1. Title of proposed investigation

Please be concise but specific. Titles should be consistent with those used on any external funding application.

Student and teacher perspectives on pedagogical content knowledge in the senior mathematics classroom.

2. Expected commencement date:  
Expected completion date of project:
### 3. Investigators

**CHIEF INVESTIGATOR**

Note: This is the researcher with ultimate responsibility for the research project.

*The Chief Investigator cannot be a student.*

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<thead>
<tr>
<th>Given Name</th>
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<tr>
<td>Staff Position:</td>
<td>Qualifications:</td>
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<td>Staff ID:</td>
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<td>School &amp; Division:</td>
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<td>Contact Address:</td>
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<td>Telephone:</td>
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</table>

#### A. CO-INVESTIGATOR(S)

**i) Given Name**  
Surname

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**ii) Given Name**  
Surname

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<td>Staff Position:</td>
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<td>Telephone:</td>
<td>Email: (Required)</td>
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</table>
C. STUDENT Investigator(s):

i) Given Name ____________________________ Surname ____________________________

Gender: Female Date of Birth: _______________ Preferred Title: Mr / Ms / Miss / Mrs / Dr

Student Number: ___________________________ Level: Undergraduate / Honours / Masters / Postgraduate Diploma / DBA / PhD

Contact Address:_________________________________________________________________

Telephone:___________________________ Email:___________________________

(Required)

4. Research Merit

Please note that for student projects, School approval is required. Applications for student projects cannot be accepted until School approval has been granted.

All other applications are required to have undergone a peer review process prior to submission.

Peer reviews should be conducted by independent and experienced researchers in a relevant discipline.

(a) School Approval

Is this a student project that requires School approval (e.g. being completed in partial fulfilment of an Honours, Masters or PhD)?

Yes ☒ No ☐

If no, please complete part (b) Peer Review

If yes, the project has been:

a) Submitted ☒ i) Approved ☒ ii) Not yet approved ☐

b) Not yet submitted ☐

Please provide details of the approval process:

Who reviewed the proposal and when was it reviewed?

The proposal was reviewed by Dr Chris Rayner in March 2014.
4. Research Merit

Please note that for student projects, School approval is required. Applications for student projects cannot be accepted until School approval has been granted.

All other applications are required to have undergone a peer review process prior to submission.

Peer reviews should be conducted by independent and experienced researchers in a relevant discipline.

What did the review process involve?
Dr Chris Rayner prepared detailed feedback and made some recommendations.

What were the recommendations (if any), and how were these acted upon?
Dr Rayner recommended that the researcher strengthen the justification for the use of video as a form of data collection, clarify some strategies for providing feedback to participants, and simplify the letters of introduction and consent forms so that they are more concise. The researcher has acted upon these recommendations by amending the proposal accordingly, and preparing a statement describing the ways in which the feedback has been addressed.

As data collection needs to coincide with school teaching patterns, it is logical for this to commence upon ethics approval. Therefore, on the advice of the student researcher’s supervisors, data collection will take place before there is confirmation of candidature.

(b) Peer Review

Has the research proposal, including design and methodology, undergone a peer review process? Yes ☐ No ☐
If YES – please provide details:

Who reviewed the proposal and when was it reviewed?

What did the review process involve?

What were the recommendations (if any), and how were these acted upon?

Please confirm the peer review has stated that the proposal:

- Has a set of clearly identified aims?
- Is well designed and methodologically sound?
- Is based on a thorough review of the current literature and previous studies on related topics? (NS 1.1(c))
- Has been designed or developed using methods appropriate for achieving its stated aims? (NS 1.1(b))
- Is expected to yield valid and useful data, if conducted according to the protocol?
- Will be conducted or supervised by persons with appropriate experience, qualifications and competence? (NS 1.1(e))
- Is justifiable by its potential benefit? (NS 1.1(a))

If NO – please explain why:

(c) Editorial Review

Has the application, including the public documents, undergone an editorial review?  Yes ☑  No ☐

If YES – please provide details:

Documents have been proof-read and checked for consistency by all three investigators and Dr Robyn Reaburn, who is not associated with this project.

If NO – please explain why:
5. Approvals from other Departments / Institutions

Does this project need the approval of any institution other than the University of Tasmania (e.g., Department of Education, particular wards in hospitals, prisons, government institutions, or businesses)?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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*If yes, please indicate below the Institutions involved and the status of the Approval, and attach relevant documentation. Please also indicate if the approval is dependent on HREC approval.*

**Name of Other Institution(s):** Tasmanian Catholic Education Office and the Department of Education  
**Status:** Applications for ethics approval will be submitted to the Tasmanian Catholic Education Office and the Department of Education once this application has been approved by HREC (Tasmania).

Does this project need the approval of any other HREC?  

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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</table>

*If NO, why not? (e.g. all participants are within Tasmania)*

All participants in this study are within Tasmania.

If YES, please indicate below which Human Research Ethics Committee, and the status of the application.

Other HREC(s):

Status:

6. Is the investigation a follow-up of a previous study?  

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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*If yes, what is the ethics reference number of that study?*  

H- - - - -

What was the title of that study?
7. Funding

Under the National Statement (2.2.6) a researcher must disclose:

- the amount and sources or potential sources of funding for the research; and
- financial or other relevant declarations of interest of researchers, sponsors or institutions

Is this research being funded?  
Yes ☐  No ✗

If yes, please detail amount and source of funds
(NS 5.2.7)

If this application relates to Grant(s) and/or Consultancies, please indicate the Title and Grant Number relating to it

If no external funding has been obtained, please indicate how any costs of research will be met: Any unanticipated costs will be met by the researcher’s PhD fund.

Do the investigators have any financial interest in this project?  
Yes ☐  No ✗

If yes, please give details:

8. Keywords and Acronyms  Please provide definitions for any technical terms and acronyms

<table>
<thead>
<tr>
<th>Term</th>
<th>Lay Explanation</th>
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<tbody>
<tr>
<td>PCK (Pedagogical content knowledge)</td>
<td>Pedagogical content knowledge (PCK) is a component of teacher knowledge that is the blend of mathematics content and pedagogy that encompasses all that is needed to teach a particular topic to make it comprehensible to others, including an understanding of what makes the learning of the topic easy or difficult and the common conceptions and misconceptions that students may hold.</td>
</tr>
</tbody>
</table>
9. Rationale and Background for the Project:

Please give a plain English description of the aims of this study.

This study aims to investigate the enactment of teachers’ pedagogical content knowledge for teaching senior mathematics content and to examine this knowledge from the perspectives of both teachers and students. To that end the research questions are:

1. What aspects of mathematical pedagogical content knowledge are evident in the interactions between teachers and their students during the teaching and learning of senior secondary mathematics content?

2. What aspects of mathematical pedagogical content knowledge do teachers discuss and attribute their instructional decisions to when analysing their interactions with students during the teaching and learning of senior secondary mathematics content?

3. What aspects of mathematical pedagogical content knowledge are identified by students as having an impact on their learning of senior secondary mathematics content?

Please give a plain English description of the research justification for this study.
The introduction of the concept of PCK by Shulman and his colleagues during the 1980s highlighted the importance of how subject matter is transformed from the knowledge held by the teacher into the content of instruction (1987). In essence Shulman described PCK as an intricate blend of content and pedagogy that encompasses all that is needed to teach a particular subject or topic in a way that makes it comprehensible to others. This includes an understanding of what makes the learning of a particular topic easy or difficult for students, a repertoire of the most persuasive representations, and knowledge of the common misconceptions that students may hold.

It is widely accepted in the field of mathematics education research that PCK impacts upon teaching and learning (Ball & Bass, 2000; Ball, Lubienski, & Mewborn, 2001; Hill, Ball, & Schilling, 2008) but the concept of PCK is complex and difficult to systematise theoretically (Hodgen, 2007). Several frameworks based on Shulman’s initial conceptualisation have been developed for defining and categorising PCK as a multi-faceted category of mathematics teacher knowledge (e.g., Chick, Baker, Pham, & Cheng, 2006; Hill et al., 2008; Rowland, Huckstep, & Thwaites, 2003). The framework developed by Chick and her colleagues (2006) will be of particular interest in this study because it was designed to analyse PCK and provides a detailed inventory that describes evidence for identifying different aspects of PCK.

Some recent projects have focused on secondary mathematics teachers’ PCK in relation to teacher professional knowledge and developing teachers’ practice (e.g., Goos, 2013; Vale, McAndrew, & Krishnan, 2010) and validating measures of mathematics PCK (Krauss, Baumert, & Blum, 2008). The work of Baumert and colleagues is particularly noteworthy given that their findings suggest that PCK has a statistically significant positive effect on student learning gains (2010). Other studies have examined aspects of teachers’ practice that inform us about their PCK including the choice and use of examples by teachers (e.g., Chick, 2009, 2007).

There has, however, been little research into teacher’s enacted PCK for teaching senior mathematics content such as functions and their inverses, calculus, and the binomial distribution. Furthermore, students’ perceptions of the kinds of PCK they consider to be the most useful in assisting them with their learning of mathematics have been largely unexplored. In this study, qualitative research approaches will be used to collect and examine evidence of PCK in the interactions between teachers and their students in the senior secondary mathematics classroom.

Given the complexity of classroom interactions, data showing PCK in action will be collected from multiple sources in the form of field notes from lesson observation and video recordings that provide data ripe for detailed analysis (Mousely, 1998). In addition, surveys and interviews with teachers and students will provide data to enable further analysis of aspects of PCK from their own points of view. Data will be analysed for any commonalities or differences in teacher and student perceptions of the most useful aspects of PCK in the teaching and learning of senior mathematics content. Research findings will offer teachers and researchers some further insight into the kinds of PCK that teachers bring to this abstract level of mathematics and those aspects of PCK that are most influential to students from their perspectives.

Please list the most relevant and recent literature references, both by the investigator and/or by others, that support the justification for the study.


## 10. Participants

### Number of Participants

How many participants do you intend to recruit?

The participants will include 3 teachers responsible for teaching the pre-tertiary Tasmanian Certificate of Education course ... Mathematics in 2014 and up to 75 students (enrolled in the classes taught by the 3 teachers) as there are typically 25 students enrolled per class.

Provide *research justification* for the number of participants you intend to recruit (this question relates to research justification for your sampling approach).

This investigation will use case study research methods (O’Leary, 2010) such as interviews and classroom observation. Therefore the small number of teacher participants is appropriate. The larger student sample size accounts for the possibility of each teacher having a maximum class size of 25. Each student from each of the 3 classes will be invited to participate in the study.

### Selection of Participants

Clearly describe the experimental and, where relevant, control groups. Include details of sex, age range, and any special characteristics (ethnic origin, demographic details, health status etc). Give a justification for your choice of participant group(s).
10. Participants

As the study aims to investigate the enactment of teachers’ pedagogical content knowledge for teaching senior mathematics content, teacher participants will be selected from at least two different senior secondary schools. The schools will be selected from senior secondary schools and colleges in Northern Tasmania using purposive sampling (O’Leary, 2010). The teacher participants will be teachers who will be teaching... during 2014 at the selected schools or colleges. If possible the teacher participants will include at least one male and one female. The student participants will be year 11 or 12 students who are in the ... classes taught by the three teachers.

All students enrolled in the ... classes taught by the participating teachers will be invited to participate in one or more aspects of the research (e.g., being part of the class being observed and video-recorded by the researcher, having some of their written work photographed, by completing post lesson short answer questionnaires, and/or participating in post lesson focus group interviews). Up to six students from each class will be invited to participate in the post lesson focus group interviews and will be selected using the following procedure. The researcher will ask the teacher to provide a list of the names of students of varying mathematical abilities (relative to the demands of the ... syllabus), who he/she thinks would be amenable to talking about how they learn. This list will be cross referenced, by the researcher, with the pool of students who consent to participate in the interviews. Subsequently, the researcher will select and invite two students, ideally with different mathematical abilities, to participate in each of the 8 focus group interviews. The other 4 participants will be selected on the day of each focus group interview, based on the researchers’ observations during the day’s lesson. For example, if the researcher observes a particularly interesting learning interaction between a consenting student and the teacher, then she may invite that student to participate in the day’s focus group. Any consenting student may also volunteer to participate in a focus group. The purpose of this selection process is to form focus groups that consist of a combination of regular participants, and those who may be participating on a single occasion.

Will the project involve any of the following participants? Please indicate how each of the following ‘types of research participants’ will be involved in the project.

<table>
<thead>
<tr>
<th>(a) Pregnant Women?</th>
<th>Primary intent of (or affected by) research</th>
<th>Possible coincidental recruitment</th>
<th>Design specifically excludes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(NS 4.1)</td>
<td>☐</td>
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<tr>
<td>(b) Minors, i.e. children under 18 years of age?</td>
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<tr>
<td>(NS 4.2)</td>
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<tr>
<td>(c) People highly dependent on medical care who may be unable to give consent?</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
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<tr>
<td>(NS 4.4)</td>
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<tr>
<td>(d) People with a cognitive impairment, an intellectual disability, or mental illness?</td>
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<td>(NS 4.5)</td>
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</table>
10. Participants

<table>
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<tr>
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<th>People who may be involved in illegal activities?</th>
<th>People in other countries?</th>
<th>Aboriginal and Torres Strait Islander peoples?</th>
<th>People who are identifiable by their membership of a cultural, ethnic or minority group?</th>
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<tbody>
<tr>
<td>(e)</td>
<td>(NS 4.6)</td>
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<tr>
<td>(f)</td>
<td>(NS 4.8)</td>
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<td>(g)</td>
<td>(NS 4.7)</td>
<td>☐</td>
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For each group identified as a “Primary intent of (or affected by) research”, show how your research complies with the relevant chapter of the *National Statement*.

If you answered “Primary intent of (or affected by) research” to (g) you must also attach a statement indicating how Aboriginal and Torres Strait Islander sensitivities will be recognised (see the following publication for guidance: http://www.nhmrc.gov.au/publications/synopses/e52syn.htm)

For each group identified as “Design specifically excludes”, please explain how and why these participants will be excluded.

**Minors:**
As school age students will be involved in this study, the research will be conducted in accordance with section 4.2 of the national statement. The students involved in this study are expected to be aged 17-18 years, therefore respect will be shown through seeking their informed consent, along with that of their parents. Students who volunteer to participate in any aspect of the study will have the procedure fully explained to them and will be free to withdraw at any time and to withdraw any unprocessed individually identifiable or re-identifiable data (e.g., video recording of lessons, questionnaires and audio-recorded focus group interviews, and photographs of written work). Students will be informed that their decision to participate in the study or not to participate, will in no way impact upon their assessment by the teacher. Parents and students will be asked for specific permission to have the students’ learning interactions observed and video recorded, their work photographed, to complete short-answer questionnaires, and/or to participate in audio-recorded post lesson focus group interviews. Parents and students will be able to select the student’s level of involvement in the research.

**Recruitment of Participants**

How will participants be recruited? From where will your participants be recruited?
Give specific details about how participants will be recruited. Some questions to consider include:

- Are you recruiting through advertisements? If so, indicate where they will be placed and
The researcher will contact principals of Catholic and Department of Education schools and colleges in Northern Tasmania to seek permission to invite their teachers of ... to participate in the study. Permission will be sought via email (refer to Appendix A).

With the permission of the principals, information letters and consent forms for teachers, students and their parents will be distributed via an email to the principals; the teachers and students will receive a hard copy. First, each principal will be asked to select his/her most experienced teacher(s) of ... This selection criterion is based on the assumption that experienced teachers will have had time to develop and explain the kinds of PCK that students are likely to notice in this study. The researcher will distribute information sheets and consent forms (appendices B and C respectively) to the teachers based on their principal’s recommendation. In the event that more than two teachers from the same institution volunteer to participate in the study then the researcher will select those teachers based on their accessibility and availability.

Following the teachers’ acceptance to participate in the study the students in their classes will be invited to participate. The researcher will distribute the student and parent information letters (appendices D and F respectively) and consent forms (appendices E and G respectively) to each student towards the end of one of their ... lessons taught by the participating teachers. The researcher will also explain the contents of the information sheets and consent forms to students who attend this lesson.

Teachers’ signed consent forms will be returned directly to the researcher in person Students and parent/guardian signed consent forms will be returned to the researcher via their child’s teacher.

11. Data Source and Identifiability

Does the project involve information sourced from databanks? 

(NS 3.2) Yes ☐ No ☒
11. Data Source and Identifiability

If yes, state which one(s) and indicate what permission for access is required. Include a description of any conditions of access and attach any relevant approvals.

Is the data collected about individual participants:

a) Non-identifiable?
Non-identifiable data is data which have never been labelled with individual identifiers or from which identifiers have been permanently removed, and by means of which no specific individual can be identified. A subset of non-identifiable data are those that can be linked with other data so it can be known that they are about the same data subject, but the person’s identity remains unknown.

b) Re-identifiable?
Re-identifiable data is data from which identifiers have been removed and replaced by a code, but it remains possible to re-identify a specific individual by, for example, using the code or linking different data sets.

c) Individually Identifiable?
Individually identifiable data is data where the identity of an individual can reasonably be ascertained. Examples of identifiers include the individuals name, image, date of birth or address, or in some cases their position in an organisation.

Please note that this question refers to the format in which data is collected and stored, rather than the format in which data is published.

Please give details of the information that will be collected:

The re-identifiable data will include: the field notes taken during the lesson observations, the audio transcripts of the interviews with participating teachers and focus group interviews with students, and any photographs of participants’ written responses or explanations to mathematical tasks. The individually identifiable data will include the students’ responses to the questionnaire and the video recordings of the lessons. Details of how this data will be collected and stored are provided in the following sections.

Re-identifiable data
Care will be taken not to include any identifying information about the participating
### 11. Data Source and Identifiability

Teachers in notes made by the researcher during observations of lessons or during the interviews with teachers. The real first names of the student participants may be used in field notes, but is it likely that the researcher will not know the names and will only be describing attributes of the students. Files containing transcripts of the students’ focus group interview responses will be labelled using pseudonyms as will photographs of participants’ written responses or explanations. In subsequent reporting of the study all participants will be assigned pseudonyms. A file linking participants’ names to pseudonyms will be stored on a password-protected computer and separate from the transcripts of the interview and only the researchers will have access to this material.

**Individually identifiable data**

The student questionnaire data will need to be individually identifiable because the researcher may refer to a student’s own response to the post lesson questionnaire during their focus group interview.

Only the researchers will view the video recordings, except for in rare cases where the teacher may view some of the footage during an interview, in order to recall a particular incident. This, however, is unlikely, especially given the relatively short duration of each of the interviews. The video footage will be stored with a pseudonym identifier on a password-protected computer. It is inevitable that the video footage will contain the teacher’s name, as students will refer to the teacher during classroom interactions. Pseudonyms will be used for all participants in any reporting and intermediate analysis.

Only the researchers will hear audio recordings, and pseudonyms will be used in any transcripts or summaries. Audio files will be stored in password protected digital audio files on a secure server at the University of Tasmania, Launceston Campus.

### 12. Federal Privacy Legislation

The following questions are part of the requirements concerning federal privacy legislation.

(a) Is this project medical research (including epidemiological research?)  

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
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</table>
| If yes, will you require the use or disclosure of information from a Commonwealth agency? | Yes | No | Go to (b)  
| If yes, will the information to be disclosed be personal information, i.e. identifiable information? | Yes | No |  
| If yes, will you be obtaining consent from the individuals to whom the information relates? | Yes | No |  

A PARTNERSHIP PROGRAM BETWEEN THE DEPARTMENT OF HEALTH AND HUMAN SERVICES AND THE UNIVERSITY OF TASMANIA

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Form updated 19.11.2013
(b) Is this Research relevant to public health or safety, or to the management, funding or monitoring of a health service? 

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<thead>
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<th>Yes</th>
<th>No</th>
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Go to (Question 13)

If yes, does the research involve the collection, use or disclosure of information from a private sector organisation?

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If yes, will you be collecting, using or disclosing health information?

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<th>Yes</th>
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If yes, will consent be obtained from the individuals to whom the health information relates?

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<th>Yes</th>
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13. Procedures

Describe the procedures to which participants will be subjected or the tasks they will be asked to carry out (please detail exactly what you will be doing).

Case study research methods (O’Leary, 2010) will be used to examine the PCK evident in the interactions between teachers and students in the teaching and learning of senior mathematics content. Three case studies involving participants from at least two different schools/colleges will be conducted. Each case study will involve one teacher and up to 25 student participants. The teacher participants will be teachers from senior secondary schools or colleges in Northern Tasmania who will be teaching ... during 2014. The student participants will be year 11 or 12 students who are enrolled in the ... classes taught by the three teachers. The participants in each case study will be invited to contribute data in one or more of the following ways.

- by being part of the class that will be observed and video recorded by the researcher (all possible consenting students and teacher).
- by having some of their written work photographed (all possible consenting students and teacher).
- by participating in audio recorded follow-up interviews or focus groups for up to 20 minutes after each lesson (teachers and a subset of consenting students).
- by completing a post lesson short-answer questionnaire (all possible consenting students).

Data will be collected throughout 2014. As … is an externally assessed pre-tertiary course there will be no data collected during the three week period leading up to the midyear examination or during term 4 when participants and non-participants will be engaging in intensive revision and preparation for the final examination. The following sections provide details of the research procedures for each case study.

Procedures for each case study

Lesson observations, video-recording of lessons, and photographs

The researcher will observe up to 8 lessons (each lesson being up to 110 minutes in duration) per case
study. Lesson observations will be unobtrusive and will be conducted by the researcher while the participants and non-participants are engaging in usual activities of teaching and learning. The researchers appreciate the daily demands faced by teachers in a busy school environment. Therefore, in accordance with section 1.4 c of the National Statement, the researcher will avoid planning classroom visits on days that are particularly busy for the teacher (e.g., yard duty, teaching all periods, meetings, co-curricular responsibilities). Furthermore, the research is quite specifically related to experienced teachers teaching ... – it is highly unlikely that they will be subject to other research requiring demands on their time.

It is anticipated that these 8 lessons will include at least two different mutually agreed topic areas such as the binomial distribution, transformations of trigonometric functions, or an aspect of calculus. Informed consent will be sought from all student participants. The information sheet and consent forms for students and parents will include all options for participation (appendices D, E, F and G) in the study. Students who do not consent to be involved in any aspect of the study can still attend the lessons as usual but will not be video-recorded or interviewed and the researcher will not record or photograph any aspects of their involvement in the lesson observations.

Data collected during the lesson observations will be in the form of field notes that document evidence of PCK in the interactions between the teacher and participating students and in the teacher’s direct instruction to the whole class. Each lesson observed by the researcher will also be video recorded for the purpose of obtaining visible and revisable documentation (Rosenstein, 2002) of evidence of PCK in action. Video recording the lessons will enable the researcher to obtain an overarching and detailed record of the sequence of lessons examined in each case study. Furthermore, the researcher will be able to compare and cross reference her own observation notes with the events in the video footage. The video camera will be placed in a fixed position at the back of the classroom, with the lens set on a wide-angle in view of all participating students and the teacher. Students who have not consented (or their parent/guardian has not given consent) will be seated in an area of the classroom that is out of video shot range. It is important, however, that any change in seating arrangements, takes place inconspicuously and should have minimal impact on the classroom dynamics. If any non-consenting students inadvertently appear in any of the video footage they will be pixelated in the recordings.

In order to enhance the detail provided in the video footage, the researcher may use a still camera to photograph the participants’ written work (e.g., the teacher’s worked examples or diagrams on the whiteboard, and students’ responses to tasks in their exercise books). All photographs taken will depict samples of written work, the participants themselves will not be photographed. The researcher will ask for permission from each participant before photographing his or her work, and the photography will be conducted respectfully and unobtrusively.

Although the video footage will be used as data by the researcher, on rare occasions (although this is not likely), they may also be used in the interviews with the teachers should visual stimulus be required to remind them of particular incidents/actions.

**Student questionnaires**

Student participants will be invited to complete a short-answer questionnaire (appendix H) during the last part of each of the lessons observed by the researcher. The questionnaire should take at most 10 minutes to complete and consists of two questions designed to elicit responses from students about the
types of explanations, examples and strategies that assisted them with their learning of particular mathematics content. Inviting the students to complete the questionnaire in the remaining 10 minutes of their lesson should not interfere with their usual learning activities. It may also give students to opportunity to reflect productively on their learning during the day’s lesson.

**Audio recorded focus group interviews with student participants**

Up to 6 consenting students will be invited to take part in a follow-up focus group interview with the researcher at the end of each lesson, at a time that is feasible for the students. The focus group interviews will take place in the same classroom as the lesson, if the room is not otherwise occupied. The researcher will organise for an alternative space if required. Ideally the students will be interviewed as a group, but separate interviews may also take place depending upon the accessibility and availability of individual students following each lesson. Each focus group interview will take up to 20 minutes and will be audio-recorded and transcribed. During the focus groups, each student will be invited to contribute responses in one or both of the following ways.

- By expanding upon and or clarifying aspects of his or her responses to the student survey for the day’s lesson (refer to appendix I for proposed student focus group schedule).
- By responding to questions that arise from the researcher’s observations of particular teaching and learning interactions during the lesson itself (appendix I).

**Audio recorded interviews with participating teacher**

After each lesson has been observed by the researcher, and following the focus group with the students, the teacher will be interviewed. Each teacher will be invited to participate in up to eight 20 minute interviews over a period of one to two consecutive school terms. The interviews will be audio-recorded and transcribed. As discussed on page 20, in accordance with section 1.4 c of the National Statement, the organisation and timing of the lesson observations and follow up interviews will be determined by the teacher’s daily schedule. Furthermore, the interviews will provide an opportunity for the teachers to discuss and reflect on their practice in ways that are routinely part of their planning for teaching and learning. During the interviews the researcher will invite the teacher to respond to questions that arise from the following sources:

- Observations of particular teaching and learning interactions that occurred during the day’s lesson.
- General questions about the teachers’ own identification and perception of significant teaching and learning interactions. On rare occasions this may include the use of video footage, should video-stimulus be required to remind the teacher of specific incidents/actions during the lesson. While the interview questions will arise from observations of the day’s lesson, an interview schedule of possible questions is provided in appendix J.
| 14. Data |
|----------------------|--------|--------|
| Will photographs be taken? | Yes ☑️ | No ☐ | |
| Will video-recordings be made? | Yes ☑️ | No ☐ | |
| Will interviews or focus groups be audio-recorded? | Yes ☑️ | No ☐ | |
If you answered “Yes” to any of the above, please describe the information to be collected, and provide a research justification.

Photographs of the teacher’s and participating students’ work may be taken to accompany and supplement video footage of particular learning and teaching events in the lesson, for the purpose of qualitative data analysis.

As this study aims to investigate the enactment of PCK in the senior secondary mathematics classroom, close examination of teaching and learning as it unfolds, will be necessary. The use of video is needed because the researcher is unlikely to witness, or recognise, as many interesting teaching and learning incidents in detail by using direct observation alone. Furthermore, due to the complexity of the content being taught, video footage will enable the researcher to revise the visual documentation, to compare and cross reference her own observation notes, and obtain an overarching, detailed record of the observed lesson sequences. The video footage, and subsequent transcription, in addition to the field notes, will enable rich and complex data (Mousley, 1998) to be revisited and the events described in detail. PCK is extremely complex involving many aspects of teachers’ practice, such as choice of examples, questioning and use of representations. Other studies involving investigations of teachers’ PCK in classroom environments have often made use of video footage because of the nature of the work being investigated (e.g., Muir, 2010).

To a minor extent, the video footage may also be used, but only in rare cases, as visual stimulus for the teacher participants in their interviews. Student participants will not see the video footage.

The researchers appreciate the high stakes involved in studying a pre-tertiary subject, and this was taken into consideration when the decision was made to include video recording as a method of data collection in this study. In order to be as unobtrusive as possible, the video camera will be placed in a fixed position at the back of the classroom, with the lens set on a wide-angle in view of all participating students and the teacher. Students who have not consented (or their parent/guardian has not given consent) will be seated in an area of the classroom that is out of video shot range. It is important, however, that any change in seating arrangements, takes place inconspicuously and should have minimal impact on the classroom dynamics. The researcher will inform parents and students in their information sheet and consent form, that a student’s participation or non-participation in the study will have no influence on any aspect of their enrolment in ... including the instruction they receive from their teacher and their assessments. It is the professional responsibility of the teacher to assist all students in the class and to provide individual attention upon request (e.g., when a student puts his/her hand up to ask for assistance with a mathematical task). Therefore, while non-consenting students will be seated outside of the range of the video camera, this will not impact on their access to the teacher or their interaction with the teacher.

Audio recording of all interviews (with students and teachers) will be used to allow accurate recording of information and transcription.
What options will participants be offered to check the information collected?

Students who participate in the focus groups will be given the option of reading the transcripts of their focus groups. For example, in the second focus group, the participating students will be able to read the transcript of their first focus and so on.

The teachers will be offered the option to read the transcripts of their own interviews. Video footage will not be transcribed in its entirety but will allow the identification and later description of classroom interactions. The teachers will also be given the option to check the video-recorded data.

15. Disclosure and Consent

| Does the project collect information from which individual participants can be identified? (NS 2.2) | Yes ☒ No ☐
| If yes, could the research be conducted using non-identifiable information? | Yes ☐ No ☒

| Does this project use any form of implicit or passive consent? (NS 2.2.5, 2.3) | Yes ☐ No ☒
| If yes, please describe how your research complies with the relevant section of the National Statement |

| Will there be any deception of participations including concealment and covert observation? (NS 2.3.1, 2.3.2) | Yes ☐ No ☒
| If yes, please describe how your research complies with the relevant section of the National Statement |

Describe how participants will consent to participate in this study and how they will be informed of their rights (NS 2.2.1-2.2.7). Attach copies of your Information Sheet and Consent Form (where relevant) and give an explanation of the process by which you will obtain consent. (Pro formas for Information Sheets and Consent Forms are available on our website at: http://www.research.utas.edu.au/human_ethics/social_science_forms.htm)

The distribution of information sheets and consent forms for teachers, students and their parents is
described in the Recruitment of Participants section on pages 16 and 17. The researcher will explain the content of the information sheets and the consent forms to the participants, and emphasise that any information provided by participants in the study will be confidential, and that their involvement in the study is completely voluntary and they are free to withdraw at any time.

Other Issues of confidentiality during data collection

Given that the researcher and participants will be within close proximity of each other in the classroom setting, it will be difficult for the teacher not to know or deduce which students and their parents consented to participate in one or more aspects of the study. Therefore it would be inappropriate to assure student participants that their teacher will not know they have given their consent. It is unlikely that students and teachers will be uncomfortable with this given that the teachers will be experienced, well regarded and probably would not be insecure about what might be discussed in the focus groups with students. Furthermore, the focus group questions (see Appendix I), are objective in nature and focus on the specific actions carried out by the teacher to assist students in their learning, the personal characteristics of the teacher are not relevant to this study. The students will be reassured that their participation or non-participation in the study will in no way impact upon the internal assessment ratings allocated to them by the teacher. and that their responses will not be discussed with their teacher. They will also be reminded to respect the protocols around focus group interviews and ‘that what is said in the group, remains in the group’. The researcher will inform parents and students in their information sheet and consent form, that a student’s participation or non-participation in the study will have no influence on any aspect of their enrolment in ... including the instruction they receive from their teacher and their assessments. It is the professional responsibility of the teacher to assist all the students in the class, and to provide individual attention upon request (e.g., when a student puts his/her hand up to ask for assistance with a mathematical task). Therefore, while non-consenting students will be seated outside of the range of the video camera, this will not impact on their access to the teacher or their interaction with the teacher.

Teachers’ signed consent forms will be returned to the researcher directly. Students and parent/guardian signed consent forms will be returned to the researcher in individual sealed envelopes via their child’s teacher. Although it is likely that the teachers may know who is participating in the study they will not necessarily know at which level the students have agreed to participate (e.g., some may consent only to completing the questionnaires).

16. Reimbursement

Is any reimbursement, payment, or other reward (outside of course credit) being offered to participants in the study? (NS 2.2.10) Yes ☐ No ☒
If yes, please state what will be offered, what amount will be offered and for what purpose (e.g. a voucher as a prize, reimbursement to cover expenses etc).

17. Intrusiveness

Are there any aspects of the study that are intrusive in areas ordinarily considered personal and private, or that could create apprehension and anxiety for participants? 
Yes ☐  No ☒

Video recording of the lessons is unlikely to be intrusive to participants because the video recorder will be set up in one spot to capture the teaching and learning taking place in the classroom overall. Furthermore, the video footage will be seen primarily by the researchers and in only in rare cases, although it will be unlikely, by the teacher.

As the research is in no way concerned with student attainment, it is less likely to create apprehension and anxiety for students who find the course particularly challenging. Students tend to appreciate that ... is a demanding mathematics syllabus that requires tenacity and commitment. The researcher will reassure all students that their contribution to the research is valuable and that a key purpose of the research is to find out more about the kinds of teaching strategies and approaches that assist students to grasp complex mathematics content.

Are you collecting personal details or private information? 
Yes ☐  No ☒

Is there any kind of dependency relationship between the researcher and any of the participants? 
Yes ☐  No ☒

If you answered “Yes” to any of the above, please explain in more detail.

18. Potential benefits, risks and harms (NS 2.1)

(a) What are the possible benefits (if any) of this research to:
18. Potential benefits, risks and harms (NS 2.1)

(i) The participant?

The study will give participating teachers an opportunity to reflect upon, examine and discuss their own practice.
The study will give the student participants the opportunity to reflect on their learning of senior mathematics and to identify aspects of teaching practice that particularly assist them with their learning.

(ii) The wider community?

The mathematics education research community and the teaching community may benefit from the findings of this study in terms of identifying the kinds of teaching practices that are most influential in assisting students in their learning of senior secondary mathematics content.

(b) What are the possible risks or harms of this research to the participants? (NS 2.1)

Could your research evoke anxiety or lead to the recall of painful memories?  Yes ☒ No ☐

Will participants be asked to provide any information or commit any act, which might diminish self-respect or cause them to experience shame, embarrassment or regret?  Yes ☐ No ☒

Will any procedure be used which may have an unpleasant or harmful side effect?  Yes ☐ No ☒

Does the research use any stimuli, tasks, or procedures, which may be experienced by subjects as stressful, noxious, or unpleasant? (NS 2.1)  Yes ☐ No ☒

Will you induce or create physical pain beyond mild discomfort?  Yes ☐ No ☒

Does your research explore potentially confidential business practices or seek to elicit potentially confidential commercial information from participants?  Yes ☐ No ☒

Are there any other possible risks or harms of this research to the participants?  Yes ☐ No ☒

If yes, please list other possible risks or harms.
18. Potential benefits, risks and harms (NS 2.1)

If you answered yes to any of the above, please describe how your research will comply with the National Statement (2.1). In addition, please describe the process(es) you will use to manage possible risks (e.g. if interviews may cause distress, provide details of support processes that will be put into place). If participants are to be referred to support services, contact details for these services must be included on the participant information sheet.

While this is not anticipated, there is a chance that teacher and student participants in classroom observations, interviews or focus groups, may experience anxiety as a result of knowing that their actions and or responses are being closely observed. Participants in these aspects of the research will be advised by their information sheets (appendices B and D), and reminded before these activities commence that they are free to decline to answer any or all interview questions or ask that the interviews and observations cease. Students will be advised that they can speak to the school counsellor if they experience any discomfort as a result of any aspect of the research. Participants will have the opportunity to view and amend transcripts of interviews or focus groups and will be advised of their right to withdraw unprocessed re-identifiable and individually identifiable data at any point during the project.

If you plan to refer distressed research participants to external support services such as Lifeline, BeyondBlue, Kids Helpline, etc. you will be placing an additional burden on predominantly volunteer / not-for-profit / charitable organisations, typically funded by public donations. We ask you to undertake a risk assessment for this project – factoring in the number of participants and the likelihood of distress so as to calculate the actual costs you are imposing on your chosen support organisations – and to consider making a contribution to cover the counselling expenses your project will create.

19. Monitoring

What mechanisms do you intend to implement to monitor the conduct and progress of the research project?

Please ensure that you include annual reporting to the HREC, and the reporting of any adverse incidents or unexpected outcomes, as required by Section 5.5 of the National Statement.

As the researcher is a PhD candidate, a minimum of one meeting per month will be held with the candidate’s supervisors. HREC annual reports will be prepared for the duration of the project. Any adverse events will be reported immediately to the HREC.

20. Feedback
What feedback will be given to participants? (NS 1.5)

After the completion of data collection at the end of 2014, the researcher will provide a summary report of the data for participating teachers and students.

How will feedback be given?

Participating schools and teachers will be provided with the thesis in electronic form, which will also be available to students and their parents upon request. Students and parents will be advised of the reports availability via the school Principal.

21. Data Storage

Please state how and where your data will be stored, for how long it will be retained, and how it will be destroyed or archived. Address any issues of data security.

Please note: Data must be stored in accordance with the Australian Code for the Responsible Conduct of Research, which recommends a minimum retention time of 5 years after publication.

UTAS researchers should refer to the UTAS Research Data Management policy and procedures.

Hard copies of interview and focus group transcripts, video and audio recordings, and photographs will be stored on the Launceston campus of the University of Tasmania in a locked cabinet in ..., the office of one of the researchers, accessible only by the researchers. Names and other identifying information will be removed from these data and replaced with codes. Computer files will be password protected and stored on a secure server in the Faculty of Education, Launceston campus. Files connecting participants’ names and codes will be stored separately from the data. No sooner than 5 years from the publication of the thesis, all transcripts and field notes will be shredded and computer files deleted.

The Australian Code for the Responsible Conduct of Research and the UTAS Management of Research Data Policy ask researchers to consider the potential value of their data for further research, making this available for use by other researchers where there is no ethical, privacy or confidentiality objection and disseminating a full account of their research as widely as possible.
Is there any ethical reason NOT to share the data from this project?

The original data will not be able to be shared because providers will only have consented to allow the researchers to see the video recordings and hear the audio recordings. The de-identified transcripts of these recordings may be shared.

### 22. Other Ethical Issues

The participating schools in this study will be anonymous in all publication of results. Pseudonyms will be used for each school in all publications of results of the study.

Are there any issues of researcher safety? Yes ☐ No ☒

If you answered “Yes”, please explain how these will be managed.

Are there in your opinion any other ethical issues involved in the research? Yes ☐ No ☒

If you answered “Yes”, please explain in more detail.

### 23. Declarations

#### a) Statement of Scientific Merit:

The Head of School or the Head of Department is required to sign the following statement of scientific merit:

“This proposal has been considered and is sound with regard to its merit and methodology.”

The Head of School’s or Head of Department’s signature on the application form indicates that he/she has read the application and confirms that it is sound with regard to:

(i) educational and/or scientific merit; and
(ii) research design and methodology.

This does not preclude the SSHREC from questioning the research merit or methodology of any proposed project.

If the Head of School is one of the investigators, this statement must be signed by an appropriate person. This may be the Head of School/Department in a related area or the Dean. The certification of scientific merit may not be given by an investigator on the project.

Name

Position

Signature

Date

b) Conformity with the National Statement

The Chief Investigator is required to sign the following statement:

I have read and understood the National Statement on Ethical Conduct in Human Research 2007. I accept that I, as chief investigator, am responsible for ensuring that the investigation proposed in this form is conducted fully within the conditions laid down in the National Statement and any other conditions specified by the HREC (Tasmania) Network.

Name

Position

Signature

Date

c) Signatures of other investigators
I acknowledge my involvement in the project and I accept the role of the above researcher as chief investigator of this study.

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CHECKLIST

Please ensure that the following documents are included with your application:

- Information sheet/s (if not attached ensure you have explained why in Section 10)
- Consent form/s (if not attached ensure you have explained why in Section 15)
- Questionnaires (if applicable)
- Interview schedules (if applicable)
- A copy of any permissions obtained i.e. Other HREC, Other Institutions (if applicable)
- All documents relevant to the study, including all information provided to subjects.
- Telephone Preambles (if applicable)
- Recruitment Advertisements (if applicable)
- Email Contents (if applicable)

FINANCE AND ADMINISTRATION

Fee Schedule as of 1 July 2013

<table>
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<th>Item</th>
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<tr>
<td>Researchers affiliated with the University of Tasmania or the</td>
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<tr>
<td>Department of Health and Human Services for the purposes of the</td>
<td>the Researcher</td>
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<td>research</td>
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<tr>
<td>Full Applications by External Researchers</td>
<td>$600</td>
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</tbody>
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Invoice Details

Name:  
Organisation/University:  
ABN Number:  
Address:  
Phone:  

TO SUBMIT THIS APPLICATION:

1. You must email an electronic copy of this application form (can be unsigned)
and all supporting documents to:

Katherine.Shaw@utas.edu.au

(Please submit as Microsoft Word documents) .pdf versions are acceptable for appropriate documents, eg., posters or advertisements, some questionnaires etc.

2. A signed copy of this form also needs to be forwarded electronically.

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<th>Has the 'Statement of Scientific Merit' been signed</th>
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<td>Have all investigators signed the form?</td>
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Appendix A

Email Preamble for school principals.

Dear,

My name is ..., I am a PhD candidate at the University of Tasmania, under the supervision of ... and .... I am writing to request your permission to invite some of your experienced teachers of ..., and their students, to participate in my research project.

My study aims to investigate the kind of knowledge that effective mathematics teachers have, in order to convey complex mathematics ideas to their students. Such knowledge encompasses more than the knowledge of the mathematics content itself, and I am particularly interested in those aspects of this knowledge that students identify as being particularly beneficial for their own learning. I fully appreciated that Mathematics Methods 3 is a demanding pre-tertiary syllabus, and you can be assured that your teachers’ and students’ participation in this study would not interfere with the usual activities of teaching and learning. Data collection would occur at mutually agreed times and not around revision and examination periods.

Data collection, including lesson observation and interviews, would involve up to 8 lessons in total per Mathematics Methods class, over two different times of the year. I have attached the letters of introduction and consent forms for both teachers and students which explain, in detail, the procedures involved in participating in this study. Thank you for taking the time to consider allowing your school to assist with this study and please do not hesitate to contact me if you require any further clarification. Would you please advise me of your decision to participate by return email?

Kind regards,

...
Student and teacher perspectives on pedagogical content knowledge in the senior mathematics classroom

Appendix B

Teacher Information Letter

Dear Teacher,

Invitation

You are invited to participate in a study to explore the teaching and learning of senior secondary mathematics content in ... This study is being conducted in partial fulfilment of a PhD for ..., under the supervision of ... and ...

What is the purpose of this study

The purpose of this study is to investigate the ways in which teachers transform the content of senior secondary mathematics to make it comprehensible to their students, and to explore this from the perspectives of both teachers and students. We are particularly interested in those actions carried out by teachers that students identify as being particularly helpful for their learning of the content in this course, such as explanations, specific examples, and diagrams. The personal qualities and attributes of individual teachers will not be the focus of this research.

Why have I been invited to participate?

You have been selected to participate in this study because you are currently teaching a senior secondary mathematics course, ..., and have the experience to be able to talk about the instructional decisions that you make in the classroom.

What will I be asked to do?

If you consent to participate in this study, you will be invited to contribute data in the following ways:

- by having your teaching observed and video-recorded and your written work (e.g., worked examples, diagrams or explanations on whiteboard or on paper) photographed.
- by participating in audio-recorded follow-up interviews for up to 20 minutes after each lesson.

You will also be asked to distribute consent forms to students and parents. Details of the above activities are given in the next sections.

Lesson observations

The researcher will observe up to 8 double lessons of your ... class. It is anticipated that these 8 lessons will include at least two different mutually agreed topic areas, preferably contrasting areas such as probability and function study. The lesson observations will be as unobtrusive as possible and will be conducted by the researcher while...
you and your class are engaging in usual activities of teaching and learning. Data collected during the lesson observations will be in the form of field notes that document the teaching and learning interactions that take place between yourself and participating students, as well as aspects of your direct instruction to the whole class. During the last 10 minutes of each lesson, with your permission, some consenting students will be invited to complete a short answer questionnaire relating to their learning in the day’s lesson.

*Video recording of lessons and written work photographed*

With your consent and that of at least some of your students, and their parents, the lessons observed by the researcher will be video-recorded. The primary purpose of video-recording each lesson is to obtain documentation of teaching and learning interactions for later description. The researcher may also take photographs of participants’ written work such as your examples on the whiteboard, and students’ responses to mathematical tasks in their exercise books to supplement the video footage.

The video camera will be placed in a fixed position at the back of the classroom, with the lens set on a wide-angle in view of all participating students and yourself. Students who have not consented will be seated in an area of the classroom that is out of video shot range. If any of these students inadvertently appear in any of the recordings they will be pixelated in the recordings. Only the researchers and possibly, on rare occasions yourself, will see the video footage.

*Audio recorded interviews*

After each of the eight lessons observed by the researcher, you will be invited to participate in an interview with the researcher at a mutually convenient time. Each interview will take no longer than 20 minutes and will be audio-recorded and transcribed. During the interviews the researcher will invite you to respond to questions that arise from the following sources:

- Observations of particular teaching and learning interactions that occurred during the day’s lesson. On rare occasions, this may include viewing video footage, as a visual reminder of particular learning and teaching events.
- General questions about your own identification and perception of significant teaching and learning interactions.

You will be offered the option to read and amend the transcripts of your own interviews.

*Are there any possible benefits from participation in this study?*
The study will give you an opportunity to reflect upon, examine and discuss your own practice. The mathematics education research community and the teaching community may benefit from the findings of this study in terms of identifying the kinds of teaching practices that are most influential in assisting students in their learning of senior secondary mathematics content. The findings from this study will offer teachers, researchers and students some further insight into how mathematics content at this abstract level is transformed in ways that are most beneficial to students’ learning from their perspectives.

Are there any possible risks from participation in this study?

The researchers appreciate that ...is an externally assessed pre-tertiary subject and so your participation in the study will not interfere with the usual activities of teaching and learning with your class. Data collection will occur at mutually agreed times and not around revision and examination periods.

Although this is not anticipated there is a chance that you may feel anxious during an interview or during lesson observations when your teaching is being observed and video recorded, and aspects of your written work photographed. During the interviews you can decline to answer any or all questions or ask that the interview cease at any time without any explanation or consequence. Similarly you may ask that any observation and video recording and photographing of your participation in the lesson cease at any time without explanation or consequence.

You will be able to view and amend interview transcripts and ask that any unprocessed part of the data or all unprocessed data that you have contributed be withdrawn from the study at any point during the project. If you experience any discomfort as a result of any aspect of this research you are able to access free counselling provided through the Department of Education by calling ...

What if I change my mind during or after the study?

If you decide to decline your participation at any time, you may do so without providing an explanation. You will be able to view and amend your own interview transcripts and ask that any unprocessed part of the data or all unprocessed data that you have contributed be withdrawn from the study at any point during the project.

What will happen to the information when this study is over?

Surveys, hard copies of interview transcripts, audio and video files, and photographs will be stored on the Launceston campus of the University of Tasmania in locked cabinet in room ..., accessible only by the researchers. Your name and other identifying information will be removed from these data and replaced with a code. Computer files will be password protected and stored on a secure server at the Faculty of Education, Launceston campus. After a period of five years from the publication of the thesis, all transcripts and field notes will be shredded, computer files delete, raw audio and video recordings, and photographs deleted. All information collected by the researchers will be treated confidentially. We will remind all participants of the importance of
confidentiality but cannot guarantee that other participants, such as students participating in focus groups, will maintain confidentiality.

**How will the results of the study be published?**

After the completion of data collection at the end of 2014, the researcher will provide a summary report of the data for participating teachers and students. You will be provided with the thesis in electronic form by the end of the 2016 school year. The thesis will also be available to students and their parents upon request. Teachers, students and schools will be anonymous in all publication of results. Pseudonyms will be used when referring to quotes from interview transcripts and in descriptions from lesson observations in all publications of results of the study.

**What if I have questions about this study?**

If you have any questions relating to this study, please feel free to contact one of the researchers:

(Investigator contact information)

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number [Hxxxxx].

Thank you for taking the time to consider this research. If you would like to participate in this study, please indicate on the consent form, the aspects of the research in which you agree to be involved and sign it. Please place your consent form in the envelope provided and hand it to the school office where the researcher will collect it. This information sheet is for you to keep.
Student and teacher perspectives on pedagogical content knowledge in the senior mathematics classroom

Appendix C

Teacher Consent Form

1. I have read and understood the Information Sheet for this study.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves:
   
   • Having my teaching observed by the researcher for up to 8 of my ... lessons.
   • Having my teaching video-recorded by the researcher for up to 8 of my ... lessons.
   • Having photographs taken of my written work that I produce/use in class.
   • Participating in a post-lesson audio recorded interview following each lesson observed by the researcher.

4. I understand that my participation in this study involves low risk.
5. I understand that all research data will be securely stored on the Launceston campus of the University of Tasmania.
6. Any questions that I have asked have been answered to my satisfaction.
7. I understand that the researcher(s) will maintain confidentiality and that any information that I supply to the researcher(s) will be used only for the purposes of the research. I understand that in any public documents arising from this research, pseudonyms will be used for my own name and the names of my school and students.
8. I understand that the results of the study will be published so that I cannot be identified as a participant.
9. I understand that my participation is voluntary and that I may withdraw at any time without any effect.
   
   If I so wish, I may request that any unprocessed data I have supplied be withdrawn from the research.

I give consent to participate in this study.

Yes [ ] No [ ]
Participant’s name: _______________________________________________________

Participant’s signature: ____________________________________________________

Date: ________________________

**Statement by Investigator**

☐ I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐ The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Investigator’s name: _______________________________________________________

Investigator’s signature: ____________________________________________________

Date: ________________________
Dear Student

1. **Invitation**

You are invited to participate in a study to explore the teaching and learning of senior secondary mathematics content in .... This study is being conducted in partial fulfilment of a PhD for ... under the supervision of ... and ....

2. **What is the purpose of this study?**

The purpose of this study is to explore the way your teacher helps you to understand the content of senior secondary mathematics. Teachers use a range of approaches to express and present mathematics content in ways that assist you to learn particular skills and concepts, including their use of explanations and examples, diagrams and there are many more. We are particularly interested in those actions carried out by your teacher that you identify as being particularly helpful for your learning of the content in this course. Your perspective will provide valuable insight into teachers’, researchers’ and other students’ understanding of what are the most powerful ways in which teachers transform senior secondary mathematics content to enable students to grasp it.

3. **Why have I been invited to participate?**

You have been selected to participate in this investigation because you are studying an intellectually challenging senior secondary course in mathematics (...) and your teacher has also been selected to participate.

The researchers appreciate that ... is one of your pre-tertiary subjects and that this is a busy year for you. We can assure you that your participation will in no way interfere with your school commitments.

4. **What will I be asked to do?**

If you and your parents’ consent to your participation in this study, you will be invited to contribute data in the following ways:

- by being part of the class that will be observed and video recorded by the researcher.
- By having some of your written work photographed by the researcher.
- by completing post lesson short-answer questionnaires
- by participating in audio-recorded focus group interviews for up to 20 minutes after each lesson.
Details of each of the above activities are given in the following sections.

**Lesson observations**

The researcher will observe up to 8 of your ... lessons. The lesson observations will be unobtrusive and will be conducted by the researcher while you are engaging in usual activities of learning in the classroom. If you do not wish to be involved in this part of the research you may still attend your mathematics lessons as usual but the researcher will not observe or take notes on any aspect of your involvement in the lesson. You are not expected to do anything differently in the lessons; the class will be conducted in the usual ways.

**Lessons video recorded and written work photographed**

With your consent and that of your teacher and some other students, the lessons observed by the researcher will be video-recorded. If you do not give consent to be video-recorded, you may still attend the mathematics lessons as usual, and the researcher will make sure that you are not within video shot range. If inadvertently you do appear in any video footage, your image will be pixelated. In order to supplement the detail of the video footage, the researcher may also ask for your permission to take photos of some of your mathematics work.

**Post-lesson questionnaire**

During the last part of each lesson observed by the researcher, you will be invited to complete a post-lesson questionnaire. The questionnaire should take no more than 10 minutes to complete and will involve answering two questions relating to your learning in the day’s lesson.

**Post-lesson interview**

To help us better understand the way that teaching affects your learning, we would like to be able to talk to you about what worked well for you in the lessons that we observed. If you are willing, you may be invited to participate, along with up to 5 other student from your class, in an audio-recorded focus group after each lesson that is observed by the researcher. The focus groups will take no longer than 20 minutes and will take place at a mutually suitable time as soon after the lesson as feasible. This may involve part of your lunch-time or study line.

During the focus groups, you will be invited to respond to questions that arise from the researcher’s observations of particular teaching and learning interactions during the lesson itself. You may also be invited to respond to
questions in relation to your own responses to the post-lesson questionnaire. The researcher will ask for your permission to share your responses before referring to these in the focus groups.

You will be offered the option of reading the transcripts of your own focus groups interviews.

Audio recordings of the focus group interviews will be heard only by the researchers and pseudonyms will be used to label files containing transcripts or summaries of these

You will be asked to respect the confidentiality of all other participants and not to disclose any information shared during the focus groups.

Your informed consent

If you wish to participate in this study you will be asked to provide separate consent to each of these components of the research. You may give consent to contribute to some, all or none of the components of this research.

5. Are there any possible benefits from participation in this study?

Participation in this study will give you the opportunity to reflect on your learning of the content that you are studying in mathematics and to identify aspects of teaching practice that particularly assist you with your learning.

The mathematics education research community and the teaching community may benefit from the findings of this study in terms of identifying the kinds of teaching practices that are most influential in assisting students in their learning of senior secondary mathematics content.

6. Are there any possible risks from participation in this study?

Although this is not anticipated there is a chance that you may feel anxious during a focus group interview or while you are participating in a lesson that is being observed and video recorded. During the focus group interviews you can decline to answer any or all questions or ask that your participation in the focus group cease at any time without any explanation or consequence. Similarly, you may ask that any observation and video recording and photographing of your participation in the lesson cease at any time without explanation or consequence.

You will be able to view and amend interview transcripts and ask that any unprocessed part of the data or all unprocessed data that you have contributed be withdrawn from the study at any point during the project. If you experience any discomfort as a result of any aspect of this research you are able to access free counselling provided through the Department of Education by calling ...
7. **What if I change my mind during or after the study?**

If you decide to decline your participation at any time, you may do so without providing an explanation.

8. **What will happen to the information when this study is over?**

Surveys, hard copies of interview transcripts and audio and video files, will be stored on the Launceston campus of the University of Tasmania in locked cabinet in the office of ... and will be accessible only by the researchers. Your name and other identifying information will be removed from these documents. Computer files will be password protected and stored on a secure server at the Faculty of Education, Launceston campus. No sooner than 5 years from the publication of the PhD thesis, all transcripts and field notes will be shredded and computer files deleted. All information collected by the researchers will be treated confidentially. We will remind all participants of the importance of confidentiality but cannot guarantee that other participants will maintain confidentiality.

9. **How will the results of the study be published?**

After the completion of data collection at the end of 2014, the researcher will provide a summary report of the data for participating teachers and students. Your school will be provided with the thesis in electronic form by the end of the 2016 school year. The thesis will also be available to you and your parents upon request. You, your teacher and your school will be anonymous in all publication of results. What if I have questions about this study?

If you have any questions relating to this study, please feel free to contact one of the researchers:

(contact details)

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number [Hxxxxx].

Thank you for taking the time to consider this research. There are two consent forms attached, one is yours and one is for your parents as they also need give their consent for you to participate in this study. The consent forms include all options for participation in the study. If you wish to take part in the research please sign your consent form and indicate which option(s) you wish to be involved in. When both you and your parents have completed both consent forms, please place them in the envelope provided, seal it and hand it to your MTA315 Mathematics Teacher for the researcher to collect. This information sheet is for you to keep if you wish.
Appendix E

Student Consent Form

1. I have read and understood the Information Sheet for this study.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves:

   - Having my involvement in up to 8 of my lessons observed by the researcher.

     I agree to have my involvement in these lessons observed.
     Yes ☐ No ☐

   - Having my involvement in up to 8 of my lessons video recorded by the researcher.

     I agree to have my involvement in these lessons video recorded.
     Yes ☐ No ☐

   - Having some of my written work photographed during the lessons by the researcher.

     I agree to have my written work photographed by the researcher.
     Yes ☐ No ☐

   - Completing a short-answer questionnaire at the end of each of the lessons observed by the researcher.

     I agree to complete the questionnaires at the end of these lessons.
     Yes ☐ No ☐

   - Participating in a post-lesson audio recorded focus group interviews with up to 5 other students in my class, after each lesson that is observed by the researcher.

     I agree to participate in the post-lesson focus group interviews.
Yes □ No □

I agree to have my responses in the focus group interviews audio-recorded by the researcher and I agree to keep the discussion from the focus group interviews confidential.

Yes □ No □

4. I understand that my participation in this study involves low risk.

5. I understand that all research data will be securely stored on the Launceston campus of the University of Tasmania.

6. Any questions that I have asked have been answered to my satisfaction.

7. I understand that the researcher(s) will maintain confidentiality and that any information I supply to the researcher(s) will be used only for the purposes of the research. I understand that the researchers will remind participants of the importance of confidentiality but cannot guarantee that other participants will maintain confidentiality such as when several participants are involved in a focus group interview. I understand that any public documents arising from this research will use pseudonyms for my name, the name of my school and my teacher.

8. I understand that the results of the study will be published so that I cannot be identified as a participant.

9. I understand that my participation is voluntary and that I may withdraw at any time without any effect.

   If I so wish, I may request that any unprocessed data I have supplied be withdrawn from the research.

Participant’s name: ________________________________________________________________

Participant’s signature: ____________________________________________________________

Date: ______________________

Statement by Investigator
I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐ The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Investigator’s name: _______________________________________________________

Investigator’s signature: ___________________________________________________

Date: ________________________
Appendix F

Parent Information Sheet

Dear Parent/Guardian

1. Invitation

Your child is invited to participate in a study to explore the teaching and learning of senior secondary mathematics content in ... This study is being conducted in partial fulfilment of a PhD for ... under the supervision of ... and ....

2. What is the purpose of this study?

The purpose of this study is to explore the way in which your child’s teacher helps students to learn senior secondary mathematics. Teachers use a range of approaches to express and present mathematics content in ways that assist students to learn particular skills and concepts, including explanations, examples, diagrams and there are many more. We are particularly interested in those actions carried out by your child’s teacher that he/she identifies as being particularly helpful for his/her learning of the content in ... Your child’s perspective will provide valuable insight into teachers’, researchers’ and other students’ understanding of what are the most powerful ways in which teachers transform senior secondary mathematics content to enable students to grasp it.

3. Why has your child been invited to participate?

Your child has been selected to participate in this investigation because he/she is studying ..., and his/her teacher has also been selected to participate.

The researchers appreciate that ...is one of your child’s pre-tertiary subjects and that this is a busy year for him/her. Your child’s participation or non-participation will in no way interfere with his/her school commitments. Furthermore, his/her decision to participate or not to participate in this study will in no way impact upon any aspect of his/her enrolment in ....

4. What will your child be asked to do?

If you and your child consent to your child’s participation in this study, he/she will be invited to contribute data in the following ways:

- by being part of the class that will be observed and video recorded by the researcher.
- by having some of his/her written work photographed.
- by participating in audio-recorded focus groups for up to 20 minutes after each lesson.
- by completing a post lesson short-answer questionnaire after each lesson.
Further details of each of the above activities are given in the following sections.

*Lesson observations*

The researcher will observe up to 8 of your child’s ...lessons. These lessons will not necessarily be consecutive but will ideally include lessons on at least two different topic areas. If you do not want your child to be involved in this part of the research then he/she can still attend the lessons as usual but the researcher will not observe or take notes on any aspect of your child’s involvement in the lesson. You are not expected to do anything differently; the class will be conducted in the usual ways.

*Lessons video recorded and written work photographed*

With your consent and that of your child and his/her teacher, the lessons observed by the researcher will be video-recorded. The video camera will be placed in a fixed position at the back of the classroom, with the lens set on a wide-angle in view of all consenting students and the teacher. If you do not give consent for your child to be video-recorded, he/she may still attend the mathematics lessons as usual, but the researcher will make sure that your child is not within video shot range. If inadvertently your child does appear in any video footage, his/her image will be pixelated.

In order to enhance the detail of aspects of the video footage, the researcher may also take photographs of participants’ written work, such as the teacher’s examples on the whiteboard, and consenting students’ responses to mathematical tasks written into their books. Photographs of your child’s work will not be taken without his/her and your consent.

*Post-lesson questionnaire*

During the last part of each lesson observed by the researcher, your child will be invited to complete a post-lesson questionnaire. The questionnaire should take no more than 10 minutes to complete and will involve answering two questions relating to your child’s learning in the day’s lesson.

*Post-lesson interview*
To help us to better understand the way that teaching affects students’ learning, we would like to be able to talk to your child about what worked well for them, in the lesson we observed. If you give consent, your child may be invited to participate, along with up to 5 other student from his/her class, in an audio-recorded focus group after each lesson that is observed by the researcher. The focus groups will take no longer than 20 minutes and will take place at a mutually suitable time as soon after the lesson as feasible. This may involve part of your child’s lunch-time or part of a study line. During the focus groups, your child will be invited to respond to questions that arise from the researcher’s observations of particular teaching and learning interactions during the lesson itself. Your child may also be invited to respond to questions in relation to his/her own responses to the post-lesson questionnaire. The researcher will ask for your child’s permission to share his/her responses before referring to these in the focus groups.

Your child will be offered the option of reading the transcripts of his/her own focus groups. Some of his/her focus group responses that refer to teaching actions that assisted him/her with his/her learning, may be shared with the teacher. Your child’s individual identity however, will not be disclosed at any time.

Audio recordings of the interviews will be heard only by the researchers and pseudonyms will be used to label files containing transcripts or summaries. Audio files will be stored in password protected digital audio files on a secure server at the University of Tasmania, Launceston Campus.

Your child will be asked to respect the confidentiality of all other participants and not to disclose any information shared during the focus groups.

Your informed consent

If you wish your child to participate in this study you will be asked to provide separate consent to each of these components of the research. You may give consent for your child to contribute to some, all or none of the components of this research.

5. Are there any possible benefits from participation in this study?

Participation in this study will give your child the opportunity to reflect on his/her learning of the content that he/she is studying in mathematics and to identify aspects of teaching practice that particularly assist him/her with his/her learning.

The mathematics education research community and the teaching community may benefit from the findings of this study in terms of identifying the kinds of teaching practices that are most influential in assisting students in their learning of senior secondary mathematics content.

6. Are there any possible risks from participation in this study?

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Form updated 19.11.2013
Although this is not anticipated there is a chance that your child may feel anxious during an interview or while he/she is participating in a lesson that is being observed and video recorded. During the interviews your child can decline to answer any or all questions or ask that the interview cease at any time without any explanation or consequence. Similarly your child may ask that any observation and video-recording and photographing of his/her participation in the lesson cease at any time without explanation or consequence. If your child experiences discomfort as a result of any aspect of the research you are able to access free counselling provided through the Department of Education by calling ...

7. **What if I change my mind during or after the study?**

If you decide to withdraw your child’s participation at any time, you may do so without providing an explanation.

8. **What will happen to the information when this study is over?**

Surveys, hard copies of interview and focus group transcripts, audio and video files, and photographs will be stored on the Launceston campus of the University of Tasmania in a locked cabinet accessible only by the researchers. Your child’s name and other identifying information will be removed from these documents. Computer files will be password protected and stored on a secure server at the Faculty of Education, Launceston campus. No sooner than 5 years from the publication of the PhD thesis, all transcripts and field notes will be shredded and computer files deleted. All information collected by the researchers will be treated confidentially. We will remind all participants of the importance of confidentiality but cannot guarantee that other participants will maintain confidentiality.

9. **How will the results of the study be published?**

After the completion of data collection at the end of 2014, the researcher will provide a summary report of the data for participating teachers and students. Participating schools and teachers will be provided with the thesis in electronic form by the end of the 2016 school year. The thesis will also be available to students and their parents upon request. Your child, his/her teacher and your child’s school will be anonymous in all publication of results. Pseudonyms will be used when referring to quotes from interview transcripts and in descriptions from lesson observations in all publications of results of the study.

10. **What if I have questions about this study?**

If you have any questions relating to this study, please feel free to contact one of the researchers:

(Contact details)

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 7479 or email [human.ethics@utas.edu.au](mailto:human.ethics@utas.edu.au). The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number [Hxxxxx].
Thank you for taking the time to consider this research. There are two consent forms attached, one is yours and one is for your child. The consent forms include all options for participation in the study. If you would like your child to take part in the research please sign your consent form and indicate which option(s) you would like your child to be involved in. When both you and your child have completed both consent forms, please place them in the envelope provided, seal it and ask your child to hand it to his/her MTA315 Mathematics Teacher for the researcher to collect. This information sheet is for you to keep.
Appendix G

Parent Consent Form

1. I have read and understood the Information Sheet for this study.

2. The nature and possible effects of the study have been explained to me.

3. I understand that the study involves:
   
   - Having my child’s involvement in up to 8 of his/her lessons observed by the researcher.

   I give consent for my child’s involvement in these lessons to be observed.

   Yes ☐ No ☐

   - Having my child’s involvement in up to 8 of his/her lessons video recorded by the researcher.

   I give consent for my child’s involvement in these lessons to be video recorded.

   Yes ☐ No ☐

   - Photographs taken of some of my child’s written work.

   I give consent for my child’s written work to be photographed.

   Yes ☐ No ☐

   - My child completing a 10 minute short-answer questionnaire at the end of each of his/her lessons observed by the researcher.

   I give consent for my child to complete the 10 minute questionnaires at the end of these lessons.

   Yes ☐ No ☐

   - My child participating in a 20 minute post-lesson, audio-recorded focus group after each lesson that is observed by the researcher. This focus group may involve up to 5 other students from my child’s maths class.

   I give consent for my child to participate in the 20 minute post-lesson focus groups.

   Yes ☐ No ☐
I give consent for my child’s focus group responses to be audio-recorded by the researcher and agree that my child must keep the discussion from focus group interviews confidential.

Yes [ ] No [ ]

4. I understand that my child’s participation in this study involves low risk.

5. I understand that all research data will be securely stored on the Launceston campus of the University of Tasmania.

6. Any questions that I have asked have been answered to my satisfaction.

7. I understand that the researcher(s) will maintain confidentiality and that any information that my child supplies to the researcher(s) will be used only for the purposes of the research. I understand that the researchers will remind participants of the importance of confidentiality but cannot guarantee that other participants will maintain confidentiality such as when several participants are involved in a focus group.

8. I understand that the results of the study will be published so that my child cannot be identified as a participant.

9. I understand that my child’s participation is voluntary and that he/she may withdraw at any time without any effect.

   If I so wish, I may request that any unprocessed data my child has supplied be withdrawn from the research.

Participant’s name: ______________________________________________________

Participant’s signature: __________________________________________________

Date: ______________________

Statement by Investigator
I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐ The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Investigator’s name: ___________________________________________________________

Investigator’s signature: _____________________________________________________

Date: ___________________________
Appendix H

Student short-answer Questionnaire

You are invited to provide written responses to the following two questions

What did you find to be the most helpful explanation, example or strategy that your teacher used in today’s lesson?

What did it help you to learn?
Appendix I

Interview schedule for post-lesson interviews with consenting students

The student focus group interviews will take no longer than 20 minutes and will include questions that arise from the following sources:

- By expanding upon and or clarifying aspects of his/her responses to the student survey for the day’s lesson.
- By responding to questions that arise from the researcher’s observations of particular teaching and learning interactions during the lesson. This may include the use of video footage and accompanying photographs of written work as a visual stimulus for participants to recall particular incidents/actions during the lesson.

Following are specific examples of the generic types of questions that students will be invited to respond to.

i) How much did you know about this topic before class today?

ii) What do you know now?

iii) What happened in the lesson that particularly helped this knowledge growth?

iv) What are some of the effective things your teacher does to help you with your learning of these skills/concepts?

v) What was special about the examples chosen by the teacher that assisted you with your understanding of the problem?
Appendix J

Interview schedule for post-lesson interviews with teachers

The interviews will take no longer that 20 minutes and will include questions that arise from the following sources:

- Observations of particular teaching and learning interactions that occurred during the day’s lesson.
- Some of the responses given by student participants in their interview in relation to any teaching and learning interactions (e.g., explanations, worked examples, counter examples) that assisted them with their learning from their perspective.
- General questions about the teachers’ own identification and perception of significant teaching and learning interactions.
- Video footage and accompanying photographs of written work may be used as a visual stimulus for teacher to recall specific incidents/actions that took place during the lesson.

Following are examples of the generic questions that teachers will be invited to respond to.

i) What experience have you had with teaching this topic?

ii) Have you used any different approaches/strategies in your teaching of this topic this time?

iii) What do you see are the most important considerations in planning to teach this topic to your students?

iv) What are some of the difficulties/misconceptions that some students have in relation to this topic?

v) How do you anticipate these?