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Pattern Language Development in the Preparation of Inclusive Educators

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Pattern language is the lexicon used to express the schema of a field of professional practice (Smethurst, 1997). This lexicon is frequently presumed to exist in communities of practice in educational settings, although the findings derived from the longitudinal study of schools (Elmore, 1996; Goodlad, 1984; Lortie, 1975; McLaughlin & Talbert, 2001; Sizer, 1987) indicate that the presence of such a lexicon is much more likely to be the exception than the rule. This study sought to establish the differential effects on pattern language of embedding evidence-based practice in the design of an inclusive education teacher preparation course. Embedded design involves creating self-repeating patterns in the instructional design of a course by expressing essential design features at multiple levels in the teaching and learning experience. In this case study, classroom communities of practice were employed as a learning context for students to develop their pattern language and as vehicle for applying the embedded design principle. The study also sought to establish whether increases in the frequency and sophistication of pattern language use increased as the pre-service course progressed through four teaching cycles and students learned more about inclusive approaches. The results indicate that pattern language frequency and sophistication covaried with participation in the course, and increased over time. The findings are discussed within the context of building more rigorous teacher preparation programs and the role of embedded design in pre-service inclusive education.

Over the last 20 years, collaboration techniques have become a cornerstone of inclusive education practice used to develop and review individual education plans, for instructional problem-solving, as a medium of engagement with parents, and by the different professionals who serve students with diverse educational needs (Friend & Cook, 2003; Idol, Paolucci-Whitcomb & Nevin, 1986; Salend, 2005). Collaboration among regular and inclusive educators is also frequently identified as a key to the successful conduct of all classrooms and schools (Loreman, Deppeler, & Harvey, 2005; Smith, Polloway, Patton & Dowdy, 2007; Villa & Thousand, 2000; Villa, Thousand & Chapple, 1996; West, Idol & Cannon, 1989).

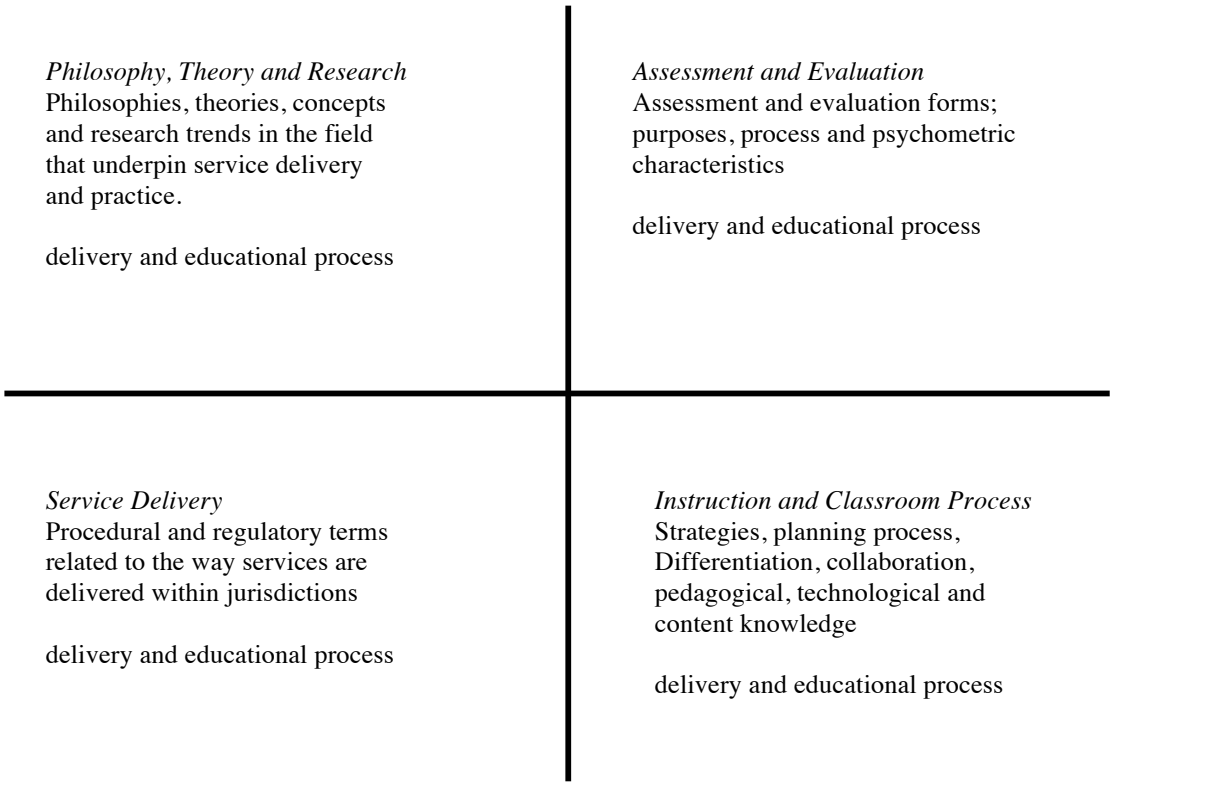
The role and process of collaboration have also been connected to the related construct of communities of practice (Lave & Wenger, 1991; Wenger, 2000). Wenger (2000) describes a community of practice as a social container for the competence that makes up a system. Communities of practice are characterized by mutual engagement, joint enterprise, and a shared professional repertoire (Wenger, 1999). They involve those individuals who wish to deepen their knowledge and expertise about a shared concern, process or problem through ongoing interaction (Wenger, McDermott, & Snyder, 2002). Participation in a community of practice defines what constitutes competence in a given professional context.

Like collaboration, the construct of communities of practice also resonates powerfully with the challenges of inclusion (Wesley & Buysse, 2001) and especially the need for school-wide teacher collaboration if the inclusion of students with diverse educational needs is to be successful (Buell, Hallam, Gamel-McCormick, & Scheer, 1999). Communities of practice have been widely advocated in inclusive education to tap expertise and bring stakeholders together for problem-solving and the communication of professional knowledge (Buysse, Sparkman, & Wesley, 2003; Linehan, Muller & Cashman, 2005; Ryba, Selby & Kruger, 2001; Wesley & Buysse, 2001). They can be viewed as entities where the instrumental process of collaboration and collaborative problem-solving are embedded systemically in a local context.

To be effective, a community of practice must possess a shared repository of communal resources, as well as the routines and shared repertoire that relates to the purpose of the community (Wenger, 2000). This common conceptual framework for action or schema (Marshall, 1995) is shared by all members and defines each member's interaction with the community. The schema represents what the community believes and values about its work (Bain, 2007).

For a teaching community of practice to be the social container for genuine professional interaction, all teachers require the knowledge associated with the teaching and learning approaches valued by the community. This includes the pattern language used to locate those approaches within the community's broader schema. A pattern language consists of the terms the community uses to express the models and practice that constitute its schema (Smethurst, 1997). For example, if inclusive educators are to work together to solve a problem related to the use of cooperative learning or peer assisted learning they all need to

Figure 1
Pattern Language Source Matrix



understand the roles and goals of those practices within the broader context of the community's overall schema of inclusive practice.

Figure 1 describes a matrix of possible pattern language domains for inclusive educators indicating the scope of language development required for overall schema building. The present study focused specifically on the instruction and classroom process domain.

The existence of this pattern language is a prerequisite for schema development and ultimately for articulating and evaluating the professional standards of the teaching profession at scale (Yinger & Fredericks-Lee, 2000). A complete schema would call for an integration of the domains in the matrix as interpreted by individuals and ultimately a community of practice.

While there are many descriptions of the application of communities of practice in educational settings (Colley, James, & Diment, 2007; Elmore, 2007; Gunawardena et al., 2006; Hartnell-Young, 2006; O'Donnell & Tobbell, 2007) the extent to which they actually represent venues for sophisticated schema-driven professional collaboration is unclear (Wenger, 2006). Whether these communities share the kind of professional pattern language and cultures required to meet Wenger's definition of a practice community is also less apparent from existing accounts.

The longitudinal study of schools by researchers including Goodlad (1984), Lortie (1975), McLaughlin and Talbert (2001), and Sizer (1984) would indicate that communities of practice, when defined as venues for sophisticated professional exchange, do not occur naturally in schools nor are they characterized by the use of a collaborative professional pattern language. Each of the aforementioned authors characterized schools as predominantly autonomous systems focused on individualized engagement, possessing only limited and idiosyncratic cultures of shared professional knowledge and collaborative action. This characterization of schools is problematic given the kind of collaborative action required for successful inclusive practice in schools and especially if that practice is expected to occur systemically at some level of scale within and across schools and preservice teacher education.

The aforementioned multi-generational research would suggest that building capacity with a pattern language and schema of inclusive practice represents a challenge for both pre and in-service

education if teachers and schools are to be capable of participating in and/or building communities of practice systemically and/or at scale. This requires that teacher education programs provide more than the explicit instrumental skills related to professional practice. They need to develop among teacher education students, a deep meta-cognitive understanding of the approaches they address, including the way any given teaching and learning practice fits within a broader professional schema.

While all communities of practice are locally constructed and should reflect the context in which they evolve (Wenger, 2000), they should also include the cumulative professional knowledge of the field in which they are situated. Building this professional knowledge and the capacity to share it begins in preservice education where teacher candidates should learn the kind of professional pattern language required to exchange sophisticated ideas about student learning needs, pedagogy, assessment, and curriculum. This language represents the cornerstone of a professional schema or conceptual framework that develops over time and becomes contextualized within the schools in which teachers work.

Recent reforms in the design of pre-service teacher education programs have the intent of enabling students to build a more sophisticated schema or conceptual understanding of their learning by requiring that programs possess an extant form or framework that permits schema building to occur (e.g., National Council for Accreditation of Teacher Education [NCATE], 2006). This standard is applied to all NCATE (2006) approved programs that prepare inclusive education teachers.

For example, a program at the University of Cincinnati (2007) has extended the conceptual framework dimension of the NCATE program standards to include the explicit development of a pattern language and lexicon as a graduation outcome and a way of articulating the conceptual design of the program in practice. This pattern language is based on what is described as professional ways of knowing, professional ways of being and professional ways of doing which focus on the content knowledge and pedagogical knowledge of the field (University of Cincinnati, 2007). What remains less clear at this time is the ways in which the design of pre-service preparation can assist students to develop pattern language required to be successful members of professional communities of practice.

We contend that to develop pattern language the key ideas, skills and knowledge required in any program of professional preparation need to be deeply and repeatedly embedded in all courses in a program of study. It is this deep embedding and repeated exposure that brings practical value to a conceptual framework and makes schema development possible.

Embedded Design

Our goal in this study was to determine whether we could further the development of pattern language among pre-service teachers by designing an inclusive education course using principles derived from prior work on a theory of self-organizing schools (Bain, 2007). That theory, and the research that supports it, focuses on the way in which a system's design can enable pattern language and schema development through the process of embedded design (Bain, 2007).

Successful complex systems exhibit self-repeating patterns within their organizational structure (Waldrop, 1993). Embedded design involves creating these self-repeating patterns in a system by expressing the essential features of a pattern language and schema at many levels in the system's design while also embedding each of those design features in all others. For example, if a system assigns value to collaboration as a key concept then it is important that collaboration becomes deeply embedded in the pattern language and overall schema for the system.

According to the theory, embedding collaboration or any other practice generates a deeper and elaborated understanding of, and facility with, the role of collaboration in inclusive practice and the role of inclusive practice as it relates to collaboration. When this principle of embedded design is extended to all features of the course or system, the theory posits that a common understanding and regularity required for pattern language and schema development can emerge (Bain, 2007). Previously completed studies have shown that the application of the embedded design principle covaries with increases in the self-efficacy (Lancaster & Bain, 2007) and pedagogical content knowledge (Bain, Lancaster, Zundans & Parkes, in press) of pre-service inclusive educators.

Purpose

The purpose of this study was to establish whether the application of the embedded design principle in classroom practice communities covaried with the frequency and sophistication of pattern language use by students. Pattern language was developed through the creation of collaborative communities of practice within which students were exposed to the embedded design of inclusive practice. Pattern language was expressed in reflections about inclusive lesson designs written by students. The designs required students to use an inclusive practice, including its research-based characteristics, to construct a lesson. The students were then required to differentiate the content, process and product of their lessons (Tomlinson, 2001). The designs

were a graded component of the course. Those approaches that were the subject of the reflections (i.e., explicit teaching, cognitive strategy training, peer assisted learning and cooperative learning) are widely acknowledged as cornerstones of inclusive educational practice (Ashman & Elkins, 2004; Mastropieri & Scruggs, 2004).

Further, the study sought to establish whether changes in the frequency and sophistication of pattern language use increased over time as students became more engaged with the course and the collaborative communities of practice in which they worked. It was our expectation that as students experienced each of the teaching and learning cycles implemented for the aforementioned approaches, and using the embedded design principle, that they would use more pattern language in more sophisticated ways. We expected that the embedded design of the approaches in each teaching cycle would drive increased pattern language use. For example, according to Slavin et al. (1994), explicit or direct teaching (Rosenshine, 1986) is recommended as the way to begin a cooperative learning lesson, while cognitive strategies can be embedded in explicit, peer and cooperative teaching approaches. As such, a rationale existed for the way pattern language use could build over the weeks of the course based on the connections across the approaches learned by the students.

Method

Participants

The participants were 54 volunteer preservice teacher educators enrolled in a mandatory inclusive education course in the second year of the Bachelor's Degree in Primary (Elementary) Education. Of the total, 14 were male and 40 were female.

Setting

The sessions of the 13-week course were held in the lecture theatres and tutorial rooms on the university campus. Lectures were of one hour and included all students while tutorial/workshop sessions were of two hours and included approximately 20 students in each class.

Embedded Design

The embedded design principle was applied to the course design and implementation at four levels. They were as follows:

Level I: Knowledge and Awareness. All students were required to complete pre-reading on collaboration, explicit teaching, cognitive strategy training, cooperative and peer assisted learning, in preparation for lectures. Lectures were then used to develop and apply the concepts and ideas described in the readings. Students attended seven lectures over the 13 week period. The reading and lectures were threaded together by a set of specific objectives provided to students on the week prior to the introduction of a new topic. The objectives explained the key understandings for each topic and how related information would be provided either in reading, by lecture or both. Students were accountable for developing responses to each of the objectives for each week. Quiz questions were based upon the objectives.

Level II: Active Experience. At this level of course design and implementation, workshops were used to translate knowledge and awareness into skill in a series of practical experiences. Students participated in five two-hour skill-building workshops. Workshops were conducted in collaboration, explicit teaching, cognitive strategy training, cooperative learning, and peer-assisted learning. Students were taught how to build lesson designs 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, students learned about cooperative learning by using cooperative learning (i.e., Jigsaw II - Slavin et al, 1994) as the medium of instruction in the workshop. The same approach was applied to the design and implementation of workshops on explicit teaching, peer assisted learning, and cognitive strategy training.

Level III: Continuous Application and Feedback. The embedded design principle calls for the embedding of key elements in all others (Bain, 2007). This was accomplished in the course design and implementation by using the collaborative process in all subsequent workshops as a medium for learning about other approaches. In the first workshop meeting (week 2), students were randomly placed in collaborative practice communities for the duration of the course and learned a collaborative problem-solving process together (Friend & Cook, 2002; West, Idol & Cannon, 1989), practicing it first with simple problems like naming their community. The application progressed to more sophisticated instructional problem-solving related to the lesson designs.

Students convened their communities as a part of the teaching cycle for each inclusive approach in order to share their lesson designs. Students shared copies of their designs with peers. After reading the design, the group used the collaborative process to provide feedback on each lesson. This process embedded collaboration in the learning about all other practices and called upon students to make active use of their knowledge of the pattern language of explicit teaching, cognitive strategy training, cooperative learning and peer assisted learning by deploying their knowledge of those practices in the feedback exchange.

Level IV: Personal Impact. At the personal impact level, embedded design has a direct, "non-simulated" effect on the students' engagement with the course. Students use the inclusive practices in ways that have consequences for their performance in the course. This involved using the inclusive practices taught from week to week as part of the students' preparation for their assessment tasks. In the present case, this happened in two ways. Students used collaborative, peer assisted and cooperative learning in preparation sessions to prepare for the quizzes they would take as part of their assessment. Students met in pairs or cooperative groups in those class sessions in which quizzes were scheduled. For 20 minutes prior to the administration of the quizzes, the students used the respective processes 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 and ultimately their quiz grade (Bain, Lancaster, Zundans, & Parkes, in press). In this way, the embedding was intended to result in a more visceral or direct level of impact where students could experience, authentically, the effect of the approaches on their own learning and performance. Further, the student lesson designs described in the previous section were also graded as an assessment requirement. The quality of the collaborative feedback each student received form the community influenced the quality of their revisions that in turn influenced the grade they received. The Personal Impact Level of embedding occurred on three occasions for quiz preparation and on four occasions for lesson feedback in the course schedule.

Teaching Cycle

The four levels of embedding were implemented sequentially for each topic and framed the week-to-week teaching cycle for the course. The cycle included pre-reading, lecture, skill building workshop, lesson draft development, collaborative feedback, lesson submission, and quiz. Each level of embedding focused on reinforcing the learning experience acquired at other levels. For example, the approaches to cooperation (Slavin et al., 1994) used in quiz preparation were the same approaches that students read about and were described in lecture. The collaborative process used in class to review lesson designs was the same process introduced in the active experience workshop. In this way, each level of embedding was designed to have a self-reinforcing effect on the other as students' learning experience at one level was reinforced at another (Bain, 2007). Students engaged in a procedurally consistent and self-reinforcing approach focused first on building knowledge level capacity with new pedagogical knowledge, the elaboration of that understanding through exchange with their peers and then the application of that knowledge in lesson designs.

The collaborative communities of practice were the vehicles employed by groups of students to express the four levels of embedded design included in each teaching cycle. The exchange in those communities reflected the knowledge of the inclusive pedagogies (Level I), the application of learning derived from workshops (Level II), the venue for the use of collaborative process to provide feedback (Level III), and for test preparation (Level IV). At all levels, the communities provided both the context and opportunity for students to share and elaborate upon the knowledge and skill developed throughout the course.

The study is premised on the view that students would engage in a deeper and more reflective engagement with the course content if key pedagogical knowledge was developed over the course of each teaching cycle using the four levels of embedding. This deeper engagement would translate into greater facility with the use of that knowledge in lesson designs, in tests and quizzes and in the use of professional pattern language. The collaborative communities of practice were the vehicles employed by groups of students to express the four levels of embedded design included in each teaching cycle. The exchange in those communities reflected the knowledge of the inclusive pedagogies,

Research Design

A simple uninterrupted time series design (Brockwell & Davis, 1991) was employed in the study focusing on the common event history of the participants. Measurements were taken after the conclusion of each teaching cycle for all participants in the cohort in order to establish any pattern of responding that covaried with the teaching cycles.

Measuring Pattern Language

Student pattern language was measured by asking students to write a reflection about their lesson designs on four occasions throughout the course. This occurred after the completion of each teaching cycle. Reflections were produced in weeks 5, 7, 10, and 13 after completion of the teaching cycle for each of explicit teaching, cognitive strategies, cooperative learning and peer assisted learning. Students were asked to write for up to 30 minutes using four guiding questions and were given the same amount of space and time to record each reflection. The questions were the following:

> Question 1: How well is the inclusive approach represented in your lesson design?
> Question 2: What are the strengths of your design?
> Question 3: What are the weaknesses of your design?

Question 4: How would you change or improve your design?

The students were asked to draw upon their own experiences developing the lesson designs and the feedback they received from their peers. Students were not asked, directed, or encouraged to try and include pattern language in their reflections nor were the reflections graded. The reflection questions did not require students to incorporate knowledge from prior reflections although it was possible to do so.

Analysis of the Reflections

The reflections were analyzed in two ways. First, a frequency count was taken of the number of pattern language terms included in each student response. Pattern language terms were defined as those words that comprised the professional lexicon of the teaching approach or strategy taught in the class. For example, with respect to explicit teaching, words like *modeling guided practice, anticipatory set, independent practice*. For cooperative learning, words like *task structure, interdependence, group reward, individual accountability* were deemed to constitute pattern language terms. These terms describe the critical sub-components of the pedagogies, knowledge of which is essential to implement the pedagogies with integrity and to problem-solve their use in classroom settings. Figure 2 describes a list of the terms included in the study.

A repeated measures analysis of variance (occasion as the repeated measurement factor) was used to determine any statistically significant changes in the frequency of pattern language usage over each of the four teaching cycles.

The ways in which the terms were used in the narrative constituted the second form of data analysis. We considered that it would be possible to use pattern language terms frequently as part of a reflection in ways that did not necessarily have clear meaning, communicative intent, or show any level of sophistication in understanding or analysis. It is also possible that a sophisticated response could be produced without pattern language terms, although the successful use of the practices included in the study is predicated upon knowledge of their structural elements (e.g., task structure, guided practice). We considered the use of terminology related to those structural elements to be an important component of a sophisticated response. The Structure of Observed Learning Outcomes taxonomy (SOLO) was used to make a determination of the sophistication of the reflection narratives and address the way pattern language terms were used.

The SOLO was developed by Biggs and Collis (1982) as a means of assessing the sophistication of learner responses across a range of domains and across students of various ages (Chan, Tsui, Chan, & Hong, 2002). The taxonomy is structured into five major levels as indicated in the table below and is hierarchical in nature increasing in structural complexity. Figure 3 describes the categories employed in the SOLO taxonomy.

These hierarchical levels reflect the quality of learning for a particular task and are suited to the content analysis of prose passages or process analysis such as mathematical problem solving (Biggs, 1995). SOLO has been used extensively in assessing responses including secondary science (Levins, 1997); knowledge of biology, in particular evolution amongst stage six students (Creedy, 1993); use of LOGO computer language (Hawkins & Hedberg, 1986); the visual arts in higher education (Hulsbosch, 2006); and assessment in higher education across subject areas (Biggs, 1992).

In the present study, a trained research assistant who did not possess knowledge of the study's research questions undertook the coding and analysis of the reflections. In the first round of analysis, the assistant identified all instances of use of the pattern language terms on each of the reflections. In the second round of analysis, each reflection was reviewed and coded according to the SOLO level to which it corresponded. The identification of terms and designations of the assistant were compared to ratings made by the second author for 20% of the reflections. The checks achieved or exceeded 80% agreement for the identification of terms and the designations of response sophistication on the SOLO Taxonomy. Reliability was calculated by determining the instances of coding agreements for both factors in the reflections across the sample for the two raters and then dividing those by coding agreements plus disagreements. This included agreements/ disagreements for the presence of pattern language terms and the SOLO level of coded responses. Excerpts from responses at each of the SOLO levels are described in Table 1. The categorical data produced by the SOLO taxonomy was analyzed using a contingency table analysis. In this case, the distribution of the responses across the SOLO categories were compared by question within each reflection. Each of the four questions that comprised a reflection became the unit of measurement and, as with the parametric analysis, occasion or teaching cycle was the unit of comparison.

Figure 2

Pattern Language Lexicon

Cognitive Strategy (CS)	- Cognitive strategies Direct Instruction - Guided practice - Independent practice - Assessment of outcomes

	- A learning framework - Different learning styles - Self-monitoring - Metacognitive learning - ET framework -
Peer Tutoring (PT)	- Tutor - Tutee - Tutor procedures - Same age - Cross age - Class wide PT - Independent - Supplemental practice - Interrelated - Structure - Sequence - Reinforcement - Practice - Feedback
Cooperative Learning (CL)	- Face to face interaction - Positive interdependence - Interpersonal skills - Focus on group process - Individual accountability - Social cohesion - Cognitive elaboration - Metacognition - Procedural - Declarative - All levels of learning - Differentiation - Motivation
Explicit Teaching (ET)	- Outcomes/ objectives identified - Anticipatory set - Link to prior learning - Teacher model - Guided practice - Independent practice - ET in conjunction with mastery learning - levels of learning - Differentiation

Figure 3
SOLO Coding System Categories

Code	SOLO Level	Criteria
0	Blank	The explanation section has been left blank and no explanation is provided.
1	Prestructual	The response does not appear to answer the question or may simply be stating the question.
2	Unistructural	One piece of information was evident in the response. Responses at this level contain one fact.
3	Multistructural	More than one piece of information was provided in the explanation. Responses at this level contain several facts, but consider the facts in isolation; no clear links are made amongst the facts.
4	Relational	Pieces of information have been presented and related together. Various facts are linked together and are related to a main concept, the explanation is valid only for the given context.
5	Extended Abstract	A response of this type goes beyond what is asked in the question however the explanation presented by the respondent clearly indicates how the additional information relates to the question. The response generalises across contexts.

(Biggs & Collis, 1982)

Table 1
Example Responses at Each Level on the SOLO Taxonomy

SOLO Level	Response
Prestructural	"One weakness my group pointed out after listening to everyone was there were no safety steps for using the frying pan. I too saw that this as possibly a very important part of the lesson that needs to be involved at the very beginning and spoken about throughout the lesson."
Unistructural	"I think one of the strengths of the lesson is that I broke the lesson down into a series of steps. Each step was in a logical sequence that flowed on to the next."
Multi-Structural	"More emphasis on definitive stage level. Need to list equipment. Be specific with outcome, must make sure (outcome) has three explicit parts (lacked condition). Methods of differentiation."
Relational	*"I thought a weakness was the fact that even though I checked each step in guided practice the steps needed to be put together in a sequence to match the modelling stage. This was affirmed by the group."*
Extended Abstract	"Some of the strategies included in my design include students having knowledge of the task structure. Students will have individually accountability to ensure they learn enough of the correct material. Students (we)re also interdependent… the group have to learn as much as they can for the group. The students will also have an understanding of the goals that they must achieve as a group and the fact that they will be rewarded for their work. I have also used the motivational strategy to encourage the students to work their hardest. These elements focus on the need for students to have a clear understanding of what is expected from them both in an academic and social sense. The combination of these elements allows students to gain as much as possible from the lesson content as they have directed questioning and a motivational reason and social perspective to do well. They depend on each other."

Results

Table 1 provides a narrative description of responses at each of the SOLO levels. The descriptions provide a term of reference for interpreting the quantitative data presented in this section.

The examples show both the presence/absence and form in which students used the professional language taught in the course. At the pre-structural level, the example makes no reference to any of the professional language taught in the course. The unistructural level example alludes to the language with reference to steps

in the lesson although specific terms are not employed. The multi-structural level makes reference to terms employed in direct or explicit teaching in a meaningful context. The relational level example used similar terms and indicated a capacity to relate those terms to each other and evaluate the way they were employed in a lesson design. At the extended abstract level, the terms were used in a highly interrelated form showing a deep understanding of the terminology, in this instance related to cooperative learning.

Pattern Language Frequency

Table 2 describes the mean and standard deviation scores for the frequency of pattern language use by students for each teaching cycle. Summing the instance of pattern language across the four questions derived a score for each reflection. The results show an increase in the frequency with which students used the professional pattern language terms within the body of their reflections after each of the teaching cycles. This was consistent across all four cycles.

A Repeated Measures ANOVA indicated statistically significant differences in pattern language use over the four teaching cycles ($F(3, 141) = 49.59$, $p = .0001$). The results of follow-up comparisons (using the Scheffe-F test procedure) comparing the teaching cycles indicated statistically significant differences between the means for the initial explicit teaching cycle and all three subsequent teaching cycles ($p = .05$), for the second cycle (cognitive strategies) and the fourth peer assisted learning cycle ($p = .05$) and between the third (cooperative learning) and fourth and final (peer assisted learning) cycle ($p = .05$). What is clear from the results of the omnibus test and the pair wise comparisons is that the frequency of pattern language use progressed in a manner that covaried with the addition of those teaching cycles. As the pre-service teachers progressed through the course, they used the pattern language of inclusive practice with greater frequency every time a new teaching cycle was added.

Sophistication of Reflections

Contingency table analyses were used to ascertain whether the proportion of responses in the SOLO categories to each question (1-4) varied in a statistically significant manner over the four teaching cycles. Table 3 describes the results for question 1 (elements of the inclusive method).

The results indicate an increase in the sophistication of responses to question one over the four teaching cycles. Fifty percent of responses in the first cycle (explicit teaching) fell in the pre-structural and uni-structural categories. In the fourth cycle (peer assisted learning), over 70% of responses fell in levels 3-4 (multi-structural and relational) categories. The contingency table analysis confirmed that the observed pattern of responding diverged from the expected showing an increase in the sophistication of response as the teaching cycles progressed (chi square $(3,4) = 48.90$, $p = .0001$).

Table 2
Mean and Standard Deviation Scores for Frequency of Pattern Language by Teaching Cycle

Teaching Cycle (in order)	Mean	SD
Explicit Teaching (ET)	7.04	3.61
Cognitive Strategies (CS)	15.21	5.01
Cooperative Learning (CL)	16.93	7.91
Peer Assisted Learning (PAL)	20.59	10.13

Table 3
Summary of SOLO Responses for Question One

SOLO Level	Question 1			
	ET	CS	CL	PT
1	19 (35.19)	3 (6.25)	4 (7.55)	6 (11.11)
2	10 (18.52)	8 (16.67)	4 (7.55)	2 (3.70)
3	22 (40.74)	17 (35.42)	18 (33.96)	20 (37.04)
4	3 (5.56)	14 (29.17)	23 (43.40)	22 (40.74)
5	0 (0.00)	6 (12.50)	4 (7.55)	4 (7.41)

Note. Percentage of total responses in parentheses

Table 4
Summary of SOLO Responses for Question Two

SOLO Level	Question 2			
	ET	CS	CL	PT
1	12 (22.22)	2 (4.08)	3 (5.66)	1 (1.89)
2	18 (33.33)	14 (28.57)	4 (7.55)	3 (5.66)
3	24 (44.44)	18 (36.73)	20 (37.74)	22 (41.51)
4	0 (0.00)	12 (24.49)	24 (45.28)	26 (49.06)
5	0 (0.00)	3 (6.12)	2 (3.77)	1 (1.89)

Note. Percentage of total responses in parentheses

Overall, the change in the structure of student responses corresponded to the results for pattern language frequency indicating that the amount of pattern language use increased along with the sophistication of responses as the course progressed. This did not occur in as clear a linear fashion as was the case with the frequency data. For example, the pattern of responding in category three (multi-structural) was consistent across all cycles while the responses in category four decreased slightly from the third to fourth cycle. It should be noted that responses in the highest level of the SOLO taxonomy (extended abstract) were lower for question one in all cycles.

Question 2. Table 4 describes the results for question 2 (strengths of the design) across the four cycles. The results were highly similar to those reported for question 1 and indicate an increase in sophistication of response to question two from the first cycle (explicit teaching) where over 50% of responses fell in the pre-structural and uni-structural categories to the fourth cycle where 90% fell in the multi-structural and relational categories. The contingency table analysis confirmed that the observed pattern of responding diverged from the expected (chi square F (3,4) = 64.93, p = .0001). As was with Question 1 (characteristics of the approach), the responses corresponded broadly to the results for pattern language frequency. The amount of pattern language use covaried with an increase in the sophistication of responses as the course progressed occurring in an even clearer and more incremental fashion across all four cycles. It should be noted that responses in the extended abstract level were again lower in all cycles.

Question 3. Table 5 describes the results for question 3 (weaknesses of the design) across the four cycles. The results concurred with those reported for Questions 1 and 2. The predominance of responses fell in the pre and uni-structural SOLO categories for the first two cycles (over 60% for each) with a predominance of responses in the multi-structural and relational categories (85%) for teaching cycles 3 and 4. The contingency table analysis was also statistically significant for Question 3 (chi square F (3,4)=57.86, p=.0001). Responses in the highest level of the SOLO taxonomy were again lower in all cycles.

Question 4. Table 6 describes the results for question 4 (changing the design) across the four cycles. The results also remained consistent with those reported for questions one through three. A higher proportion of responses fell in the pre and uni-structural categories for the first two cycles (over 45% for both explicit teaching and cognitive strategies) with a predominance of responses in the multi-structural and relational categories for teaching cycles 3 and 4 (over 85%) . The contingency table analysis was also statistically significant for question 4 (chi square F (4,3) = 57.39, p = .0001) Responses in the highest level of the SOLO taxonomy were again lower in all cycles.

In summary, the sophistication of response across all four questions increased as the teaching cycles and embedded design principle was implemented in a manner that covaried with an increase in the frequency of pattern language use. This increase did not result in high levels of responding in the most advanced (extended abstract) SOLO category for any question under any of the four teaching cycles.

Discussion

The first and most obvious finding of this study is that the pre-service teachers increased the frequency and sophistication of pattern language use over the course of the study and in a manner consistent with the application of embedded design in each teaching cycle. By the completion of the last teaching cycle, approximately 10 percent of those words were professional pattern language terms. Practically speaking this means that most sentences in the reflection included at least one professional term on average. Further, the sophistication of use of those terms fell predominantly within the multi-structural and relational categories indicating that the students were able to present multiple professional ideas and for relational responses, link those to a main idea or concept. The terms used in the student reflections were consistent with those identified in the literature

Table 5
Summary of SOLO Responses for Question Three

SOLO Level	Question 3			
	ET	CS	CL	PT
0	1 (1.85)	0 (0.00)	0 (0.00)	0 (0.00)
1	19 (35.19)	13 (27.08)	3 (5.66)	1 (1.85)
2	16 (29.63)	20 (41.67)	14 (26.42)	13 (24.07)
3	14 (25.93)	9 (18.75)	19 (35.85)	33 (61.11)
4	4 (7.41)	5 (10.42)	16 (30.19)	6 (11.11)
5	0 (0.00)	1 (2.08)	1 (1.89)	1 (1.85)

Note. Percentage of total responses in parentheses

Table 6
Summary of SOLO Responses for Question Four

SOLO Level	Question 4			
	ET	CS	CL	PT
0	1 (1.85)	0 (0.00)	0 (0.00)	0 (0.00)
1	11 (20.37)	5 (10.42)	6 (11.32)	0 (0.00)
2	14 (25.93)	18 (37.50)	7 (13.21)	2 (3.70)
3	24 (44.44)	19 (39.58)	25 (47.17)	25 (46.30)
4	4 (7.41)	3 (6.25)	13 (24.53)	23 (42.59)
5	0 (0.00)	3 (6.25)	2 (3.77)	4 (7.41)

Note. Percentage of total responses in parentheses

as being important for inclusive practice (Ashman & Elkins, 2004; Mastropieri & Scruggs, 2004).

Few responses fell into the extended abstract category which requires evidence of generalization beyond the immediate context. This level of responding is consistent with the expectation that the inclusion of the four levels of embedded design in the course teaching cycles would contribute to a broader and deeper conceptual understanding of practice. As students engaged with embedded design in their collaborative communities and across teaching cycles experience, their use of pattern language improved. Using this definition, few students appeared to respond in a manner that was indicative of the existence of a broader schema. However, such a schema would be expected to emerge from a cumulative and interrelated professional exposure in multiple courses and field-based experience. As such, schema development was not expected as an outcome of the experience in just one course, and one experience with the course design approach.

The time series design employed here produced evidence that that the design of the teaching cycles to include the four levels of embedded design in collaborative communities covaried with increases in both the frequency and sophistication use of professional pattern language. These findings are reinforced by existing research that has shown similar increases in self-efficacy and professional knowledge under comparable instructional conditions where the embedded design principle was applied (Bain, Lancaster, Zundans & Parkes, in press; Lancaster & Bain, 2007). The findings also support existing research on the importance of collaborative communities for inclusive practice (Buysse et al., 2003; Linehan et al., 2005; Ryba et al., 2001; Wesley & Buysse, 2001) and shows that the use of professional language increases with community participation.

The findings lend support to the role of embedded design in assisting early career educators to contribute professional knowledge to those communities with which they engage in the early stages of their careers. They also signal the importance of ensuring that communities of practice include the professional language of the field as a term of reference for effective collaboration.

The application of the embedded design principle as described here need not be restricted to course design in the field of inclusive teacher education. The approach may be relevant to higher education teaching in range of areas where collaborative work is desired and valued and the development of a professional language and lexicon is necessary. This is especially the case in fields that have a well-established professional language (e.g., medicine, architecture, engineering). The results are nonetheless encouraging in teacher preparation given the difficulty the

education field has experienced in translating its research base into practice at scale in schools (Cuban, 2003; Elmore, 1996). Efforts to address this issue begin with the methods employed in pre-service education.

The results of this study also provide important formative or emergent information about the kind of pattern language that needs to exist in an inclusive education course. This information can inform the broader conceptual framework for an elementary pre-service teacher education program. Based on the preliminary findings described here, more controlled research can investigate the relative contributions of the levels of the embedded design principle, the discrete role of collaborative communities, and their application across courses at a program level.

Limitations and Conclusions

This study's generalizability is clearly limited by its focus on just one university program, an available population of students, and the quasi-experimental nature of the time-series design which limits causal inference. A most obvious and important consideration in the interpretation of the data described herein pertains to the extent to which the circumstances of the teacher education program and its students account for, or contribute to the findings. It is altogether possible that these factors exerted an influence on the implementation and results. Further, the data described here represent just one, albeit important, dimension of inclusive practice, the use of those pedagogies that have been shown to enable inclusion.

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. This remains as the next step in the broader program of research to which this study pertains.

With due recognition of these limitations, the direction of the findings in the study lends support to the potential for pattern language development in teacher preparation. This is especially the case given the general paucity of data associated with the development of pattern language in preservice preparation or education in general. These findings should stimulate the continued examination of the role of course design and specifically collaborative communities in building pattern language in teacher preparation programs. This includes an examination of those factors that contribute to building a pattern language lexicon, benchmarks for the development of pattern language by pre-service teacher educators, and the way design coherence across multiple courses can contribute to higher levels of professional understanding and schema development.

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