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Designing University Courses to Improve Pre-Service Teachers' Pedagogical Content Knowledge of Evidence-Based Inclusive Practice.

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Abstract: The study described here is part of a program of research investigating the application of a theoretical course design approach to pre-service teacher education. In this study the focus was to establish the effects of the design approach on pre-service teachers' mastery of pedagogical content knowledge about inclusive education. A quasi-experimental comparison group design was employed to establish the differential effects of two course designs, one based on the theoretical principle of embedded design derived from self-organization and the other based on classroom instruction and practicum-type experience. The results indicated statistically significant findings in favour of the embedded design group for pedagogical content knowledge. Recommendations are made for the design of pre-service teacher inclusive education courses.

Introduction

Responding to learner diversity is the cornerstone of successful teaching in inclusive classroom settings (Ashman & Elkins, 2012; Kerzner-Lipsky & Gartner, 1997; Senge et al., 2000). Reaching this benchmark requires that all teachers can successfully deploy well-researched pedagogies and collaborative approaches to differentiate classroom instruction (Buell, Hallam, Gamel-McCormick, & Scheer, 1999; Darling-Hammond & Youngs, 2002; Loreman, Deppeler, & Harvey, 2005). Pre-service teacher education programs are the vehicles for providing teachers with the preparation they require to work in inclusive classrooms. Discussions in the literature surrounding teacher preparation for inclusion are extensive (e.g., Allday, Neilsen-Gatti, & Hudson, 2013; Killoran, Woronko, & Zaretsky, 2014; McHatton & Parker, 2013). While there is widespread support for university-based teacher preparation, there continues to be national and international concern about the adequacy of that preparation for inclusion, and whether it provides what schools require to address student learning needs (Forlin, Kawai, & Higuchi, 2015; Husebo, 2012; Snyder, 2012). Serious concerns exist about whether pre-service teachers can effectively employ inclusive teaching practices (Forlin, Loreman, Sharma, & Earle, 2009; Jung, 2007; Lombard, Miller, & Hazelkorn, 1998; Reed & Monda-Amaya, 1995).

Recent reforms in the design of pre-service teacher education programs have focused on enabling pre-service teachers to build a deeper and more coherent understanding of teaching practice. For example, in the United States, preparation programs must possess an extant form or framework that permits a more integrated and deeper treatment of content, pedagogical knowledge, and differentiation. This standard is applied to all Council for the Accreditation of Educator Preparation (CAEP) approved programs that prepare teachers (CAEP, 2016).

In the Australian context, the Teacher Education Ministerial Advisory Group (TEMAG, 2015) noted that although there is a growing international focus on research and evaluation of initial teacher education programs there is a lack of research about their effects and whether the practices and approaches taught have an impact. The group called for a rigorous evidence base about effective initial teacher education that would allow programs to learn from and be benchmarked against effective practice (AITSL, 2015). The New South Wales Institute of Teaching Standards have also been pursuing similar objectives of focusing on a more robust treatment of content, pedagogy and differentiation (NSWIT, 2009).

For many pre-service teachers, their only exposure to the field of inclusive education is participation in a mandatory, introductory course included in their pre-service teacher program (Ministerial Advisory Council on the Quality of Teaching, 1997). This remains the case in many jurisdictions. The limited exposure to inclusive education experienced by pre-service teachers and the gap between preparation and practice for classroom differentiation has created a driver for the examination of approaches taken to design the courses that prepare teachers for inclusion. This is especially the case when seeking ways to provide students with deeper learning about inclusive pedagogies including explicit teaching, cooperative and peer mediated learning, and the selection and differentiation of curriculum content for diverse learners. Effective learning in these areas is necessary to develop learning experiences that are maximally responsive to the pedagogical demands graduates will face in diverse inclusive classrooms.

Pedagogical Content Knowledge about Inclusion

Pedagogical Content Knowledge (PCK) as defined by Shulman in 1986, is the requisite expert knowledge about content as well as the pedagogies required to teach the content effectively. This knowledge is essential if research-based inclusive pedagogies are to be implemented with high degrees of fidelity. Empirical research on the acquisition of PCK through teacher preparation is limited and particularly in relation to studies where outcomes are measured directly in terms of the acquisition of knowledge and/or skill by pre-service teachers.

Dooly and Sadler (2013) studied two groups of pre-service teachers in Spain and the United States who were required to work together in an online environment to give each other peer feedback and evaluation of pedagogy implementation. Using tools such as Moodle, Skype, emails, Wikis, Second Life and Podcasting, the pre-service teachers collaborated with each other to provide feedback on activities and teaching sequences they demonstrated for each other. Multimodal data was collected over two years of the project during the collaboration between the two groups of pre-service teachers. Data analysis included meeting transcripts, audio files, and final teaching portfolios. The ethnographic methods of analysis indicated that the online collaboration enhanced pre-service teacher PCK development through opportunities unavailable in more traditional teacher education classrooms. The online collaboration enabled pre-service teachers to elaborate on connections between theory and practice although direct measures of the impact of these connections on knowledge and/or skill were not provided.

Zundans-Fraser and Auhl (2016) studied the application of an embedded design approach also described in this study to the development of knowledge about three evidence-based pedagogies of inclusion: explicit teaching, cooperative learning and collaborative practice. Their study generated pre-service teacher reflections of 60 participants following completion of their inclusive education course. Employing an analysis approach described by Yin (2011) and lexical analysis using Leximancer to confirm the themes and concepts, the

findings suggested that the application of design principles throughout the course assisted pre-service teachers with their learning, the completion of assessments, and enhanced their confidence in being able to meet the needs of students with diverse needs. Again, any effects on knowledge and skill beyond self-reported impacts were not established in this study.

A study by Bain, Lancaster, Zundans and Parkes (2009) compared three different learning methods to determine which method was the most effective for pre-service teachers in their learning of pedagogical content knowledge. The learning methods included self-study, peer tutoring, and structured collaborative learning groups. Collaborative groups using a cooperative learning structure resulted in the largest effect size of $d = 0.3$. The collaborative learning effect size supports the methods that require learners to actually share and elaborate on their pedagogical content knowledge. The dependent measure in this study was a test of student knowledge.

While current research calls for teachers to possess high degrees of pedagogical content knowledge (e.g., Cook & Tankersley, 2012; Kretlow & Helf, 2013), there is also evidence of a broad and substantive research-to-practice gap in the field (Antil et al., 1998; Grima-Farrell, Bain & McDonagh, 2011; Grima-Farrell, 2012; 2013; Hennessey & Dionigi, 2013). These studies show that practicing teachers frequently have limited knowledge and understanding of the details of evidence-based inclusive teaching practices and their application. Findings about this research to practice gap are disconcerting given the potential benefits that accrue to students when the key procedural features of those inclusive pedagogies are implemented with high degrees of integrity (Slavin & Lake, 2009).

The limited research that directly measures knowledge about inclusive pedagogies and the broader research to practice gap in the area represent drivers for the current study. The goal of this study was to examine whether innovative approaches to the educational design of a teacher preparation course would strengthen pre-service teachers' knowledge about differentiated research-based inclusive classroom pedagogies. This work is part of an ongoing program of research that applies principles of self-organization and self-organizing systems to the design of pre-service teacher preparation in inclusive education.

The Self-Organizing Systems Approach

The self-organizing approach involves applying principles derived from the work of Bain (2007) on a self-organizing K-12 school, and then adapted and extended to other school settings (Bain, Walker & Chan, 2011; Bain & Weston, 2012) and the higher education sector (Lancaster & Auhl, 2013; Zundans-Fraser, 2014; Zundans-Fraser & Lancaster, 2012; Zundans-Fraser & Auhl, 2016). Self-organizing systems theory involves the application of six principles that enable change from the ground up. The principles include: Simple rules, *embedded design*, and similarity at scale, emergent feedback, dispersed control and use of a schema to guide action and accommodate change (Bain, 2007). The focus of this study involves investigation of the effect of *one* of these principles, that of '*embedded design*' as it is applied to a course within some pre-service teachers' inclusive education program. The *embedded design* principle is seen to be the overarching and pivotal principle that guides application of all others (Lancaster, 2016; Zundans-Fraser, 2014).

Embedded Design

Successful complex systems exhibit self-repeating patterns within their organizational structure (Waldrop, 1992). The reiteration of *embedded design* makes it possible for agents

in those systems to engage more deeply with the way their systems function. *Embedded design* is proposed here to develop the deep and coherent pedagogical content knowledge required to implement recognized forms of pedagogical practice pre-service teachers need to experience the essential features of inclusive practice deeply and in a manner that effects their own learning experiences. For example, if a course assigns high value to a given form of pedagogical differentiation and content knowledge, then it is important to ensure that such knowledge becomes deeply embedded in the learning experience of pre-service teachers and in the delivery at all levels of the course design.

In the current application of the principle, *embedded design* occurs at four levels, first introduced at a knowledge and awareness level, then in skill building through active experience, in "real world" application with feedback, and then at a personal impact or consequential level as part of the course assessment. These levels of embedding are described in detail in the method section of this study. *Embedded design* allows for the inclusion of common features to courses such as: self-questioning, peer mediation, structured collaborative problem solving, authentic assessment, advance organization, and concept mapping into a research driven framework (Bain, 2007; Bain & Zundans-Fraser, 2015). According to the theory, embedding pedagogical content knowledge in this way generates a deeper and more elaborated understanding of, and facility with inclusive practice.

In an earlier study by Bain et al. (2009), the authors employed a time series design to examine the extent to which pre-service teachers had mastered the essential pedagogical knowledge related to the inclusive practices taught in the course. The results showed that the application of the *embedded design* principle to an inclusive education course design co-varied with mastery level performance (set at 80% and above) on assessments that covered the course content. While the data from the study showed that pre-service teachers exhibited a clear mastery level of achievement over time, the time series design employed in that work lacked the control necessary to more confidently attribute the findings to the *embedded design* approach.

As such, the present study seeks to extend that initial research related to pre-service teacher mastery of pedagogical content knowledge using a comparison group research design that compares a classroom only condition using a specific *embedded design* approach, and the combination of a classroom condition with an additional in-situ *applied experience* in an inclusive school setting. The latter was identified as a legitimate comparison given the recognition in the literature of applied in-situ experience as an important source of efficacy and as an alternative way to embed course content in the students' learning experience (Dinnebeil & McInerney, 2001; Rusznyak & Walton, 2016; Taliaferro, Hammond, & Wyant, 2015; Walton & Rusznyak, 2014; Wyss, Siebert, & Dowling, 2012). The in-situ applied experience is also defined in detail in the methods section. It involves the classroom condition as well as practice in the field with students who have differing needs.

In this study, more control was sought over the course design, content and implementation in both conditions than was the case in the earlier work, to establish any differential effects of the approaches on pre-service teacher achievement. This included monitoring the integrity of implementation and matching participants in each condition using their demographic information and scores on a pretest measure to address any differences in the groups of pre-service teachers prior to participation. The design for the research is represented in the following figure:

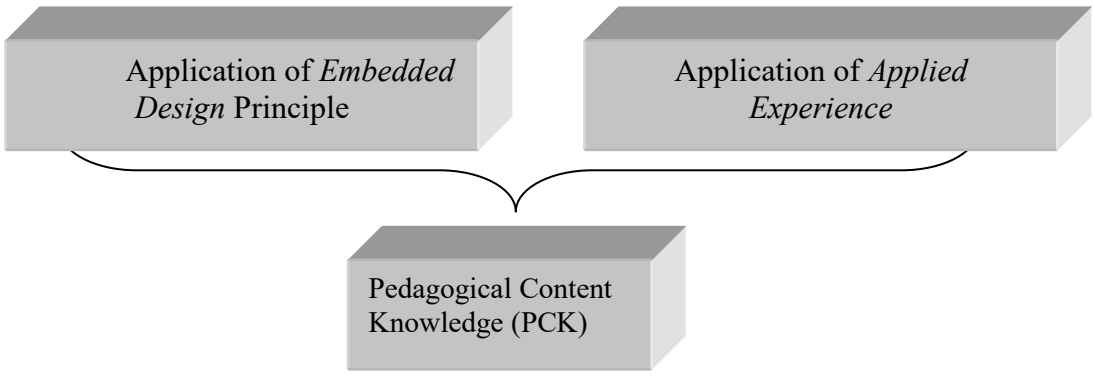

Figure 1. Comparison group design for building pedagogical content knowledge capacity.

The focus for this paper is on the impact of the independent variable on pedagogical content knowledge about differentiation. Specifically, the purpose of the study was to determine whether a course developed using principle of '*embedded design*' co-varied with an increase in the degree of pedagogical content knowledge about classroom differentiation and working with students who have difficulty learning. The research question addressed in the study was as follows:
Is achievement of pedagogical content knowledge about pedagogical differentiation differentially affected by the type of course design experienced by pre-service teachers?

Method

The following section describes: research design, participants, settings, independent variables and dependent variables.

Research Design

The research employed a comparison group design where one group was compared to another, with one manipulated independent variable. The experimental group received a 'treatment' (that of *embedded design* derived from self-organization theory) and the comparison group received a different treatment (that of *applied experience* based on in-situ experience where pre-service teachers were able to teach students in schools) (Fraenkel & Wallen, 2006; Shaughnessy et al., 2009).

Participants

Forty pre-service teachers participated in this study, of which 33 were female and 7 were male. Twenty participants were involved in the *embedded design* condition and 20 were in the *applied experience* condition. The participants were volunteer pre-service teachers enrolled in the second year of the Bachelor's Degree in Primary (Elementary) Education at an Australian regional university. They were enrolled at two campuses (described here as the *embedded design (*ED) cohort and the *applied experience* (AE) cohort, located in regional Australian cities 200 km apart using a matched sample taken from a larger data set using demographic variables and a pre-test on knowledge of inclusive education to determine any differences between the groups prior to participation in the two iterations of the course (Burns, 2000). Participants were

matched based on: age, with 85% being aged between 20-25 and 15% over 25; previous exposure to students with disabilities, 50% having some exposure, 25% little exposure and 25% having no exposure; and grade point average scores of 4.65 for previous university course completion.

Settings

The sessions of a 13-week inclusive education course were held in the lecture theatres and tutorial rooms across two university campuses. The ED cohort included a total pre-service teacher contact time of 39 hours AE cohort had the same 39 hours as well as 11 hours of additional time completed in-situ settings, bringing the total time for pre-service teachers on *applied experience* to 50 hours. The applied in-situ experience (AE) involved site visits to centers where pre-service teachers were working for an hour a week and mostly one-to-one with students who had been identified as having learning difficulties and applying the content from the inclusive education course to their work with the school students. The two instructors involved with the inclusive education course both had more than 10 years of university experience as well as extensive experience in the field of inclusive education.

Intervention and Levels of the Independent Variable

Lectures were of one hour and included all pre-service teachers while tutorial/workshop sessions were two hours and included approximately 20 pre-service teachers in each class. The type of 'course design' experienced by the pre-service teachers distinguished the two levels of the independent variable which were: '*embedded design*' and '*applied experience* design' (See Figure 1). *Embedded design* is a critical component of self-organizing systems theory that has been applied to educational contexts (Bain, 2007, Grima-Farrell, 2012; Zundans-Fraser, 2014).

Embedded Design

Embedded design (ED) creates a means to substantiate a schema to guide action. "It provides a forward mapping process that translates the assessment needs and simple rules into a design" (Bain, 2007, p.107). The *Embedded design* principle was used as the treatment to be implemented for *the embedded design cohort* and is enacted with four different components or levels: knowledge and awareness (quizzes); active experience (lesson plan designs); continuous feedback (from peers); and personal impact (grades achieved). The following is a description of the ways these components played out in the course design.

Specialist pedagogical content knowledge is the component identified in the literature as being essential for use with students who have varied learning needs. There is a need for these research-based pedagogies to be deeply understood as identified in the literature as they are rarely implemented with integrity involving the necessary characteristics for success (Hennessey & Dionigi, 2013). All pre-service teachers were required to complete pre-reading on: collaboration, explicit teaching, cognitive strategy training, and cooperative and peer mediated learning, in preparation for lectures. Lectures were then used to develop and apply the concepts and ideas described in the readings and quiz questions were based upon the objectives set in the readings.

The second component of the course design involved workshops that translated knowledge and skills gained in tutorials into active experiences, thus deepening the learning experience. Pre-service teachers participated in five two-hour skill-building workshops and

were conducted in collaborative problem solving, explicit teaching, and cooperative learning. Pre-service teachers were taught how to build lesson plans using each of the approaches and then differentiate those designs for an inclusive classroom. In each case the teaching approach that constituted the topic of the workshop was employed to teach the workshop. For example, pre-service teachers learned about cooperative learning by using cooperative learning (i.e., Jigsaw II - Slavin, 1991) as the medium of instruction in the workshop.

The third component, feedback, is essential to assist teachers to build a framework for instantiation of the research-based approaches in practice. The capacity to progress depends on feedback as it allows the schema to evolve while capacity of the participants grows (Bain, 2007, p.112). The *embedded design* principle provided feedback along the way for participants to ensure mastery of the teaching strategies (Bandura, 1989; Schunk, 2004). This was accomplished by using collaborative student meetings in all workshops as a medium for learning about other approaches. The collaborative process was utilized to solve more sophisticated instructional problem-solving related to the lesson designs and their differentiation and create a venue for feedback (Friend & Cook, 2013).

As a fourth personal impact component, *embedded design* had a direct, "non-simulated" effect on the pre-service teachers' engagement with the course. Pre-service teachers used the inclusive practices in ways that had consequences for their assessment performance in the course. This involved using the inclusive practices taught from week to week as part of their own preparation for their assessment tasks. For example, pre-service teachers met in their collaborative groups using the approach they were learning about for twenty minutes to prepare for their quizzes. As such, their capacity to employ the research-based characteristics of the inclusive approaches influenced the quality of their preparation for assessments and ultimately their own performance in the course (Bain, et al., 2009).

Applied Experience Course Design (AE)

The first two components noted above (knowledge and active engagement) are not unlike the content and approach in any existing well-organized course. Participants in both conditions were required to complete pre-reading on inclusive practice in preparation for lectures. The same content and lecture presentations were employed in class meetings and tutorials for each condition. The same assessment items of quizzes and lesson plans were required to be completed under both conditions.

It is the delivery of the content that differed during tutorials. Tutorials and workshops for *the embedded design cohort* were used to translate knowledge and awareness into skill in a series of six practical experiences with the aim of building lesson plans. Pre-service teachers in *the applied experience cohort* also translated knowledge into lesson plans during tutorials with instructor support and input in a more traditional format. They were also involved in site-visits to two different centers where they worked for an hour per week and mostly one-to-one with students who had been identified as having learning difficulties. As such, pre-service teachers in *the applied experience cohort* developed 'field-site' lesson plans designed specifically for those field sites. The lesson plans followed the structure of pedagogies studied by *the embedded design cohort* included explicit teaching, cooperative learning and differentiation of each. The *applied experience* cohort designed their lesson plans for the school students they worked with in-situ. Pre-service teachers in the *embedded design* cohort designed lessons in their tutorial groups using collaborative meetings for problem-solving about hypothetical students.

Reliability of Implementation across Campuses

To counter the variations in the way the independent variable was implemented, a course implementation fidelity table was constructed by the first author. Each week the first author sent all PowerPoint slides used in lecture delivery and activities planned to be covered in tutorials to the corresponding course coordinator of *the applied experience cohort.*

Towards the end of the week both coordinators completed a fidelity check that summarised these activities and content. This involved rating the extent to which the key features of the class were addressed during the session and included items on the course content (e.g., the extent to which a topic was addressed) and process associated with the structure of the class (e.g., whether reading objectives were reviewed) The reliability between coordinators was scored at 99%. The scale completed ranged from:

- ✓ Strong agreement = (yes I did all of this during the week)
  This was attributed 3 marks as a score
- ✓ Moderate = (I did SOME of this during the week)
  This was attributed 2 marks as a score
- ✓ Weak = (I did NOT do this during the week)
  This was attributed 1 mark as a score

Data Gathering Techniques

The primary dependent measures in the study were researcher-made tests and quizzes of pedagogical content knowledge. The pedagogical content knowledge test was a criterion-referenced test that involved a comparison against predetermined levels of performance rather than against other pre-service teachers (Gay & Airasian, 2003). In the present study, the test was comprised of questions drawn directly from weekly learner objectives. These objectives represent the 'universe' of content being measured and what pre-service teachers were expected to learn (Burns, 2000, p. 351; Cohen et al., 2007). Twenty questions were selected from the learning objectives to develop the pretest and posttest for pedagogical content knowledge. The data for the pedagogical content knowledge tests were collected from participants on two occasions: the first occasion was prior to the commencement of the intervention and the second following the intervention period.

Each of the quizzes consisted of 5 questions also drawn from the objectives, scored out of 12 and employed the same question format in each instance. The pre-service teachers completed each quiz after a thirty-minute preparation period at the beginning of the tutorial sessions during which the quizzes were scheduled (weeks, 5, 7 and 13).

A range of moderation strategies were used both before and after the tests to enhance the reliability of these researcher made tests: thoroughly defining marking criteria, providing exemplification and group moderation meetings; group moderation of grades; post-hoc adjustments to grades. A decision table was constructed to facilitate coding and to ensure a high degree of consistency (Johnson & Christensen, 2008). Agreement trials and practice marking for inter-scorer reliability were undertaken immediately following each pedagogical content knowledge test or quiz establishing reliability among the two instructors and a third research assistant. Reliability of 95% was achieved by noting agreements divided by agreements plus disagreements. Reliability exceeding 95% was achieved by grading a sample of 20% of quizzes randomly selected across cohorts from each test and quiz occasion.

Data Analysis

An omnibus two-factor Analysis of Variance using pretest means for the cumulative mastery tests (repeated measures factor) and condition (between factors) was used to determine any significant differences at pretest. A repeated measures Analysis of Variance was used to indicate differences between combined means of the two conditions across the three occasions where the quizzes were scheduled. The pretest scores were used as a covariate to determine differences between groups prior to intervention so that matching across campuses could occur.

Results

Implementation Integrity

A descriptive statistical analysis of the checklists completed by the instructors in each condition produced a 98% agreement between the expected and actual activities for the *Embedded design* (*the embedded design cohort*) condition and a 93% agreement for the *Applied experience* (*the applied experience cohort*) condition. Both instructors reported that the key content in each condition was implemented with high-levels of integrity.

An omnibus two-factor Analysis of Variance using pre-test means for the cumulative mastery test (repeated measures factor) and condition (between factor) revealed no statistically significant differences on the pretest (F) 1, 38= .225 p= .63). Table 1 describes the mean and standard deviation scores for the pre and post cumulative mastery test.

Condition	Pre-test M	SD	Post-test M	SD
Applied experience	4.00	1.58	18.42	6.48
Embedded design	3.75	1.74	27.21	4.04

Table 1: Pre and Post-test Mean and Standard Deviation Scores by Condition

The two-factor analysis of variance revealed statistically significant differences between the post-tests where higher scores were recorded by the pre-service teachers in the *embedded design condition* (F) 1.36 = 25.12, p= <.0001), *effect size = 1.35.* Table 2 describes mean and standard deviation scores derived from the average of the three mastery quizzes.

Condition	M	SD	% Mastery
Applied experience	7.66	3.13	63.83
Embedded design	10.61	1.77	88.40

Table 2: Mean and Standard Deviation Scores for Knowledge Quizzes

A repeated measures Analysis of Variance indicated that the differences between combined means were also statistically significant (F1, 38 = 46.90 p<.0001) with higher scores recorded in the *embedded design condition*. Table 3 describes the mean and standard deviation scores on each of the three occasions quizzes were scheduled.

Condition	Quiz 1		Quiz 2		Quiz 3	
	M	SD	M	SD	M	SD
Applied experience	9.60 (80%)	1.81	9.25 (77%)	1.48	4.15 (34%)	2.32
Embedded design	11.05 (92%)	1.23	11.10 (92.5%)	91	9.70 (81%)	2.47

Note: number in parenthesis = % of total possible score.

Table 3: Individual Quiz scores by Condition

In the *applied experience condition* mastery quiz scores ranged from 34-80%. In the *embedded design condition* all quizzes exceeded a predetermined mastery threshold of 80%, with scores ranging from 81-92.5%. Separate one way ANOVA comparing each quiz by condition revealed statistically significant differences between conditions for Quiz 1 (F) 38, 1 = 8.7 p=.0054; Quiz 2 (F) 38, 1 =22.59 p<.0001; *df* 38, and Quiz 3 (F), 38,1 = 53.58 p <.0001 in favor of the *embedded design condition* in each case.

Discussion

Many authors have called for the demonstration of improved pedagogical content knowledge by pre-service teachers. Arthur-Kelly et al. (2013) for example, suggest that building evidence-based pedagogical content knowledge was necessary for inclusive practices to be successful. Using direct measures of the efficacy, the present study provides evidence that pedagogical content knowledge can be demonstrated at a mastery level of performance when a course is developed using the principle of *embedded design*.

The first and most obvious finding of this study is that the implementation of the *embedded design* principle co-varied with higher levels of mastery on the knowledge posttest when compared to the applied experience condition. This result was consistent with the mastery levels described in the earlier study by (Bain et al., 2009). The embedded design approach also produced mastery level performance for most pre-service teachers on the three quizzes. This was not the case for the *applied experience condition* where pre-service teachers reached a mastery level of 80% in just one of the three quizzes. In addition, the overall average quiz score fell well below the mastery threshold despite there being no statistically significant differences between the groups on the pretest prior to participation in the course. These findings support the idea that the *embedded design* approach attenuates the achievement distribution by increasing overall pre-service teacher mastery. The negatively skewed achievement distribution would suggest that the application of the *embedded design* principle improved understanding of inclusive pedagogies over the *applied experience* approach. The finding of a mastery achievement distribution not only stands in contrast to the more common normal achievement distributions produced in the *applied experience condition* and by other courses in the pre-service teacher degree. These findings are important given the theory to practice-gap in inclusive teaching practice. If students are to carry forward learning derived from pre-service preparation to their routine normal work as practicing teachers, new learning needs to be mastered if it is to serve as a robust foundation for future practice. The results indicate that the learning derived from the embedded design experience is capable of generating a mastery pre-service learning experience. This is consistent with

calls in international reviews of teacher preparation for a more rigorous treatment of content and pedagogical knowledge (CAEP, 2016; TEMAG, 2015).

The additional eleven hours of in-situ *applied experience* did not result in increased achievement levels over those recorded in the *embedded design condition.* We view this finding more as an affirmation of the need for a deep and sustained student learning experience with inclusive practice in university courses than any implied devaluing of the role of practicum in real world settings. For example, participants in the Zundans-Fraser & Auhl (2016) study reported that teaching in real settings would be beneficial for their learning. Participants in a study by Conderman, Johnston-Rodriguez, Hartman, & Walker (2013) also noted, "student teaching provided the opportunity to understand the realities of the profession and [our] future roles and to try various instructional methods with a supervising teacher before trying them in [our] own classrooms" (p. 70). Of importance however, is the extent to which students possess adequate knowledge of the practices and approaches to be deployed in practice settings if they are to extract the best value from those practicum experiences. It should not be assumed therefore that exposure to a range of in-situ teacher practices in school settings are necessarily more beneficial than a theoretically well-designed course (Rusznyak & Walton, 2016; Walton & Rusznyak, 2014) or as an adequate context for building skill and knowledge. Both course and practicum offer necessary, reciprocal and complimentary opportunities and benefits. The embedded design approach holds promise in providing a mastery-oriented learning experience for inclusive pedagogy.

Limitations and Conclusions

This study's generalizability is clearly limited by its focus on just one university course, an available population of pre-service teachers and the quasi-experimental nature of the design. A most obvious and important consideration in the interpretation of the data described here is the extent to which the circumstances of the teacher education course and its participants account for or contribute to the findings. It is possible that these factors exerted an influence on the implementation and results described, including effects related to different instructors at the two sites and the inability to randomly assign pre-service teachers to a condition. The differences between instructor teaching methods, familiarity with the subject matter, ability to lead discussions and answer questions, etc., cannot be overlooked despite the substantive effort to monitor the fidelity of implementation. Short of scripted lessons for the instructors, the design would be better if one instructor had taught both sections of the course. Although, as is common in applied research of this kind, the barriers to creating those conditions are substantial. There is also the potential for a testing effect related to the use of the same criterion measure in pre and post-test conditions. While an effort was made to ensure the integrity of implementation at both campuses, the instructors were different and may have exerted an effect on the outcome. Further, the data described here represent just one, albeit important, dimension of inclusive practice, the use of those pedagogies as well as differentiation that have been shown to enable inclusion to occur successfully.

With due recognition of these limitations, the direction of the findings in this study when viewed with the findings of existing work (i.e., Zundans-Fraser & Auhl, 2016; Bain, Lancaster, Zundans & Parkes, 2009) lends support to the potential of an educational design and specifically the *embedded design* approach to influence pre-service teacher performance in a teacher preparation course. This is especially the case given the general paucity of data associated with the scalable influence of a design approach in teacher preparation. These findings should stimulate the continued examination of the role of theory driven course

design in teacher preparation programs. This includes an examination of the way in which the application of the *embedded design* principle across multiple courses in a program could contribute to higher levels of professional understanding and, as mentioned previously, the extent to which it could co-vary with change in classroom practice. Clearly, the ultimate test of the effects of the approaches described in this study is in the extent to which they exert a summative influence on the actual classroom practice of pre-service teachers. A study focused on this is forthcoming.

Finally, while the predominance of discussion about the reform of teacher preparation is focused at the policy, standards and structural design level (Darling-Hammond & Bransford, 2005; NSWIT, 2009), there is significant opportunity for more effective approaches to emerge bottom-up by examining practice in the educational design of courses and in the application of generalizable principles to the teacher preparation context (Bain & Zundans-Fraser, 2015). The program of research, of which this study is a part, seeks to make an emergent contribution to that conversation with a view to improving the quality of teacher preparation overall beginning at the level of course design.

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