

USING MOST SIGNIFICANT CHANGE STORIES TO DOCUMENT THE IMPACT OF THE TEACHING TEACHERS FOR THE FUTURE PROJECT: AN AUSTRALIAN TEACHER EDUCATION STORY

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Abstract

The Teaching Teachers for the Future (TTF) project engaged teacher educators from all Australian institutions in a professional learning network that provided targeted professional development and fostered collaboration within and between teacher education institutions and relevant teacher education partners to build capacity within each institution. This paper explores the Most Significant Change (MSC) method used to demonstrate the impact of the National Support Network on Information Communication Technology Education (ICTE) in teacher education that formed part of this project. The MSC approach was developed as a tool for sharing practice and monitoring project impact in a participatory way. The process involved collecting stories from the field to establish the impact of the project. These stories were shared by participants to identify the Most Significant Change across the three domains of change: Course development, ICT capacity of teacher educators and ICT capacity of pre-service teachers. The stories and comments by participants in the project represent the initial secondary data analysis presented in this paper. These data were analysed to identify the patterns of change using content analysis and Leximancer analysis. The results indicate that the development of confidence, knowledge and understanding are important when developing TPACK in teacher education.

One of the challenges in developing and delivering teacher education programs is addressing the ever increasing impact of the inclusion of technology in education contexts both within the university and school context (Abbitt, 2011; Lim, Chai, & Churchill, 2010). The complexities of the process of developing information and communication technology in education are well documented in the literature based on the work of Mishra & Koehler (2006). Their model of Technological Pedagogical Content Knowledge (TPACK) underpinned the implementation of change related to the Teaching Teachers for the Future project. There has been much debate in the literature on the most appropriate ways to measure the development of TPACK (Polly, Mims, Shepherd, & Inan, 2010). A recent review of this literature in the context of pre-service teachers indicates that it is important to use multiple mechanisms to measure TPACK in the context of teacher preparation (Abbitt, 2011).

This study contributes a qualitative approach to the analysis of self-reported data in the form of stories focused on the Most Significant Change within the context of the implementation of the Teaching Teachers for the Future project. The Most Significant Change (MSC) method is a research approach that charts the learning as it relates to an intervention (Dart & Davies, 2005; Dart, Dysale, Cole, & Saddington, 2000). In this case, the intervention was the Teaching Teachers for the Future project. The MSC approach provided an additional data source to the large scale survey for evaluating TPACK (Finger et al., 2012). The focus of the MSC approach was qualitatively exploring the impact of the work and charting the learning within the Teaching Teachers for the Future (TTF) project.

The Most Significant Change Approach

The Most Significant Change approach was selected as the most appropriate method for the collection of data in this project for four main reasons (Dart & Davies, 2005). Firstly, this approach was valuable because the data to be gathered in the form of stories involved complex and diverse outcomes being achieved in each higher education context. Secondly, the project outcome of ‘change’ was identified and the stories were focused on charting organisational learning (Wilder & Walpole, 2008) in pre-service teacher ICT capacity and teacher educator curriculum methods courses¹. Thirdly, the work was focused on a participatory approach to curriculum change at the level of the entire project and each individual site. Finally, this approach was useful to chart stories based on staff and student input at the local level in each higher education institution. Importantly, the approach complimented quantitative survey data by capturing unanticipated changes and providing contextual evidence to better understand the relationships between the observed changes and the project activities.

The initial 10 step MSC approach developed by Dart & Davies (2005) was adapted for this project to include the following four steps:

1. Identify ‘domains of change’
2. Story collection and development
3. Story sharing and identifying MSC
4. Secondary analysis of the stories and comments

These four steps were implemented within the Teaching Teachers for the Future project using the following approach.

Step one involved the identification of the ‘domains of change’ or the aspects of the project that should be captured in the stories to provide evidence of the Most Significant Change at the level of the teacher education curriculum course being delivered in the areas of Mathematics, Science, History, English or combined courses. Three domains of change were identified as the focus for reflection and learning based on the funding application for the project. These domains of change included:

1. Course development: Teacher educator use of ICT curriculum, pedagogy, assessment or resources in specific learning areas
2. ICT capacity of teacher educators
3. ICT capacity of pre-service teachers

Step two involved defining the process of story collection and development. Teacher education courses that were the focus of the TTF work were identified. Staff and students within these courses were invited to participate in specific student and staff focus groups at the conclusion of the course in accordance with the ethics protocols established for this project. The Project Coordinator (PC) or Pedagogy Officer (PO) conducted each focus group using a prepared set of questions to elicit the story of Most Significant Change from the staff and student perspective based on the selected domains of change. Most conversations were audio recorded. These recordings were then analysed and translated into short two-page stories (one for staff and one for students) using a suggested story format. Participants when developing stories were searching for and recording the impact of the TTF project at the level of the nominated course. The stories captured the changes at the level of the course both positive and negative change stories could be reported as significant by participants. These stories were shared with the participants of each focus group and edited to achieve agreement with the participants. The Pedagogy Officer or the Project Coordinator at each site then combined these two stories into one shared story for each course. The combined story was also provided to all participants

¹ ‘Course’ refers to a specific subject that is studied as a component of the teacher education program. Within different higher education contexts the term course in this context is synonymous with subject, unit or paper.

for review and the final version of the story was provided to all staff and student involved in the project.

Step three involved Project Coordinators and Pedagogy Officers sharing and publishing the agreed stories. All participants in the TTF project (Pedagogy Officers and Project Officers) were invited to join a secure website to upload their story. Forty-seven stories were submitted from Australian teaching education institutions. All submitted stories were reviewed and forty-one were confirmed as 'for publication'. This review included discussions with authors prior to confirmation and publication to ensure that individual stories: related to specific learning areas, were added to the appropriate curriculum collection, were developed using the MSC story protocol (including adherence to ethics) and that other editing issues were addressed. This process resulted in seven submitted stories not being confirmed as MSC stories primarily because they described their intentions for change rather than those that were actually implemented. This related to the delayed timing of the project in some institutions. This review process represented the selection process for identifying the Most Significant Change stories within this project. All participants in the TTF Project were invited to comment on the shared stories. Participants were asked to identify the Most Significant Change within ten stories and identify the evidence from the story that indicated this was significant. These comments were used by the researchers in addition to their own reading and analysis of the story to identify one Most Significant Change statement for each story.

Step four involved the large-scale analysis of the stories and comments. This paper reports on the initial stage of this analysis of the stories and comments that include two different techniques. The first was a content analysis of the data coded into the three domains of change. On the basis of the reading and coding of this analysis the researcher then identified relevant sub-domains and a statement of Most Significant Change for each story. The second technique used was a Leximancer 4 analysis of the Most Significant Change statements identified for each story. The Leximancer analysis provided an understanding of the relationship between the domains and sub-domains of change that emerged from analysing the Most Significant Change statements.

The research questions that formed the focus of this initial data analysis include

- What was the focus of change in the Most Significant Change stories and comments across the domains and sub-domains of change?
- What are the relationships between the concepts and themes identified in a Leximancer analysis of the Most Significant Change statements identified for each story?

Data Analysis

The data sample analysed for the secondary analysis included 41 stories in total. These stories were identified in the following learning areas: Mathematics (14), Science (9), English (8), History (4) and stories related to more than one learning area identified as 'other' (6). In addition to the 41 stories, all the comments from participants about the MSC and evidence of that change were also analysed: Mathematics (33), Science (15), English (18), History (15), Other (9).

The data were analysed in two parts using two different techniques. The first technique involved a content analysis of the stories and comments to identify the domains and sub-domains of change addressed within each story and a statement about the Most Significant Change. To be allocated to a particular domain and sub-domain of change, one aspect of the domain or sub-domain needed to be evident within the story. This means that stories could be coded across multiple domains and sub-domains. Table 1 provides a summary of the domains and sub-domains of change coded within the data.

Table 1: Domains and sub-domain coding categories and descriptors

Domain of change	Sub-domain	Sub-domain	Sub-domain
Course development	Curriculum design: A change was made to the principles and procedures for planning, implementation and/or evaluation of the course. This often related to changes to resources and/or assessment methods)	Resources: New technologies were specifically identified and included in the course that was integral to changes in the course delivery / implementation. For example, the use of tablets, laptops, online tools, specific software and interactive whiteboards.	Assessment: Changes were made to one or more assessment tasks in the course.
ICT capacity of teacher educators	Confidence: Sense of teacher educators ‘being certain of their own abilities’ or the use of the term confidence.	Knowledge and Understanding: Use of the term knowledge or understanding	Attitudes/Beliefs: Researcher interpretation against the definition of ‘a state of mind or a feeling; disposition’
ICT capacity of pre-service teachers	Confidence: Sense of pre-service teachers ‘being certain of your own abilities’ or the use of the term confidence.	Knowledge and Understanding: Use of the term knowledge or understanding	Attitudes/Beliefs: Researcher interpretation against the definition of ‘a state of mind or a feeling; disposition’

The second technique used for analysis of the data involved using Leximancer 4 software to transform the natural language of the Most Significant Change statement identified for each story into semantic and relational maps (Smith & Humphreys, 2006). Each Most Significant Change story and the associated comments were reviewed by one member of the research team and a research assistant to identify a Most Significant Change Statement. The following are examples of Most Significant Change Statements: ‘Increase in knowledge and confidence by teacher educators. Pre-service teachers improved skills and knowledge with tablets’ and ‘increase in the level of confidence of the teacher educator and his knowledge of what ICTs are available and his understanding of the value they can bring to his teaching and how this can transfer to 7-12 classrooms.’ The Leximancer 4 automated approach to content analysis was applied to the set of statements to identify concepts on the basis of word frequency and co-occurrence within the text to discover a set of concepts. The text was then coded using the concepts identified at the level of two sentence blocks to produce a co-occurrence concept map illustrating groups of concepts that travel together in the text to form themes. The automated nature of this approach removes the biases of data coded by an individual or group of researchers.

Findings

The findings in this section are presented in two parts. The first part describes the findings of the content analysis of the stories to identify the domains and sub-domains. The second part describes the findings of the Leximancer analysis.

Content analysis of stories by domain and sub-domains

Figure 1 illustrates that the most common domain of change addressed by participants in the TTF Project was ICT capacity of pre-service teachers with a total of 83% of all stories discussing outcomes of this nature in their shared stories. This was followed by course development at 71% and ICT capacity of teacher educators at 44%. Across the learning areas, the pattern was similar except in English where student and teacher educator ICT capacity were equally developed at the level of 63% and Science where the development of ICT capacity of teacher educators was much lower with only 11% of stories relating to this domain of change.

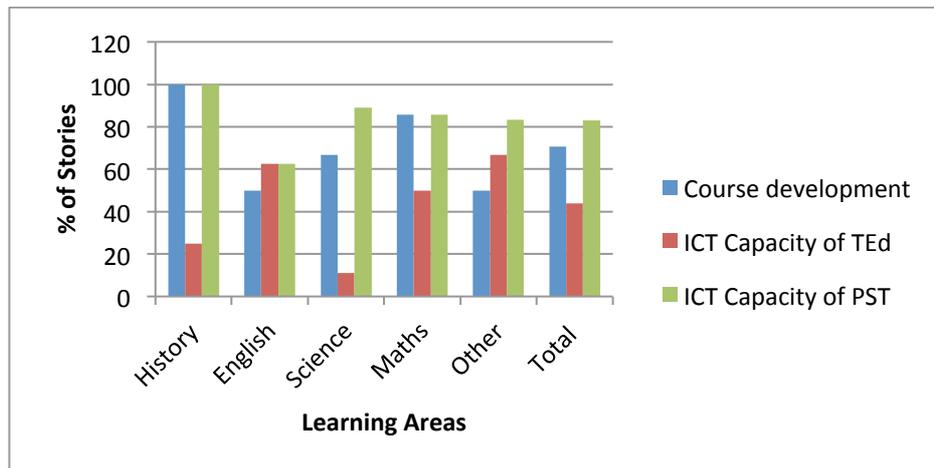


Figure 1 Percentage of stories that address the three domains of change: course development, ICT capacity of teacher educators (TEd) and ICT capacity of pre-service teachers (PST)

Figure 2 illustrates that within the domain of course development, the focus of change was on the sub-domains of curriculum design (49%) and resources (49%). Assessment was identified as a change within course development in only 34% of stories. Given the nature and timing of the development of the TTF Project a number of stories noted that the inclusion of TTF resources or changing assessment and curriculum designs was not possible in the timeframe of the project due to the extended lead time required for accreditation and approval both within the university and with external accreditation agencies.

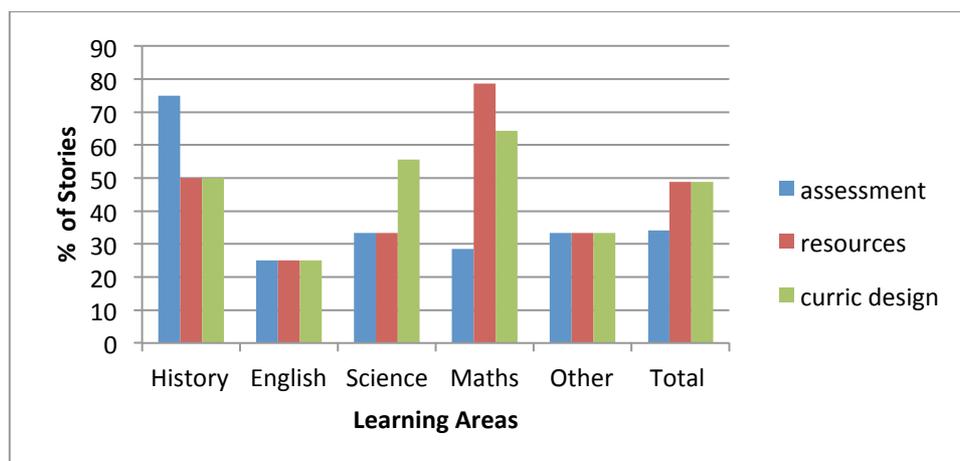


Figure 2 Percentage of stories addressing the three sub-domains of change within course development.

Figure 3 illustrates that within the domain of change of teacher educator ICT capacity, the focus of development was on knowledge and understanding (41%). This was followed by the development of

attitudes/beliefs (17%) and confidence (12%). This pattern was evident across most of the learning areas with the exception of History where no evidence of attitudes/belief development was coded.

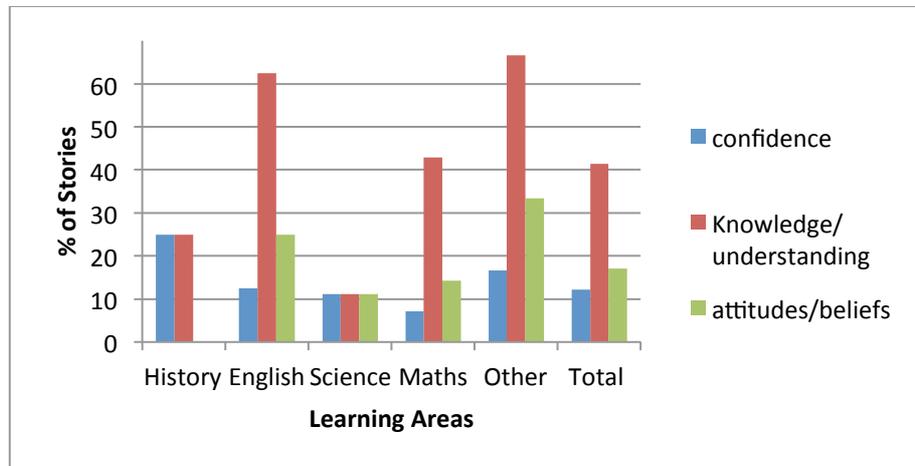


Figure 3 Percentage of stories addressing the three sub-domains of change within teacher educator ICT capacity.

Figure 4 illustrates that within the domain of change of pre-service teacher educator ICT capacity, the focus of development was on knowledge and understanding (78%). This was followed by confidence (41%) and development of attitudes/beliefs (39%). This pattern was evident across most of the learning areas with the exception of English where attitudes/belief development achieved 50% while confidence was 25%.

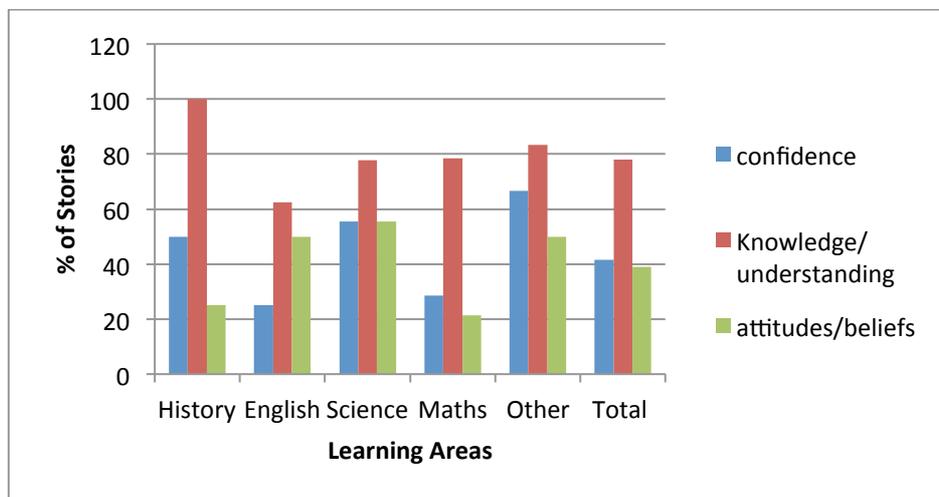


Figure 4 Percentage of stories addressing the three sub-domains of change within pre-service teacher educator ICT capacity.

Table 2 provides a summary of the top four sub-domains of change identified from the content analysis of the stories. The analysis of the Most Significant Change stories indicates that the development of pre-service teacher knowledge and understanding of ICT in Education was the most significant sub-domain of change with 78% of stories making reference to this. 49% of stories referred to curriculum design or resources as a sub-domain of the course development domain of change. The final most significant sub-domain of change was pre-service teacher confidence referenced within 41% of Most Significant Change stories.

Table 2 Top four sub-domains of change identified within the Most Significant Change stories.

Sub-domain of change	Domain of change	No. stories	Percentage
Knowledge and understanding	ICT capacity of pre-service teacher	32	78%
Curriculum design	Course development	20	49%
Resources	Course development	20	49%
Confidence	ICT capacity of pre-service teacher	17	41%

Analysis of stories with Leximancer 4

A Leximancer analysis was undertaken of the Most Significant Change statement identified for each story. This data were uploaded in an Excel database format. The analysis was undertaken using the standard 2 sentence blocks with prose threshold of 1.

The following modifications to the default settings were undertaken to develop this concept map. The first involved merging the word variants within the text this would include plural versions of terms like teacher and teachers or words used in the context of different tenses for example use, used, using. All tags were removed from the analysis for example the title MSC from the Excel spreadsheet file name. The final edit to the standard format included the creation of the compound concepts. The concepts ‘teacher’ and ‘pre-service’ when they occurred in the same two sentence block were identified as a compound concept. The terms ‘course’ or ‘subject’ were compounded as they refer to the same concept within the context of this project.

Figure 5 is the map of concepts identified from the Leximancer analysis of the Most Significant Change statements within the Teaching Teachers for the Future Project. The concept of ‘confidence’ and ‘pre-service’ were the two most frequently occurring concept within the texts evidenced by the size of the circle. The location of these two concepts close to each other in the map illustrates a close connection between these two concepts within the text. The next group of concepts included: ‘ICT’, ‘teacher’ and ‘teacher and pre-service’. The concepts of ‘teacher’ and ‘pre-service and teacher’ are closely located with the term confidence indicating that the confidence in this context related mainly to pre-service teacher confidence. The concept of ‘ICT’ is more distant in the map and travels through the text more closely with other concepts such as learning, integration, classroom, content, activities, approach and technology. ‘Use’ and ‘knowledge’ are the next highest ranked concepts in this analysis. These concepts are distant from each other, however, both are located closer to ‘confidence’ and ‘pre-service and teacher’ than the concept ‘ICT’.

Table 3 provides a summary of the top 7 concepts discovered within the text and the count of the number of occurrences within the text. The ‘relevance’ percentage indicates the linkage between the most frequently occurring concepts in this case ‘confidence’ with each of the other concepts identified. The more closely the concepts are located with each other the more similarities there are with the concepts that they are associated with. For example the concept of ‘confidence’ is most closely associated with: ‘pre-service’, ‘teacher’ and ‘pre-service’, ‘knowledge’, ‘skills’, ‘classroom’ and ‘tools’. The term ‘pre-service’ is closely associated with the terms: ‘teacher’ and ‘pre-service’, ‘knowledge’, ‘classrooms’, ‘tools’ and ‘subject’. The similarities in the highly ranked concepts associated with each of these terms indicates that they travel together closely in the text.

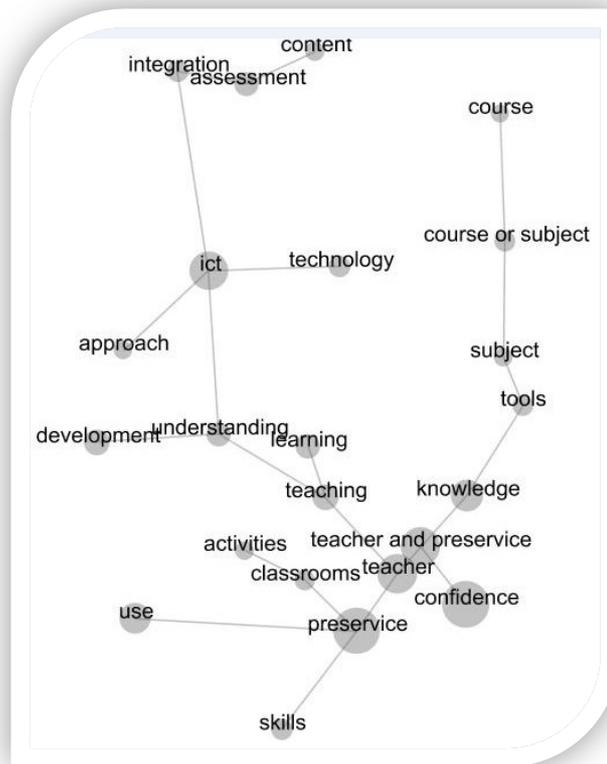
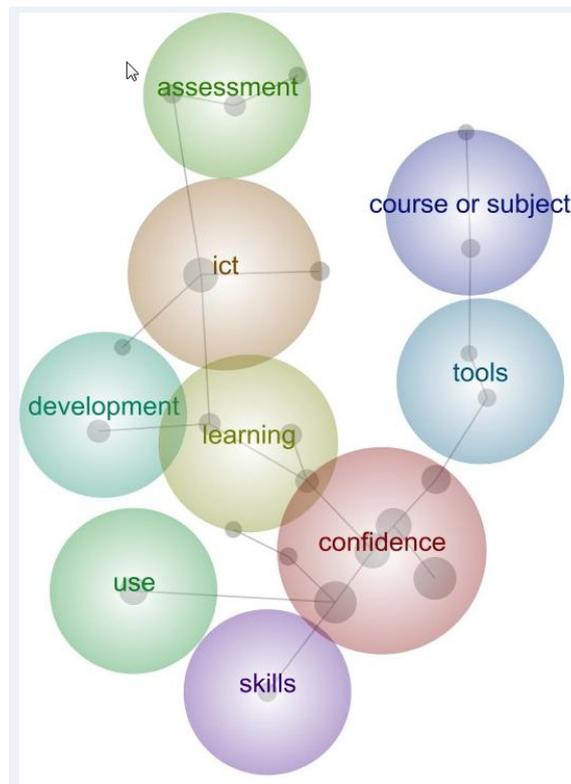


Figure 5: Leximancer Concept Map: Teaching Teachers for the Future
Most Significant Change Statement

Table 3: Count, related concepts and relevance of the Top 7 discovered concepts.

Concept	Related concepts	Count	Relevance
confidence	Pre-service, teacher and pre-service, knowledge, skills, classroom, tools, subject	31	100
pre-service	Teacher and pre-service, knowledge, classroom, tools, subject, activities, confidence	30	97
ict	Learning, integration, classrooms, content, approach, activities	23	74
teacher	Teacher and pre-service, learning, classroom, tools, teaching, skills	20	65
teacher and pre-service	classrooms, tools, teacher, teaching, learning, skills	19	61
use	Understanding, learning, approach, activities, confidence	16	52
knowledge	tools, understanding, course or subject, subject, approach	14	45

The connection between the concepts is illustrated in Leximancer by grouping commonly occurring concepts into themes. Figure 6 identifies nine themes within the data with the themes size set at 33% (standard).



**Figure 6: Leximancer Theme Map:
Teaching Teachers for the Future Most Significant Change Statements**

Table 4 indicates the related concepts within the top 5 themes. Connectivity indicates the % of connection each identified theme has with the most commonly occurring theme in this case ‘confidence’.

Table 4: Theme and concept coding categories and descriptors

Theme	Concept	Connectivity (%)
confidence	(confidence, pre-service, teacher, teacher and pre-service, knowledge, teaching, classrooms)	100%
ict	(ict, technology)	20%
learning	(learning, understanding, activities)	14%
assessment	(assessment, integration, content)	13%
use	(use)	11%
development	(development, approach)	9%

Discussion

The findings indicate that the majority of institutions focused on Mathematics with 34% of the stories published in this learning area. This was followed by 22% in Science, 19% in English, 15% in other and 10% in History. The selection of the learning area was a decision made by each of the participating institutions. This factor accounts for the different numbers of stories in each of the learning areas identified. An analysis and discussion of the focus of change in each learning area according to the domains and sub-domains of change provides an overview of the similarities and differences in the changes experienced within each learning area.

The percentage of stories in the learning area of Mathematics that addressed each of the domains of change was higher than the total for all learning areas. This suggests that change within this learning area involved multiple interrelated aspects of development. The sub-domain of resources and curriculum design within the course development domain were the site of the most change. This indicates that changes were made to the principles and procedures for planning implementation and/or evaluation of the course and this often involved the inclusion of new technologies which were integral to changes in the course delivery and implementation (e.g. the use of tablets, laptops, online tools, specific software and interactive whiteboards). Changes in the areas of confidence and attitudes/beliefs for both teacher educators and pre-service teachers were not often identified as being most significant changes within mathematics stories. The remaining sub-domains were similar to those reported in other learning areas.

The learning area of English recorded more change in the domain ICT capacity of teacher educators than the average percentage of change across all stories. It also recorded less than the average percentage in the other two domains of course development and ICT capacity of pre-service teachers. The strongest areas of reported change in this learning area were across the sub-domain knowledge and understanding for both teacher educators and pre-service teachers. In terms of the domain of change of ICT capacity of teacher educators, the English stories reported significant change most often in relation to teacher educator confidence, knowledge/understanding and attitudes and beliefs. This suggests that increases in the knowledge/understanding and attitudes/beliefs of teacher educators correlates to a similar increase in the knowledge/understanding and attitudes/beliefs of pre-service teachers. It is interesting to note that the reported change in the knowledge/understanding and attitudes/beliefs of pre-service teachers did not result in a reported increase in a Most Significant Change related to pre-service teacher confidence.

Science stories most often reported change in the domain of ICT capacity of pre-service teachers followed by course development. Very few stories discussed the development of ICT capacity of teacher educators. The Most Significant Change was most often reported in the sub-domain of knowledge and understanding with high levels of reported change in confidence and attitudes and values of pre-service teachers. The sub-domain of curriculum development was most often reported as a change followed by assessment and resources. None of the sub domains for ICT capacity of teacher educators were reported with any frequency in the learning area of Science. These findings indicate that change focused on increasing the knowledge and understandings, confidence and attitudes of pre-service teachers. This was achieved through changes to the principles and procedures for planning, implementation and/or evaluation of the course, changes to assessment tasks and use of new technologies (e.g. the use of tablets, laptops, online tools, specific software and interactive whiteboards). This is consistent with current academic research about the affordances of multimodal tools to assist teachers in producing and engaging students. It is argued that these tools support students to construct meanings and understandings in order to expand their view of Science as being more than simply content to be practised and remembered (Tytler, 2007).

The category of 'other' was identified where curriculum courses incorporated more than one learning area or represented an ICT specific course. In this group of stories the change was identified in the domains of ICT capacity of teacher educators and pre-service teachers. Change was consistently identified in the sub-domains of confidence, knowledge/understanding and attitudes/beliefs in terms of the domain of ICT capacity of pre-service teachers. This was also the case across these three sub-domains for ICT capacity of teacher educators. Course development was the area that was least likely to be identified as a change within courses in the 'other' learning areas category.

The History stories identified significant change in the area of course development and ICT capacity of pre-service teachers. Fewer stories identified the development of ICT capacity of teacher educators. The main sub-domains reported in History stories related to the development of pre-service teachers' knowledge and understandings and the development of assessment within the course development domain of change. There was no reported development in attitudes and beliefs of teacher educators.

These changes suggest that as a result of improvements to assessment tasks, there was an increase in the pre-service teachers' technological pedagogical content knowledge and their ICT skills.

The Leximancer analysis built on the content analysis through an exploration of the relationship between the concepts and themes identified from the Most Significant Change statement for each story. This analysis indicated a strong focus on pre-service teacher 'confidence' as the main concept and theme identified from this analysis. Further examination of the concept and theme mapping suggests that rather than 'confidence' being specifically related to one other concept it was directly related to a wide range of concepts namely: 'ICT', 'learning', 'assessment', 'use' and 'development'. This suggests a strong connection between confidence, knowledge, understanding and use of ICT that is supported by the content analysis where 83% of the stories focused on ICT capacity of pre-services teachers and 71% focused on course development. As a theme 'confidence' within the Leximancer analysis also demonstrated a complex level of interaction between all other themes. This suggests that the theme 'confidence' developed in conjunction with these other themes for example: 'learning', 'assessment' and 'use'. A typical example of a Most Significant Change statement coded within Leximancer as an example of both the concept 'confidence' and the theme 'confidence' was:

Pre-service teacher increased knowledge of ICTs and how these can be used to construct knowledge and assess the achievement of learning outcomes. The teacher educator modified their teaching approach to give students more time to create their own work and develop and demonstrate their understanding.

This example encapsulated Mishra and Koehler's (2008) notion of TPACK and suggests that this project supported and provided scope for the implementation of the TPACK model within teacher education in Australia. The Leximancer analysis illustrates the complexity of the relationship between all of the components of TPACK in teacher education and indicated that the development of pre-service teacher confidence plays a pivotal role.

Conclusion

The content analysis component of this research identified the pattern of change and engagement across the 41 examples of TPACK implementation within curriculum courses in English, mathematics, science, history or a combination of learning areas. The focus of the change identified in this content analysis was firmly grounded in the ICT capacity of pre-service teachers (83%) and course development (71%) with development of the ICT capacity of teacher educators identified less frequently (44%). The pattern of change was different across learning areas. For example in Mathematics, the changes related to the principles and procedures for planning implementation and/or evaluation of the course and this often involved the inclusion of new technologies that were integral to changes in the course delivery and implementation. While in science the change related to increases in pre-service teachers' knowledge and understandings, confidence, attitudes and values.

The Leximancer analysis identified 'confidence' of preservice teachers as the major concept and theme acknowledged from the Most Significant Change statement developed for each of the 41 stories. The complexity of the connection between the concepts and themes within the Leximancer analysis suggests a strong connection between confidence, knowledge, understanding and use of ICT. This view is supported by other survey based approaches designed to measure the Technological Pedagogical Content Knowledge of pre-service teachers (Jamieson-Proctor, Finger, & Albion, 2010).

The content and Leximancer analysis of the stories and Most Significant Change statements built upon each other to provide insight into patterns of change and the development of TPACK within teacher education curriculum courses. This research approach contributes to the field by providing an additional qualitative means to measure TPACK in the context of teacher education. This approach will be useful in future research seeking to examine change processes and the relationship between components of TPACK in teacher education.

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