manner.

Topics include:

- Revision and Orientation: introduction; overview of assessment tasks; revision of NSW K– 10 syllabus (Board of Studies NSW, 2012); revision of theoretical foundations to K–6 mathematics and quality mathematics teaching; number sense; mathematical representations
- Differentiating, integrating and assessing mathematics
- Number and Algebra: developing algebraic reasoning
- Number and Algebra/Problem-solving: Looking for patterns and using algebraic concepts to solve problems
- Statistics and Probability: the teaching of data and chance. Statistics: collecting, graphing, describing and analysing data; analysing NAPLAN data to inform teaching. Chance: chance concepts
- Measurement and geometry: Introduction and development of measurement concepts; teaching measurement concepts (Length, Area, Volume and Capacity and Mass).
- Measurement and Geometry: different types of geometry; theories of learning about geometry; teaching 3D space concepts; categorising 3D shapes
- Measurement and geometry: teaching 2D shape; plane figures; categorising 2D shapes; tessellations and nets; teaching Angles concepts; teaching position concepts.

Assessment

As well as an examination (50%), assessment tasks include: 1a on satisfactory/unsatisfactory basis a group task carrying out a mathematical investigation; Assessment 2 (50%): 2a in pairs analysing a video clip of a student solving a problem and analyse related work samples re assessing the student's knowledge, 2b plans future work with the same student using an ICT resource, referenced to the syllabus, classroom management and teaching considerations.

General comments

Texts and recommended readings are substantially identical as for the previous unit, with relevant sections of these works assigned to the weekly topics.

WESTERN SYDNEY UNIVERSITY

Western Sydney University (WSU) offers:

- **Bachelor of Education (Primary) – Aboriginal and Torres Strait Islander Education**
- **Master of Teaching (Primary**
- **Master of Teaching (Birth – 5 Years / Birth – 12 Years)**

Preparation to teach K – 6 Mathematics

1 Approach

- WSU provides dedicated units addressing the BOSTES Mathematics K–6 syllabus in each of these three programs. The MTeach (Primary) includes two units, the MTeach (Birth – 12 Years) contains two units one of which is common to the MTeach (Primary), and the B.Ed. contains three units in primary mathematics.
- A Bachelor of Arts (Pathway to Primary Teaching) Program contains two units of mathematical studies for those students who undertake this pathway into the Master programs.
- The professional experience units (one in each program) include a focus on subject lesson planning and development of teaching strategies in the key learning areas.

2 Content

(a) 101580 Primary Mathematics and Numeracy 1

This unit (common to both Master's programs) provides an introduction to the Mathematics K–6 syllabus, focusing on the continuum of learning within each of the syllabus strands (Number and Algebra, Measurement and Geometry, Statistics and Probability) as well as the foundational Working Mathematically.

Unit learning outcomes:

- Describe the concepts, skills and processes of mathematics related to the teaching of number and algebra, measurement and geometry, and statistics and probability in accordance with the current K–6 syllabus document, support documents and NSW Primary Curriculum Foundation Statements.
- Explain the importance of the working mathematically processes for teaching and learning primary mathematics and numeracy.
- Identify appropriate assessment strategies to inform the planning/learning activities that cater for the diverse needs of individual students using programs such as Count Me in Too and Count Me in Too (Indigenous).
- Identify through critical analysis appropriate teaching and learning resources (concrete and digital) that can be used to enhance students' understanding of mathematical concepts.
- Examine contemporary theories of learning and their implications in the primary mathematics classroom.
- Plan teaching and learning sequences that use knowledge of student learning, specific mathematics content. Curriculum requirements and effective teaching strategies.
- Demonstrate knowledge and understanding of strategies for differentiating teaching and learning experiences in mathematics to meet the specific needs of students across the full range of abilities.

Topics include:

- Purpose, rationale and structure of the NSW Mathematics K–6 syllabus
- Theories of learning and their application to primary mathematics
- Working Mathematically as foundation
- Continuum of learning within Number and Algebra
- Continuum of learning within Measurement and Geometry
- Continuum of learning within Statistics and Probability
- Programming and planning in primary mathematics
- Integrating across the mathematics curriculum
- Using concrete and digital resources to enhance students' understanding of mathematical concepts
- Assessment for learning, including timely and appropriate feedback.

Assessment

Assessment in the unit involves two equally weighted tasks, one focused on critically assessing three sets of mathematics resources for their utility in teaching and learning, referencing relevant literature, and the second task focused on designing a sequence of teaching and learning of a mathematical concept to a designated class group, addressing student diversity, explicitly applying learning theory and referenced to relevant literature.

General comments

The unit includes a one page list of references, including text books and readings. There is a focus on syllabus documents, books articles and digital resources. The textbooks are Booker, G (2014), Teaching Primary Mathematics (5th ed.), Australia: Pearson Australia and the NSW BOSTES K–10 Mathematics syllabus documentation.

(b) 101584 Primary Mathematics and Numeracy 2

This unit (only provided in the MTeach Primary program) builds on the previous unit and has a focus on mathematics pedagogy. It assumes familiarity with the full K–6 Mathematics syllabus, emphasises student engagement, assessment, differentiation for diversity and integration of technology, and is directed at the opportunity to experience, plan and assess a broad range of practices for improved student engagement with mathematics and enhanced outcomes.

Unit learning outcomes:

- Demonstrate knowledge and understanding of the development of the concepts, skills and processes of mathematics related to the teaching of space, measurement, data, patterns and algebra and number for 5 to 12 year-olds in accordance with the NSW syllabus for the Australian Curriculum: Mathematics K–10 syllabus (for K–6), and support documents.
- Explain the importance of the working mathematically processes for primary school mathematics learners and teachers.
- Identify appropriate assessment strategies to inform the planning of teaching/learning activities that cater for the diverse needs of individual students with an emphasis on the Count Me In Too program and Count Me In Too (Indigenous).
- Examine the role of mathematics within the broader school curriculum, including the relationship between mathematics, numeracy and literacy.
- Identify through critical analysis appropriate teaching and learning resources (concrete and digital) that can be used to enhance students' understanding of mathematical concepts.
- Plan effective and engaging teaching and learning experiences that include the use of a range of digital resources to enhance student outcomes.
- Apply knowledge and understanding of a range of engaging pedagogies for teaching and learning mathematics, including cooperative learning, problem-solving and investigation-based approaches.

- Evaluate student learning against curriculum requirements by interpreting student work samples, practising consistent and comparable judgements, and explain the importance of timely and appropriate feedback for student learning.
- Demonstrate knowledge of teaching strategies that are responsive to a diversity of student needs including differences in cultural and linguistic backgrounds.
- Demonstrate knowledge and understanding of strategies for differentiating teaching and learning experiences in mathematics to meet the specific needs of students across the full range of abilities

Topics include:

- Engagement and primary mathematics
- Implementing a problem-solving and investigation-based approach to primary mathematics
- Affective issues relating to the teaching and learning of primary mathematics
- Catering to learners from diverse backgrounds (eg cultural and linguistic)
- Differentiation to address a range of abilities (including social needs and gifted and talented)
- Rich tasks to promote critical literacy
- Mathematics for 21st century learners
- Assessment for learning and teaching.

Assessment

Assessment of the unit involves two equally weighted tasks, one a professional task and the other a report. The professional task requires the design of a suite of tasks for a given context promoting the use of open-ended, investigative mathematical questions that promote the Working Mathematically strand of the syllabus, and must be theoretically supported drawing on relevant literature. The report task involves a case study in administering a mathematical problem to a child. The analysis and assessment of work samples will address differentiation and feedback, will draw on literature and apply lessons learned from a tutorial on teacher judgement.

General Comments

The unit adopts the same textbooks as the previous unit. The reading list comprises six items including two focused on indigenous students and mathematics, two publications from the Australian Association of Mathematics Teachers (Standards for excellence and a position paper on assessment in mathematics) and the 2003 'Quality Teaching in NSW Public Schools' material from the NSW Department of Education's website. There is an additional reading list comprising of another 15 journal article readings.

(c) 101802 Investigating with Mathematics, Science and Technology

This unit is specific to the M. Teach (Birth to 12 Years) program and focuses generally on understanding the investigative nature of these disciplines, developing positive dispositions towards them and their applications within early childhood and primary school settings. Teaching practices are developed within the context of both the Early Years Learning Framework and the BOSTES K–6 Mathematics syllabus documents

Unit learning outcomes:

- Evaluate the different theoretical approaches relevant to mathematics, science and technology teaching and learning
- Apply the principles, practices and learning outcomes of The Early Tears Learning Framework for Australia to assessment and planning for integrated learning that includes mathematics, science and technology concepts, processes and language
- Demonstrate understanding of issues of diversity and equity in mathematics, science and technology learning and teaching and strategies to support the learning needs of Aboriginal and Torres Strait Islander students, students from low socio-economic communities and both boys and girls
- Apply knowledge and understanding of the Board of Studies syllabus and Australian Curriculum documents for mathematics and Science and Technology and the Australian Cross-curriculum Priorities and General Capabilities to plan meaningful lessons for primary school students that include relevant mathematics, science and technology concepts, processes and language
- Plan experiences and lessons that demonstrate understanding of mathematics, science and technology as ways of thinking and reasoning, as a means of communication and expression, and as a resource for extending knowledge
- Demonstrate positive attitudes to mathematics, science and technology.

Topics include:

- Mathematics curriculum birth to 12 years
- Science and Technology curriculum birth – 12 years
- Processes of investigation, exploration and problem-solving
- Using the Early Years Learning Framework principles, practices and learning outcomes to document, assess and plan for learning in the areas of mathematics, science and technology
- Issues of diversity and equity in mathematics, science and technology learning and teaching – addressing the needs of Aboriginal and Torres Strait Islander students. Bilingual students, students from low socio-economic communities, and girls and well as boys
- Teaching strategies for mathematics and science
- Planning lessons and sequences of learning for mathematics, science and technology K–6.

Assessment

Assessment of the unit includes a report focused on investigating one aspect of a child's (birth to 5 years) understanding of one aspect of mathematics, science or technology, and the implications for designing learning and teaching strategies for the child. A second professional task focuses on primary school learning, requiring analysis of the content and teaching strategies used in two lesson plans assessing them for curriculum adequacy and meaningfulness to children of that age. One lesson plan is further developed to strengthen and develop it, with an explicit justification provided for the changes.

General comments

The BOSTES K–10 Mathematics syllabus documentation is included in the references, along with science and technology syllabus material and various early years material. The unit crosses mathematics and science and technology and as with the program as a whole focuses on prior to school learning as well as primary school learning.

(d) 101113 Numeracy for Teaching

This unit (and the following two units) is specific to the undergraduate B.Ed. (Primary) – Aboriginal and Torres Strait Islander Education program. The unit builds on the existing mathematical knowledge and understanding of the enrolled students and works to systematically build mathematical capacity across the various mathematical systems, linking them with the content of the Mathematics syllabus.

The Key Content comprises eight modules that cover all of the mathematical functions and processes necessary for a beginning teacher to be able to address the K–6 syllabus requirements.

The Unit Learning Outcomes focus on identification of the strands of the separate K–6 syllabus, identifying patterns and relationships in mathematics in the real world, and solving mathematical problems in all the key areas of mathematics covered within the syllabus.

There are four assessments incorporating a practical real world exercise that requires a number of basic mathematical processes (as used in budgeting etc.), preparation of a Stage 3 K–6 Mathematics syllabus resource around financial literacy, with user notes, an online mathematics test and a final exam assessing basic numeracy.

Resources include various numeracy and mathematical support packages from BOSTES and the NSW Department of Education as well as texts on primary mathematics teaching.

(e) 102119 Early Primary Mathematics

Focused on K–3 of the primary syllabus, this unit is designed to extend the teachers capacity to develop mathematical concepts, skills and understanding of young children. It entails attention to the details mathematical requirements of the syllabus, along with developing and utilising a range of teaching strategies and resources to plan, design and implement learning.

The Key Content of the unit includes some 12 modules that traverse the nature and role of mathematics in describing and modelling patterns and relationships in generalizable, interpretative ways; role of concrete materials; explicit examination of the syllabus requirements in programming and assessment as well as the content and pedagogical demands of the various strands across K–3 Mathematics.

The Unit Learning Outcomes include being able to explain the central concepts, modes of enquiry and structure of mathematics, applying the interrelated processes of Working

Mathematically, describe the content of the K–3 mathematics curriculum, apply assessment concepts, organise learning using a range of strategies and resources to cater for diverse learners in K–6 mathematics, identifying relevant Aboriginal and Torres Strait islander perspectives and design a sequence of two lessons within the K–K–6 mathematics curriculum.

Assessment in the unit involves two related tasks focused on a specific child in K–2 Years of schooling. The first entails designated techniques to assess the child's mathematical capacity and produce an analytical report. The second task requires the design of a sequence of two lessons in an area of syllabus requirement that build on and develops the child's computational strategies and capacities.

Unit references approximate those used in 101580 above.

(f) 102135 Developing Primary Mathematics

This unit focuses on the development of mathematical concepts, skills and understanding for children from Years 3 to 6 based on the Australian curriculum and BOSTES requirements.

Key Content includes 9 modules addressing the mathematical demands of Stages 2 to 4 of the syllabus, the Working Mathematically processes the specific content of the mathematical strands across the stages of the syllabus and student assessment strategies.

The Unit Learning Outcomes apply the outcomes of the previous unit to the Stages 2–4 of the syllabus and focus on content strands, concepts of assessment and children's learning up to Stage 4, designing lesson sequences using curriculum documents, require the use of appropriate resources for diverse learners and understanding of the links of mathematics/numeracy with the whole curriculum, with literacy and with Aboriginal perspectives.

There are three assessment tasks. Firstly there is analysis of a fictional maths lesson described in a scenario, commentary on the elements of the lesson, generation of alternative approaches, design of two lessons that improve the original approach and specification of detailed strategies. The second assessment involves carrying out problem-based tasks with analysis of alternative solutions and reasons for options. The tasks are to be administered to Stage 3 children with annotation of work samples in terms of the underlying thinking in the solutions chosen. Four lessons are then developed to build on this thinking or respond to it, and these are to be applied and tested in a professional experience placement and reported on.

APPENDIX 6: MEMBERSHIP OF EXPERT PANEL

Ms Karen Ahearn
Head of Prep School
Pymble Ladies' College

Dr Catherine Attard
Senior Lecturer, Mathematics Education
Western Sydney University
Vice President
Mathematical Association of NSW

Ms Bernice Beechey
(could not attend panel forum)
Chairperson, Primary Association for Mathematics Committee
Mathematical Association of NSW

Ms Katherin Cartwright
Mathematics Advisor K–6
NSW Department of Education

Dr Michael Cavanagh
Director, Teacher Education Program
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Ms Jennifer Chu
Leader of Learning – Primary Mathematics, Eastern Region
Catholic Education Office Sydney

Mr Peter Lee
Board Inspector, Primary
Board of Studies, Teaching and Educational Standards NSW

Ms Helen Nielsen
Consultant: K–6
Association of Independent Schools NSW

Mr Peter Osland
Board Inspector, Mathematics
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Mrs Maria Quigley
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Associate Professor Anne Prescott
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University of Technology, Sydney
Executive Member, Mathematical Association of NSW

Ms Lianne Singleton
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Adjunct Professor, Faculty of Education
Member, Mathematics Teaching and Learning Research Centre
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APPENDIX 7: REFERENCES

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