OUTLINES - CRITICAL PRACTICE STUDIES

Pre-service Teachers' Appropriation of Conceptual Tools

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Abstract

Teachers and teacher educators in the US struggle with conflicting needs. They must think critically and adaptively in response to the rapidly changing demographics of their students and adjust to a policy climate that emphasizes standardization, measurement, and disregard for teachers as professionals. Embattled pre-service teacher education programs in institutions of higher education have traditionally sought to develop teacher candidates' knowledge, skills, and dispositions. The authors argue that in the current climate pre-service teachers also must appropriate conceptual frameworks to support their development as responsive professionals. While dispositions are beliefs and attitudes the origin and teaching of which remain in dispute, concepts like social justice, political-economic equity, and formative assessment are abstract ideas or concepts that inform practice. Conceptual tools, i.e., concepts, theories, and frameworks, guide novice teachers in making decisions in response to the growing and rapidly changing student populations they will teach as well as the policy contexts that constrain their teaching practice. The appropriation of conceptual tools contributes to development of vision and adaptive expertise required by responsive teacher professionals.

Using an activity theory framework developed by Wartofsky (1973/1979) that draws in particular on the classification of artifacts, or tools, this article frames and critically examines teachers' need for conceptual tools, the appropriation of those tools, and a mixed methods study of that appropriation. The study demonstrates that teacher candidates do appropriate conceptual tools, but that measurement of that process, though desirable in the current policy context, requires the development of a systematic and replicable methodology.

Keywords: Conceptual tools, appropriation, tertiary artifacts, methodology

Introduction and background

Teachers and teacher educators in the United States (US) are challenged by two contradictory pressures. Changing demographics among the nation's students require that teachers respond to very diverse learner strengths and needs. At the same time, education policy casts doubt on the professional judgment of teachers and encourages monitoring and prescription of teachers' practice in order to standardize teacher effects on student achievement and make those effects measureable. This article reports the results of an exploratory study of a sample of pre-service teachers, or teacher candidates (TCs), who are both graduate and undergraduate students in a teacher licensure program at a university in the Western US. These TCs were finishing or had completed bachelor's degrees in liberal arts or other disciplines and were enrolled in a three-semester program of courses and internships as preparation for state licensure to be teachers in public schools. After a discussion of the context of teacher education in the US and our conceptual framework, which assumes 1) the value of conceptual tools and 2) the developmental potential for individuals' use of those tools in practice, we describe the study's methodology, results, limitations, and implications. While the study shows promising development in TCs' use of conceptual tools in reflection on their practice over two academic semesters, measurement of that development proved to be labor intensive and logistically challenging.

Current context of teacher education in the US

The US student population from kindergarten through grade 12 (K-12) will continue to diversify well into the 21st century (National Center for Educational Statistics, NCES, 2009). According to Planty, Hussar, Snyder, Provasnik, and others (2008), in 2006, 43% of US public school students are people of color, and 20% speak a native language other than English. At the same time, 82% of public school teachers are White, middle class females, whose native language is English (National Center for Educational Information, 2005). Research (Gay, 2000; Harry, Kalyanpur, & Day, 1999; Irvine, & York, 2001; Sleeter, 2001) suggests a link between teachers' lack of capacity in teaching culturally and linguistically diverse learners and those students' persistent challenges in school achievement. Nationally, teacher education programs are attempting to address this gap by building the capacity of new teachers to teach diverse students in culturally responsive ways (Cochran-Smith, Feiman-Nemser, McIntyre, & Demers, 2010).

As teachers and teacher educators attempt to respond to the demographic challenge, the policy context in which teachers are prepared and develop expertise is increasingly concerned with standardization and measurement. The US Secretary of Education has proposed new measures for evaluating teacher education programs based on their graduates' public school students' scores on standardized tests. The Secretary's call for data on graduates' students, a distal measure confounded by multiple variables, is consistent with the major US teacher education accrediting council's vow to make greater use of data on the academic performance of graduates' students in their accreditation process (Kelderman, 2012). The move toward measurement and standardization is occurring at the same time that alternative teacher preparation programs, i.e., those not associated with higher education, nor constrained by state higher education policies and national accreditation standards, are actively focusing on skills and techniques which TCs learn by role-playing, practice in classrooms, observation, discussion, and repetition. The emphasis on skills and role-playing is meant to reduce the need for new teachers to make

decisions, based on the premise that prescription is preferable to what some refer to as experimentation (i.e., on the ground thinking and decision making) that is responsive to the particular diversity of students and contexts (Sawchuck, 2013). While skills are critical according to Pamela Grossman, cited by Sawchuck and later cited in the present article, this anti-intellectual approach is more about what Grossman calls preparing technicians than preparing professionals—technicians whose output is easily, and consistently measured.

This national move to standardized measures of teacher education program effectiveness is mirrored in many US states. In Colorado, new legislation requires that teachers (and principals) be evaluated, as of July 2013, by a set of measures based 50% on demonstration of effectiveness according to state Quality Standards (employing district designed bodies of evidence that include observations and student feedback) and 50% on measures of student learning based on growth on standardized state tests (Colorado Department of Education, n.d.).

An irony regarding teacher evaluation using this standardization and measurement model is that this pressure toward high standards, skills, and measurement comes as one of Colorado's state senators and one of our two national senators are advocating that teacher preparation happen through a regulation-free competition for grant funding of that preparation, or alternatively, not happen at all. The non-preparation alternative is a state level proposition that principals be able to hire anyone who passes a background check, passes a very low-stakes teacher exam (which our university uses as an entrance requirement), and has a bachelor's degree. Both of these proposals give experimentation in the classroom a whole new meaning!

They also provide the rationale for this study in which we attempt to provide TCs with conceptual tools, which they will use in their very non-standardized teaching realities, and to measure their appropriation of those tools in our teacher education program.

The case for conceptual tools

Given the wild and contradictory context of teacher education in the US and Colorado, the authors undertook an exploratory study to track the development of pre-service teachers' use of conceptual tools we believe they will need to make professional decisions in the rapidly diversifying contexts in which they will teach. As we attempted to measure TCs' changing use of key program concepts, we also systematically documented and analyzed our methods. Before moving to a description of the study, we provide the rationale for the study's conceptual framework, which assumes the value of conceptual tools and development of their use.

In a policy era in which legislators and the public demand that novice teachers very quickly demonstrate a high level of skills and techniques, and in which responsive pedagogy requires conceptual tools for deciding which of those techniques to use with whom, when, and for what, the ability to *see* problems of practice like a seasoned professional becomes an urgent need. An informed and practiced lens on problems of practice, which allows the expert professional to see detail and nuance, is, according to Bransford, Brown, and Cocking (2000), one characteristic that distinguishes experts from novices. According to Bransford, et al. (2000), experts see meaningful patterns of information that novices miss. Additionally, experts organize their content knowledge differently than novices. Experts' "knowledge is organized around core concepts or 'big

ideas' that guide their thinking about their domains" (p. 36). We contend that the conceptual tools, like theories or conceptual frameworks, provide novices with organizing frames that can guide what they notice, or see, as they grow in their practice.

Hammerness, Darling-Hammond, Bransford, et al. (2005) make a similar claim, maintaining that teachers must become lifelong learners who develop "habits of mind that can guide decisions and reflection on practice in support of continual improvement (p. 359)." They add that teachers need a "vision for their practice; a set of understandings about teaching, learning, and children…(p. 385)." Drawing on Grossman, they posit that teachers need "conceptual tools [that] can include learning theories, frameworks, and ideas about teaching and learning (concepts such as the zone of proximal development or culturally relevant teaching)" (p. 387). Teachers in today's complex and diversifying educational contexts require these conceptual tools to respond to rapidly changing groups of students and moving learning targets driven by rapidly changing policies.

Edwards (2010, 67) drawing on Vygotsky, argues that "learning to become a teacher involves, among other things, developing a capacity to interpret and act on the workplace and to question meanings and the social practices that sustain them." On a similar note, Darling-Hammond (2006) describes teachers as "knowers and thinkers" who have adaptive expertise.

According to Bransford, Derry, Berliner, Hammerness, and Beckett (2006), there are two forms of experts, routine experts and adaptive experts. Referencing Hatano and Inagaki (1986), they describe routine experts as people who become very good at solving predictable problems such that they become very efficient. Routine experts become more adept at their routines, but this form of expertise assumes that the environments for which these experts are prepared remain stable. Transferring routine expertise to today's diverse and rapidly changing, i.e., much less stable, schools is both challenging and insufficient.

Darling-Hammond (2006, p.79) notes that early educational leaders like Dewey supported the development of teachers as thinking professionals, but through much of the 20th century the field ascribed to the notion of teachers as managers and a "trickle down" theory of knowledge that assumed that conceptual knowledge would be intuited from scientific behaviors, i.e., strategies and techniques. Knowing which skills and techniques to use when and with whom was not required when teaching was assumed to be the transmission of knowledge that poured into the heads of undifferentiated students. Our growing understanding of the importance of tapping into learners' background knowledge, addressing their individual strengths and needs, and engaging them in active and interactive learning supports Bransford, et al.'s (2006) argument that teachers need not only skills and routine expertise, but adaptive expertise in order to know which skills to deploy under which circumstances.

A question for teacher preparation in the current context is how to develop adaptive expertise as well as routine expertise in novice teachers. Some degree of routine expertise can be developed through role-play and habituation. Adaptive expertise, however, requires not only the ability to adapt, but the ability to see complex situations in creatively. Grossman, Smagorinksy, and Valencia (1999) propose conceptual tools like principles, frameworks, and ideas such as scaffolding or constructivism to provide novice teachers with lenses for the decisions they have to make in their practice.

Measuring the appropriation of conceptual tools

Drawing on activity theory, Grossman, et al. describe learners' internalization and transformation of conceptual tools as appropriation—the process through which a person adopts and uses pedagogical tools, both practical and conceptual, in particular social environments and through that process internalizes "ways of thinking endemic to specific cultural practices" (1999, p. 15). They describe five levels of appropriation of conceptual tools. At the first level, there is no appropriation of the conceptual tool for dispositional or practical reasons, such as lack of perceived fit. At the second level, there is superficial appropriation of a label, or naming of the tool. At the third level, teachers understand the features of the tool, but not the conceptual whole. At the fourth level, appropriating conceptual underpinnings, the teachers grasp the theoretical underpinnings that motivate use of the tool, such that they are likely to use the tool in new contexts to solve new problems. At the fifth level, teachers achieve mastery, which is movement beyond appropriation to effective use of the tool across contexts, and which the authors suggest would take years.

In a longitudinal study of the appropriation of conceptual tools, Grossman, Valencia, Evans, Thompson, Martin, and Place (2000) found that conceptual tools appropriated in conjunction with practical strategies were the most influential. Describing conceptual tools as heuristics used to guide instructional decisions, Grossman, et al. (2000) note that these tools are useful for framing broader understandings of problems which in turn guide the selection of practical tools to be used in local and immediate contexts. Their longitudinal case studies of nine novice teachers' appropriation of the conceptual tools of instructional scaffolding and writing process in pre-service (i.e., teacher preparation) and through their first two years of teaching found that the teachers tended not to use the conceptual tools in their first year of teaching, but did so in the second year. Their evidence showed that the teachers used the conceptual tools as frameworks for engaging with practical tools in the social contexts of their classes. Noting that "Reflective practice depends on having a set of ideas with which to reflect" (p. 657), Grossman, et al. suggest that pre-service and in-service teachers be encouraged to use their conceptual tools to reflect on which practical tools, e.g., curricular materials or methods of instruction, can be used to serve what purposes in different settings with different learners.

Conceptual tools as tertiary artifacts

McDiarmid and Clevenger-Bright (2008) describe content knowledge and pedagogical content knowledge as knowing the substance of a discipline or disciplines, i.e., the content, but also "how to best represent the content to diverse learners" (p. 140). McNicholl & Childs (2010) describe pedagogical content knowledge as being "comprised of knowing what, when, why, and how to teach using a reservoir of knowledge of good teaching practice and experience" (p. 46). Using a Vygotskian approach to learning and development in social and cultural contexts, they refer to pedagogical content knowledge as a secondary artifact, using Wartofsky's (1973/1979) model. McNicholl & Childs (2010) explain secondary artifacts as "recipes, beliefs, and norms which preserve and transmit current ways of acting and thinking (p. 46)." They contrast secondary artifacts with tertiary artifacts (Wartofsky, 1973/1979, 209; McNicholl & Childs, 2010, 46), citing Wartofsky:

> [Tertiary artifacts are]… the constructions of alternative imaginative perceptual modes, freed from the direct representation of ongoing forms of action, and relatively autonomous in this

sense, feed[ing] back into actual praxis, as a representation of possibilities which go beyond present actualities.

Knowledge, then, in the teacher education academic and professional literatures, consists of the given declarative content knowledge of a discipline, the particular procedural knowledge associated with operationalizing that knowledge in order to apply that knowledge, and the pedagogical content knowledge to represent and make accessible both the declarative and procedural knowledge of a discipline.

Skills are discreet actions and operations that teachers employ in order to create the social and material contexts in which teaching and learning can occur. Often referred to as "best practices," skills are based on the collective experiences of teachers who have gone before and with whom one apprentices in training, or collaborates in practice. Skills are honed through personal experience in interaction with students and colleagues, and they contribute to the development of routine expertise, which, in turn, contributes to efficiency in the classroom. Examples of skills are techniques of classroom management, formative assessment strategies, multi-modal and redundant delivery of content for non-native speakers, etc.

Dispositions are more difficult to define, with current definitions mentioning beliefs, attitudes, and values. Tolerance for ambiguity, for example, is a disposition our program attempts to cultivate in our TCs, whose experiences in classes and teaching internships may differ dramatically from those in their first teaching position. Villegas (2007) defines dispositions as: "tendencies for individuals to act in a particular manner under particular circumstances, based on their beliefs" (p. 373). According to Villegas, this definition is predictive of behaviors and practices, which can be examined directly, and potentially measured.

McNicholl & Childs (2010) suggest that perhaps the most important disposition is the willingness and ability to "step outside of one's practice and examine it in good company and in the light of a range of data." Using conceptual tools as lenses to see and consider the ramifications of one's actions and possibilities for new actions is activity is what Wartofsky describes as off-line worlds.

Wartofsky's (1973/1979) discussion of flexible primary, secondary, and tertiary artifacts is useful in exploring how the same physical object or symbolic tool can differ in relation to its use in diverse but related contexts or activity systems. Wartofsky refers to three levels of tools: 1) Primary: physical or organizational tools used for immediate production; 2) Secondary: representations which allow the tools used in (1) to be used to replicate the activity (or actions) in the same (or similar) contexts; and 3) Tertiary: abstracted representations distanced from their original contexts, which allow the playful consideration of "possible," "off-line," other "worlds" (pp. 208-209). A tertiary artifact, like a theory, concept or framework, mediates the perception of possible other worlds. It is conceptual in nature and expansive. At the same time it feeds back on, or informs, the use of the tool as a primary and secondary artifact.

It is useful to note that for Wartofsky a tertiary artifact implies the use of tools or artifacts that a culture has used historically to produce new uses and contexts. This is an expansive notion of artifact that incorporates within itself its potential for change. That change is grounded in the use of the artifact in praxis. Wartofsky draws on Marx to argue that the perception, or seeing, of things and people and their relations is fundamentally linked to activity, and that perception is a human action that is part of all human praxis. The

perception involved in the use of tertiary artifacts includes the vision of possible worlds–innovation and adaptation grounded in praxis. The use of tertiary artifacts, or conceptual tools, in order to help TCs to see their instructional contexts through lenses shared with more expert teachers is the underlying motivation of this study. We will return briefly to Wartofsky's classification of artifacts when we discuss the scale by which we measured our pre-service teachers' appropriation of conceptual tools below. Now we turn to the context of the study.

The Urban Community Teacher Education program

The Urban Community Teacher Education Program (UCTE) prepares approximately 300 pre-service teachers, or TCs, per year for initial licensure in elementary education and secondary education in English, mathematics, science, social studies, and modern languages. The population of TCs is approximately 75% graduate (students who have completed bachelors' degrees and are returning for professional licensure) and 25% undergraduate (students who are completing the requirements for licensure in conjunction with the last year of study for their bachelors' degrees).

In order to address the need to prepare teachers for culturally and linguistically responsive teaching, faculty members from our School of Education and Human Development (SEHD), secured funding to begin research-based redesign of our teacher education program. This research led faculty to develop a conceptual framework for our program that places students and learning at the center of a dynamic model connecting equity and social justice to inquiry, collaboration, and content and pedagogical expertise that is culturally and linguistically relevant to urban students. The faculty also adapted a version of the CREDE framework (Center for Research on Education, Diversity, and Excellence, CREDE, nd; Center for Urban and Multicultural Education, CUME, 2009; Dalton, 2008). The version from CUME has six standards: 1) joint productive activity, or teachers and students learning together; 2) language and literacy development across the curriculum; 3) contextualization, or connecting to students' lives and funds of knowledge; 4) challenging activities or teaching complex thinking; 5) instructional conversation, or engaging students through dialogue; and 6) critical stance, or teaching to transform inequities, which we interpret as social justice and equity. (See Appendix 1 for the rubric.)

In order to guide our TCs in developing a critically reflective, culturally and linguistically responsive, and transformative pedagogical stance, consistent with Darling-Hammond's (2006) recommendations, we reintroduced two foundations courses that the TCs complete in their first semester before going out to internships in our professional development schools concurrent with their last two semesters of coursework. The first course guides TCs' exploration of power, privilege and personal bias while introducing an assets-based lens on communities. The second course, which introduces the CREDE standards and relationship driven classrooms, provides the TCs with conceptual and practical classroom tools to build culturally and linguistically responsive classrooms characterized by high expectations. TCs then begin the first of three internships at schools in conjunction with a third foundational course that focuses on differentiation of instruction and assessment, collaboration, and inquiry as the TCs work with small groups of K-12 students in their internship classrooms to develop lessons that support the growth of children facing particular challenges at school.

The sequence of the first three courses in our program is designed to develop an urban community lens among TCs who, for the most part, do not share the background of their

future students. We help our pre-service teachers learn "Explicit strategies to (1) confront their own deep-seated beliefs and assumptions about learning and students and (2) learn about the experiences of people different from themselves" (Darling-Hammond, 2006, p. 41). We also strive to guide our TCs in learning to handle uncertainty positively and creatively and to trust their analyses of dynamic classrooms. The development of this kind of adaptive expertise requires the explicit exploration of meanings in changing situations as opposed to a traditional apprenticeship in skills to be copied and mastered (Douglas, 2010).

Our study of TCs' developing use of program conceptual tools represents an effort to understand and improve our support for the development of conceptual frameworks and lenses that are consistent with the values of our program as well as extant research on teaching and learning, which suggests the essential role of conceptual tools in the development of adaptive expertise. Our study is also, not incidentally, framed by an effort by the SEHD to develop systematic data collection and analysis, i.e., measurement, on the outcomes of our teacher education program.

Methods

Our exploratory, mixed methods study of pre-service teachers' appropriation of conceptual tools was guided by the following questions: What changes occur over time in TCs' use of the program's core concepts? What is the viability of analysis of open-ended reflective program assignments as a measure of the appropriation of conceptual tools? TCs' written statements and reflections, collected iteratively over two academic semesters, were analyzed using a mixed methods approach. Fully mixed methods designs involve using both qualitative and quantitative methods in the research objective, data type, analysis, and/or inference in a single study (Leech & Onwuegbuzie 2009). In our study the research objective was to track change over time from qualitative data. Thus, those data were analyzed first qualitatively, using constant comparative (Strauss & Corbin, 1990) and key words in context (Fielding & Lee, 1988) analyses, then quantitatively, using a scale derived from Wartofsky's (1973/1979) typology of artifacts. The numeric values generated with the scale were subjected to repeated measures ANOVA statistical analysis. Both the qualitative shifts and statistical analysis of those shifts were used to infer the types of change in TC's use of conceptual tools. We describe this process in more detail below, followed by the outcomes and discussion.

Data collection

We began a longitudinal study, in summer 2010, of student outcomes from the sequence of three foundational courses described above. We archived, de-identified, and analyzing student products from three different course sections in each of the three courses for two licensure groups of TCs. One of the student products was an iteratively produced written reflection on the candidate's pedagogical stance called the teacher manifesto, which was to be completed at the end of each course, and for the second licensure group as an admissions document. The guidelines for writing the teacher manifesto were designed to be both specific and open. The TCs were asked to produce bulleted responses to two prompts: "As a teacher I believe," and "As a teacher I will." These bulleted responses were then to be followed by a reflection paper in which the pre-service teachers reflected upon their belief and action statements based on their growing experience within the teacher education program.

At the end of each course, we collected ungraded versions of the manifestos from course instructors. These were de-identified and assigned numerical codes. The codes allowed us to track TCs' manifestos across the three courses or iterations, which corresponded to the first and second semesters of our teacher education program. Two sets (n = 22, n = 36) of minimally prompted belief statements and agendas for future action, or teacher manifestos, from two licensure groups that began our program in summer 2010 and fall 2010 were analyzed. Inconsistencies in data collection resulted in relatively small data sets and drove us to study the processes of data collection, data management, and data analysis of the manifestos, i.e. the viability of our approach to measurement.

Table 1 represents the analyzed manifestos for this exploratory study. While three iterations were produced by each group, they differed. It is also important to note that not all manifestos collected used a consistent format. Some instructors collected only the bulleted lists of "As a teacher I believe…" and "As a teacher I will…" statements and not the additional reflective essay collected in most sections. As a result of this initial analysis, our program has implemented stricter and more consistent data collection processes.

Table 1: Number of manifestos collected by licensure group during program implementation

	Pre-Manifestos	Post Course1	Post Course 2	Post Course 3
Licensure Group 1	0	25	22	25
Licensure Group 2	26	36	37	0
Total	26	61	59	25

Data analysis

The manifestos were course and program assignments (in that they were collected on admission and from internships as well as classes). They were also personal statements or narratives. In contrast to public sources of data, personal documents "refer to any first-person narrative that describes an individual's actions, experiences, and beliefs" (Bodgan & Biklen, 2007).

We used a priori codes, or themes, based on nine core concepts guiding the curriculum of the teacher education program. Six of these were taken from the CREDE standards and rubric described above. As a reminder, the CREDE standards collectively provide a conceptual framework for culturally and linguistically responsive pedagogy for social justice and equity. The other three codes were drawn from our program's own conceptual framework which privileges inquiry, collaboration, and pedagogy.

The data were analyzed using a constant comparison procedure, both as a means to explore the data and as a means of developing any emergent codes and themes (Strauss & Corbin 1990). Dominant emergent themes reflected core program concepts, particularly advocacy and transformative pedagogy. The nine a priori codes were clarified and further defined, with two of those codes yielding sub categories of interest. The refined codes used were:

1. Role of teacher, pedagogical references (Pedagogy, UCTE Framework)
   a. understanding of formative and summative assessment
   b. understanding of differentiation
   c. instructional methodology
2. Equity and social justice issues, including power and privilege references (CREDE)

3. Collaboration, evidence of collaboration with other adults/resources (UCTE Framework)

4. Inquiry, critical reflection of practice (UCTE Framework)

5. Teachers and students working together (CREDE)
   a. Creating a relationship-driven classroom
   b. Joint productive activities

6. Developing language and literacy skills across curriculum (CREDE)

7. Connecting lessons to student's lives/funds of knowledge (CREDE)

8. Engaging students with challenging lessons (CREDE)

9. Emphasizing dialogue over lectures (CREDE)

Then, in preparation for quantitative analysis, each TC's use of any code was assigned a numerical value based on a developmental scale derived from Cole's (1996) study of the changing use of conceptual tools by undergraduates in over time. Cole's scale for developmental change in the use of conceptual tools had three forms of use based loosely on Wartofsky's (1973/1979) definition of primary, secondary, and tertiary artifacts. In Cole's (1996) scale the first or primary level involved naming and/or providing a simple explanation of the concept. This level was defined as Emerging. The second, or Developing, level involved using the concept as an explanatory tool for interpretation or action. The third, or Proficient, level involved critical consideration of the tool's usefulness for explanation and/or innovative expansion of the concept.

Because we wished to track change over a relatively short period of time (nine months), and we did not anticipate major qualitative shifts (e.g., from no use of the tool to critical and expansive use that contemplated new off-line possibilities), we expanded on Cole's scale defining seven levels in order to capture more detail about the earlier stages of development. In preliminary analysis two independent raters read electronic copies of the documents to locate and analyze key words in context based on the a priori codes or themes. Numbers for each code as well as an overall total score were listed in tables for ease of analysis. Low inter-rater reliability led to both the expansion and clarification of the original seven-level scale as well as a new analysis of the data, based on further clarification of the a priori codes, as shown in Table 2.

Table 2: Levels of use represented numerically

Not Evident	0	Teacher candidate does not name the code

Emerging	1	TC names the code, or element of the code as defined in code book
Emerging	2	TC uses or names the code in context(s)
Developing	3	TC explains concept by providing a definition, description, or example
Developing	4	TC uses code, or element of code, as a rationale for a result (a specific action, a change in belief or attitude)
Developing	5	TC argues or defends merit of code using evidence (examples or supporting references)
Proficient	6	TC critiques code (effectiveness, relevance, or use of code)
Proficient	7	TC suggests refinements, modifications, or innovative use of code based on well-developed argument and thoughtful critique

As noted above, a modified key-words-in-context analysis (Fielding & Lee, 1998) was used to explore the nine themes based on the program's conceptual framework. Once the theme was identified in the manifesto, the theme was coded using a numerical system presented in Table 2. As the study progressed, to ensure uniformity in analysis and increase legitimation, researchers randomly chose five manifestos from the initial course and analyzed them separately, and then compared results. If the numeric codes as identified in Table 2 differed, this difference was discussed until a consensus was reached and themes as well as the points on the developmental scale were clearly understood. Researchers then divided the documents for analysis.

Analysis by theme and developmental scale was both qualitative and quantitative. This mixed method analysis considered the participant's expression, or use, of the code in order to determine the teacher candidate's changing use of the conceptual tool, and allowed each occurrence of a code to be quantified using a numerical system (Table 2). The refinement of the categories in Table 2 allowed researchers to detect subtle changes in conceptual development over time while still permitting TCs' statements to be categorized as emerging, developing, or proficient, the three major categories based on Wartofsky's typology of artifacts as primary (to produce a product or name), secondary (to represent production or use as an explanatory device), or tertiary (to critically consider possibilities). Table 3 presents examples of coding.

Table 3. Examples of coding

Concept	Level of use	Key Word in Context
Collaboration	2 (Names the code in context)	It takes a cooperative teaching staff, including other grades and the principal, to have a positive school atmosphere and experience.
Collaboration	4 (Uses code as a rationale)	I believe collaborating with other educators and coworkers is extremely important. I think it is crucial for students' learning to take place across multiple subjects and with various learning formats. For example, if a specific topic is being studied in class, student learning could really be enhanced if the music, art, or physical education teachers would incorporate the same topic into their classes as well. It would give students the opportunity to look, think, and create wider understanding of the topic being studied.

Connecting with Students' Lives	2 (Names the code in context)	As a teacher, I believe in honing student's natural inquisitiveness to create lifelong learners. I will require this from students by encouraging them to question themselves, each other, and me. My hope is to develop this in a manner that stays with them throughout their life and extends to situations outside of the classroom.
Connecting with Students' Lives	4 (Uses code as a rationale)	… the community is an important contributor to school and it should be incorporated within my classroom … it is just as important to include parents and families of my students, allowing a chance to combine home and school life. Being able to relate to students and knowing their personal needs can be seen as funds of knowledge, what each student as well as myself bring into the classroom. Also, by using transformative pedagogy, I believe that it is beneficial to address multiple ways of learning at the same time.

Essentially two post-qualitative analyses were conducted to address the first and primary research question about tracking change in use of conceptual tools–first, the manifestos were looked at as a whole data set, looking for differences in code prevalence, and also numbers of TCs in the various stages of development as represented by their reflective manifestos. Second, a statistical analysis was conducted to determine significance in change of conceptual development over time. In order to meet statistical model assumptions, the groups were considered separately, looking only at complete sets of data from each licensure group: 22 from licensure group 1, and 25 from licensure group 2. Random coded documents were pulled periodically to ensure coding consistency.

The analysts recorded code and word counts of each document to explore code density (number of codes per total word count) and code prevalence. To study the viability and use of manifestos themselves as a measurement tool, multiple regression was conducted to determine whether the type of manifesto, total word count, number of codes represented, total number of codes, existence of references, and code density predicted the total manifesto score.

Results

Results indicate that TCs did show statistically significant growth in the use of conceptual tools over the first two semesters of the UCTE teacher education program. To compare manifestos statistically, a repeated-measures ANOVA, with Huynh-Feldt correction, was conducted to assess whether there were differences between the average teacher manifesto scores and core program components over time. The two licensure groups were considered separately, using complete sets of data for each. Assumptions of (a) independence of observations, (b) normality, and (c) sphericity were tested. The assumptions of independence of observations and normality were met in regard to total scores. The assumption of sphericity was violated, thus the Huynh-Feldt correction was used. Polynomial contrasts indicate a statistically significant linear trend, Group 1: $F(1, 21) = 15.51$, $p=.001$, $eta^2 =.42.5$; Group 2: $F(1,24) = 282.331$, $p<.001$, $eta^2 =.92$. Group 1 showed a medium effect size, with 41% and 42.5% of the variance explained by UCTE courses, while Group 2 showed a large one, with 89% and 92% of the variance explained. To see details of these findings, please see Appendix 2. Graphic representations of the findings are below in Figure 1.
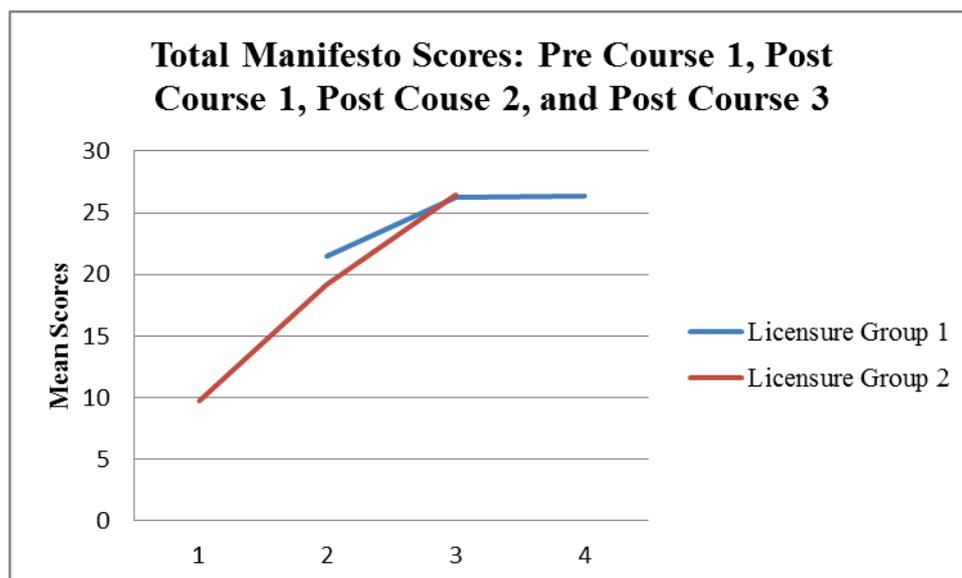
Figure 1. Analysis of change in concept use

In order to understand the development of TCs' use of individual codes over the initial series of courses, these codes were also analyzed using repeated measures ANOVA. In both licensure groups most codes showed significant growth and several had effect sizes accounting for more than 50% of the variance. Candidates' use of the concepts as tools appears to have developed over time. See Tables 4 and 5.

Table 4: Significant findings from both Licensure Group 1 and Licensure Group 2 for all UCTE core codes

Licensure Group 1	*(df)F*	*p*	*eta^2*, effect size	Observed Power[a]
General Pedagogy *(Course 3 = -1.2)	(2, 42) 33.52	.000	.62	1.00
Ped – assessment (*C1 = +3.2)	(2, 42) 35.04	.000	.63	1.00
Ped – differentiation (H) *(Course 3 = - 1.56)	(1.7, 35.0) 23.3	.000	.53	.98
Ped – Instruction *(Course 3 = -1.71)	(2,42) 11.84	.000	.36	.81
Social Justice *(Course 1 = -1.26)	(1.9, 39.6) -4.18	1.48	.17	.17
Collaboration (H)	(1.6, 33.2)1.79	.188	.08	.03
Inquiry (G) *(Course 2 = -1.70; Course 3 = -1.78)	(1.3, 26.5) -6.79	.010	.24	.22
Joint Production (H)	(1.95, 32.1) 10.7	.000	.34	.73
Caring Classroom (H) *(Course 2 = -1.2; Course	(1.6, 33.2) 18.11	.000	.46	.91

3 = -1.0)

	(df)F	p	eta², effect size	Observed Power[a]
J P activities (G)	(1.4, 29.5) 6.55	.009	.24	.27
Language	(2,42) 30.16	.000	.59	1.00
FOK connections (G) *(Course 1 = -1.1; Course 2 = -1.6; Course 3 = -1.6)	(1, 21) .46	.51	.02	.004
Challenging Curriculum (G)	(1.3, 28.2) .33	.63	.02	.003
Dialogue/instructional conv.(G) *(Course 1 = 1.17)	(1.4, 29.4) 1.6	.22	.07	.02
Total Manifesto (H)	(1.7, 34.6) 14.41	.000	.41	.82

Licensure Group 2	(df)F	p	eta², effect size	Observed Power[a]
General Pedagogy (H) *(Pre = +1.0; Couse 2 = +1.0)	(1.9, 45.5) 14.5	.000	.89	1.00
Ped – assessment (G) *(Couse 1 = + 6.0; Course 2 = +1.5)	(1.0, 24.8)10.7	.003	.31	.37
Ped – differentiation (H) *(Pre = +1.0)	(1.8, 40.6) 1.54	.226	.06	.03
Ped - Instruction	(2, 48) 11.6	.000	.33	.81
Social Justice (H) *(Course 1 = -2.4; Course 2 = -1.7)	(1.97, 47.2) 48.8	.000	.67	1.00
Collaboration (H) *(Pre = +1.2; Course 1 = +2.1)	(1.94, 46.4) 2.8	.072	.11	.09
Inquiry (G) *(Course 1 = -2.1)	(1.2, 28.2) 32.3	.000	.57	.98
Joint Production (H) *(Pre = +1.4)	(1.8, 42.8) 78.2	.000	.77	1.00
Caring Classroom *(Course 2 = -4.1)	(2, 48)	.000	.79	1.00
J P activities (H) *(Pre = 2.5; Course 1 = 1.3)	(1.98, 47.4) 25.5	.000	.52	.99
Language (G)	(1.24, 28.2) 39.3	.000	.62	.99
FOK connections (H) *(Course 1 = -1.5; Course 2 = - 1.2)	(1.6, 40.9)	.000	.70	1.00

Challenging C. (H) *(Pre = +1.4; Course 1= +1.0	(1.9, 47.6) 5.23	.010	.17	.27
Dialogue/group (H) *(Pre = +2.6; Course 1= +1.2)	(1.7, 41.2) 13.16	.000	.35	.81
Total Manifesto (H)	(1.84, 44.13)199.1	.000	.89	1.00

- a: Power computed using alpha = .001
- (H) or (G) indicates either the Huyn-Feldt or Greenhouse-Geisser adjustment to account for a violation of sphericity. The Huyn-Feldt is used when the violation is small.
- (* positive or negative number) indicates the direction and size of skew, a violation of normality against which repeated-measures ANOVA is fairly robust.

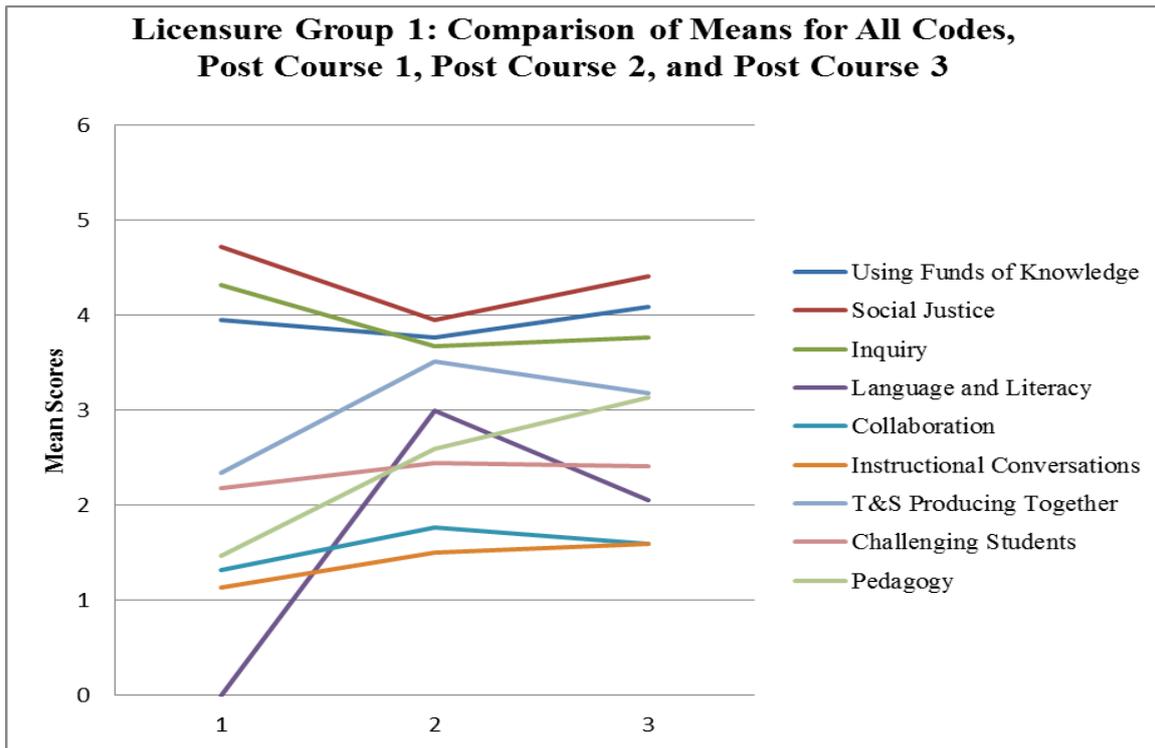Figures 2a and 2b provide graphic representations of these results.

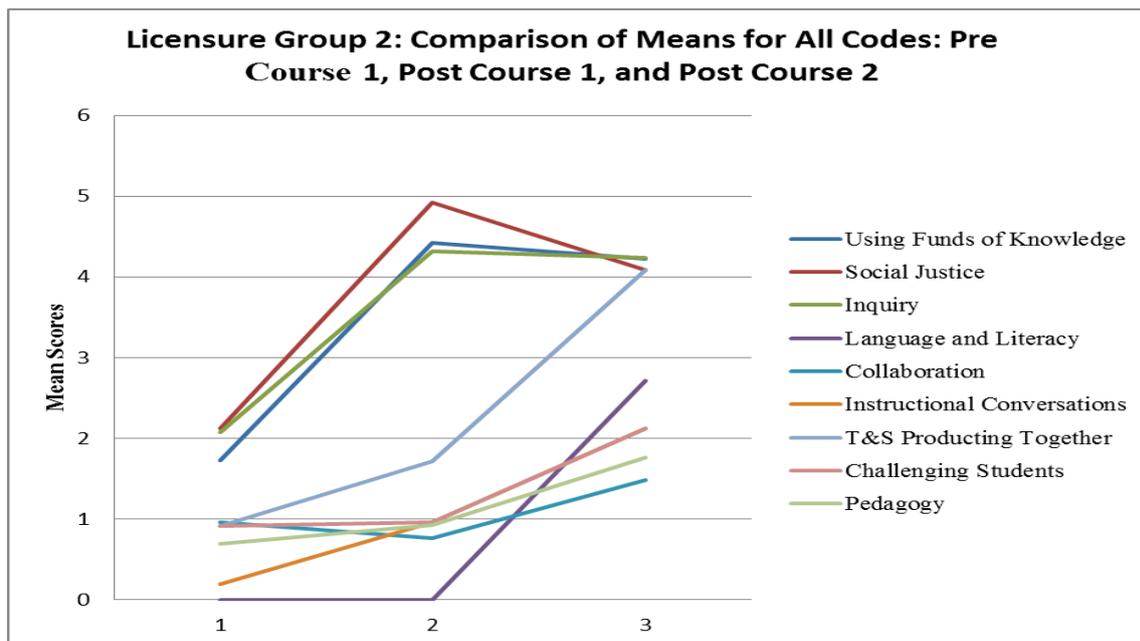*Figure 2a. Comparison of means for all codes Licensure Group 1*

Figure 2b. Comparison of means for all codes Licensure Group 2

To study the viability and use of manifestos themselves as a measurement tool, we tracked issues related to data collection and analysis as they occurred. The major issues that emerged were: 1) difficulty in collecting class products from instructors; 2) inconsistency in instructor requirements for the class products; 3) time and labor required in de-identifying data, which had to be done manually; 4) time and labor in analysis of the manifesto documents. We also conducted multiple regression to determine whether the type of manifesto, total word count, total number of codes represented, existence of references to codes, and code density were predictive of the total manifesto score. This combination of variables significantly predicted the total manifesto score, $F(5, 144) = 117.58$, $p < .001$. Table 7 suggests that two of the five predictor variables significantly contributed to the prediction: type of manifesto and number of codes. Thus, attention should be paid, not only to the consistency of manifestos across production by TCs and collection points, but to the type of manifesto collected. The type of manifesto consisting of a list of beliefs and intentions as well as an accompanying reflection on those beliefs and intentions is preferable.

Table 5: Simultaneous multiple regression analysis summary for variables predicting total manifesto score (N = 145)

Variable	B	SEB	b
Course	.83	.46	.10
Type of Manifesto	1.43	.41	.18*
Number of Codes Represented	1.97	.22	.61*
References Cited	.760	.60	.05
Total Number of Codes	.07	.04	.12

Note R squared = .81; $F(5,144) = 117.58)$, $p < .001$
* $p < .001$

Discussion

There were two purposes to this study. The first was to track the development of TCs' appropriation of conceptual tools over the course of their first two semesters as pre-service teachers. The second was to consider the viability of the teacher manifestos as a data source for measuring that appropriation. We address each of these below along with limitations of the study.

Appropriation of conceptual tools

The data on CTs' changing use of UCTE program's conceptual tools suggests that concepts were appropriated. Figure 1 illustrates that there was far more change in the sample from Licensure Group 2 whose manifestos were drawn from their pre-enrollment applications and at the end of course 1 and course 2, than is evident in the sample from Licensure Group 1, whose manifestos were drawn from the end of courses 1, 2, and 3. This indicates to us that using the manifesto in admissions documents provides a more accurate baseline of concept development, than after a course that emphasizes specific concepts. That TCs tended to use concepts more frequently and with more sophistication when they had just completed a course emphasizing those concepts supports this interpretation. What is interesting, however, is how similar the collective use of the conceptual tools by both groups is at the end of course 2. The TCs in both groups had moved from not mentioning or simply naming the concepts to using the concepts to explain or defend their beliefs and proposed actions. This corresponds to McNicholl & Childs (2010) description of Wartofsky's (1973/1979) secondary artifacts used as recipes, beliefs, and norms, to preserve and transmit ways of acting. This also corresponds to the Developing level in Cole's (1996) scale and somewhere between Grossman, Smagorinsky, and Valencia's (1999) third and fourth levels in which the teachers understand the features of the tool and are beginning to grasp the intellectual underpinnings that will later lead to use of the tool in new contexts to solve new problems.

The appropriation and use of key program concepts did differ slightly. For Licensure Group 1 the concepts with the greatest change were Pedagogy and Teachers and Students Working Together. The least change occurred in Funds of Knowledge, Challenging Classrooms, Dialogue, Collaboration and Social Justice. In Licensure Group 2, the greatest change was also Pedagogy, and Teachers and Students Working Together, while there was a also a positive change in Language, and a negative change in Inquiry. Licensure Group 2 also did not show a significant change from the end of Course 1 to the end of Course 2 in Funds of Knowledge, Challenging Classrooms, Dialogue, Collaboration and Social Justice.

Because our program supports advocacy and transformational pedagogy for social justice and equity, we were surprised at the lack of change in use of the concept of Social Justice and Equity for Licensure Group 1. The mean value of the theme across candidates was highest in Course 1 (M 4.72, SD 0.83), fell in Course 2 (M 3.95, SD 1.29), and rose again in Course 3 (M 4.41, SD 1.01). We hypothesized that changes in our advertising for the UCTE program might have led to recruitment of TCs who had already developed understanding of the concept. For Licensure Group 2, however, whose first manifesto was part of their admissions folders, the values were different. The mean values among candidates in this group (M 2.12, SD 1.36; M 4.92, SD 0.40; M 4.08, SD 1.04) suggested a lower baseline of understanding, a rise associated with Course 1, and then a moderate

decline. The relatively high baseline in both groups, as compared to the baseline values of other codes, lends credence to the recruitment argument, while the increase associated with Course 1 and decline in Course 2 support the interpretation of increased and more sophisticated use of codes associated with the course(s) in which they are emphasized.

We were also surprised by a small, but significant change in the concept of Language for Group 1. While not significant for Group 2, the trend in change of use is similar in that in the first iteration of the manifesto, for both groups, Language was not a concept in use, but by the end of Course 2, both groups were naming Language as a concept in different contexts, i.e., their appropriation of the concept as a tool was emerging.

As a contrasting example, we were surprised by the significant negative change in Inquiry over time among both groups particularly given a focus on Inquiry in all three courses. We consider that this finding may indicate a potential flaw in our analysis as the form of Inquiry stressed in Course 3 corresponds to two other codes: Pedagogy/Assessment and Connecting to Students' Lives.

In spite of the anomalous finding of negative change in the use of Inquiry as a conceptual tool, our data support the claim that TCs' use of conceptual tools key developed over time. This changing use of key concepts further suggests the development of an organizing lens, or the ability of "see" in ways that are beginning to approach the perspectives of more expert urban educators. According to Bransford, et al. (2000) this suggests emerging or developing adaptive expertise, which is similar to the findings of Grossman, et al. in the 1999 case studies. In summary, we conclude that our data do suggest the appropriation of conceptual tools by our TCs during the first two semesters of our program. Not incidentally, their coursework in the second semester includes field components that are carried out in a two-day per week formal internship in schools where the TCs experienced the opportunity to apply the concepts in classroom contexts. As did Grossman, et al.'s (2000) teachers who appropriated conceptual tools, they worked with conceptual tools in combination with practical experience with teaching skills and strategies. Having concluded that it is possible to track developmental change in the use of conceptual tools, we now move to consideration of the challenges of doing so.

Measuring the appropriation of conceptual tools

We enumerated specific challenges to our measurement approach above. Here, it is useful to note that one value of the teacher manifesto as qualitative data source is its form as an essentially open-ended general response, the specific content of which was not prompted. The manifesto has the disadvantages of self-report, but the advantages of minimal influence of researcher categories. That said, the challenges of the analysis we conducted, in particular, the lack of fidelity in implementation of the assignment and the time and labor requirements, suggest that this type of data will not be broadly used. Our experience has suggested to us that we may need to sample such a data source more selectively, looking at fewer, but representative examples. Additionally, nine a priori codes were too many. We need fewer and more predictive variables with which to code text-based data. Alternatively, we are considering the use of survey and other instruments to study concept appropriation more systematically and pragmatically. Such instruments, however, will by definition name the concepts to be addressed, rather than having the concepts emerge from the TCs themselves.

Limitations of the study

While we feel confident that the data we have presented support our claims, there are several limitations to this study. One is the relatively small sample size. Another is the lack of fidelity in data collection. The manifestos themselves were in different forms, and the iterations we sampled represented different (though overlapping) points in the semester. Another limitation was the use of a single data source in a qualitative study, which did not allow us to test our findings across data sources. Finally, in spite of our efforts to improve inter-rater reliability, our qualitative analysis was ultimately subjective, even when shared across raters. There are also qualitative researchers who would dismiss what can be called quantification of the qualitative data as a distortion, too far remove from the TCs, and heavily dependent on researcher categories.

Conclusion and implications

As a result of this study, in our UCTE program teacher manifestos will be collected upon admission, after the first course, after the first internship, and at program conclusion. The manifesto collected will be a list of beliefs and intentions with an accompanying iteratively-produced reflective essay. This essay allows students to represent more complex understandings. We will collect these data outside course work, because manifestos collected in courses tend to directly reflect components emphasized in that particular course.

Additionally, we learned that our candidates are perhaps drawn to our program because of existing interest in promoting equity and social justice, but that their defense of these ideals becomes more articulate over time. We learned that initially social justice, inquiry, and teacher and students producing together are dominant themes. We learned that collaboration, challenging students, and using instructional conversations were relatively weak. Language and literacy, though showing developmental change, did not factor in at the desired level. A benefit from this study is that the relatively lower levels of appropriation of these concepts suggest areas for program improvement.

We have also considered use of this analysis in future studies. These data can and should be used to triangulate findings gathered through other sources, such as the observational tool we use monthly to evaluate candidate development in situ in their internships. A simplified version of the manifesto analysis, using the number of codes represented might prove a more practical tool in triangulation. Similarly, a random sampling of manifestos might be used in program evaluation. Finally, data gathered from the final manifesto could potentially be used to as a tool in determining long-lasting program effects once our licensed teachers are practicing in the field, providing a new baseline for in-service appropriation of the conceptual tools.

There is renewed interest in the field of teacher education in the appropriation of conceptual tools. One example is Dooley's (2008) retrospective study of unsolicited conceptual change based on topics compelling to eight beginning literacy teachers, using Posner's (1982) developmental scale for concept development in science, which maps onto the scales used by Grossman, et al. (1999) and Cole (1996). Dooley reports slight shifts in conceptual development that she characterizes as "micro-transformations." Larkin (2012), also referring to Posner and to Grossman, analyzed the development of science concepts and multicultural concepts. Larkin argues for consistency in the unit of analysis for conceptual change among TCs whose conceptual growth occurs in social

interaction. Leko & Brownell (2011) used Grossman, et al. (1999, 2000) as their framework for analysis of special education (SPED) teachers' appropriation of conceptual tools. They found that new SPED teachers did not use conceptual tools if the context in which they were teaching was inhospitable. In more hospitable contexts they did. Leko and Brownell interpret this result as connected to a positivist/constructivist framework still at play in SPED that is relatively inflexible, in comparison to the more social constructivist framework informing the general education teachers in Grossman, et al.'s study and the present study. These few studies indicate interest, even in the current policy context that privileges measurement and skills, in documenting pre-service and in-service teachers' appropriation of conceptual tools to inform their instruction and ongoing learning.

In the forward to *Literacy teacher educators,* Lytle, (2013, pp. xv-xvi) upon her impending retirement as a teacher and teacher educator, states that "Teaching is complex; it is not composed of a set of discrete strategies or routines or even practices, no matter how studied and complicated the description. Teaching is first and foremost an adaptive, deliberative, agentive process, not a technical one." In the current context, teaching is all the more complex because teachers and teacher educators are embattled. Teachers require conceptual tools and adaptive expertise to make informed decisions in rapidly changing and diversifying contexts, and teacher educators require practical measurement tools for tracking the appropriation of those conceptual tools.

We began this study seeking evidence that our UCTE program affects the conceptual development of our TCs. Our data support the argument that TCs' use of conceptual tools key changes over time. This changing use of key concepts further suggests the development of adaptive expertise. The appropriation and use of conceptual tools to guide one's work provides TCs with key resources for developing the kind of adaptive expertise they will need to see the complexity of the changing needs of ever more diverse learners and to become responsive professional educators. Teacher educators who support the appropriation of conceptual tools among pre-service teachers promote not only the efficiency that comes with a solid repertoire of content and pedagogical content knowledge and skills, but the development of a conceptual framework from which to engage that repertoire.

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Appendix 1

STANDARDS PERFORMANCE CONTINUUM-PLUS: IUPUI 2009 VERSION 1.2
A Rubric for Observing Classroom Enactments of the Standards for Effective Pedagogy (Adapted by Teemant, Leland, and Adams (2008) at IUPUI from Doherty, Hilberg, and Tharp)

	NOT OBSERVED	EMERGING	DEVELOPING	ENACTING	INTEGRATING
General Definition:	*The standard is not observed.*	*One or more elements of the standard are enacted.*	*The teacher designs and enacts activities that demonstrate a partial enactment of the standard.*	*The teacher designs, enacts, and assists in activities that demonstrate a complete enactment of the standard.*	*The teacher designs, enacts, and assists in activities that demonstrate skillful integration of multiple standards simultaneously.*
Joint Productive Activity *Teacher and Students Producing Together*	Students work independently of one another.	Students are seated with a partner or group, AND (a) collaborate* or assist one another, OR (b) are instructed in how to work in groups, OR (c) contribute individual work, not requiring collaboration, to a joint product*.	The teacher and students collaborate on a joint product in a whole-class setting, OR students collaborate on a joint product in pairs or small groups.	The teacher and a small group of students collaborate on a joint product. (Teacher does not float.)	The teacher designs, enacts, and collaborates in joint productive activities that demonstrate skillful integration* of multiple standards simultaneously.
Language & Literacy Development *Developing Language and Literacy Across the Curriculum*	Instruction is dominated by teacher talk.	(a) The teacher explicitly models appropriate language; OR (b) students engage in brief, repetitive, or drill-like reading, writing, or speaking activities; OR (c) students engage in social talk while working.	The teacher provides structured opportunities for academic language development in sustained* reading, writing or speaking activities. (Sustained means at least 10 minutes. If it is a whole class arrangement, then more than 50% of the students are participating. No turn taking.)	The teacher designs and enacts instructional activities that *generate* language expression and development of 'content vocabulary,'* AND *assists* student language use or literacy development through questioning, rephrasing, or modeling. (Teacher can float.)	The teacher designs, enacts, and assists in language development activities that demonstrate skillful integration of multiple standards simultaneously.
Contextuali-zation *Making Meaning – Connecting School to Students' Lives*	New information is presented in an abstract, disconnected manner.	The teacher (a) includes some aspect of students' everyday experience in instruction, OR (b) connects classroom activities by theme or builds on the current unit of instruction, OR (c) includes parents or community members in activities or instruction, OR (d) connects student comments to content concepts.	The teacher makes incidental* connections between students' prior experience/knowledge from home, school, or community and the new activity/academic concepts.	The teacher integrates* the new activity/academic concepts with students' prior knowledge from home, school, or community to connect everyday and schooled concepts. (Teacher does not have to be present. This can be about activity design.)	The teacher designs, enacts, and assists in contextualized activities that demonstrate skillful integration of multiple standards simultaneously.
Challenging Activities *Teaching Complex Thinking*	Activities rely on repetition, recall, or duplication to produce factual or procedural information.	The teacher (a) accommodates students' varied ability levels, OR (b) sets and presents quality standards* for student performance, OR (c) provides students with feedback on their performance.	The teacher designs and enacts 'challenging activities'[1] that connect instructional elements to academic content OR advance student understanding to more complex levels.	The teacher designs and enacts challenging activities with clear standards/expectations and performance feedback, AND assists* the development of more complex thinking. (Teacher can float.)	The teacher designs, enacts, and assists in challenging activities that demonstrate skillful integration of multiple standards simultaneously.
Instructional Conversation *Teaching Through Conversation*	Lecture or whole-class instruction predominates.	With individuals or small groups of students, the teacher (a) responds in ways that are comfortable for students, OR (b) uses questioning, listening or rephrasing *to elicit student talk*, OR (c) converses on a nonacademic topic.	The teacher converses with a small group of students on an academic topic AND *elicits student talk* with questioning, listening, rephrasing, or modeling.	The teacher: designs and enacts an instructional conversation* (IC) with a clear 'academic goal'***; listens carefully to assess and assist student understanding; AND questions students on their views*, judgments, or rationales. Student talk occurs at higher rates than teacher talk. (No floating.)	The teacher designs, enacts, and assists in instructional conversations that demonstrate skillful integration of multiple standards simultaneously.
Critical Stance *Teaching to Transform Inequities*	Instruction that reflects appropriate content-area standards. Teacher-led instruction or student work focused on worksheets, factual information, or responses to close-ended questions.	The teacher designs instruction using variety, which includes a) multiple sources of information; OR b) values and respects multiple perspectives; OR c) supports learning through multiple modalities.	Using variety, the teacher designs instruction that positions students to generate new knowledge resulting in a) original contributions, products, or expertise OR b) students' questioning and reflecting on issues from multiple perspectives.	The teacher designs or facilitates instruction that consciously engages learners in a) interrogating conventional wisdom and practices; AND b) reflection upon ramifications of such practices; AND c) actively seeks to transform inequities within their scope of influence within the classroom and larger community.	The teacher designs, enacts, and assists in critical stance activities that demonstrate skillful integration of multiple standards simultaneously.

[1] Students generate new knowledge by _using_ information to perform complex tasks that require various forms of elaboration such as analysis, synthesis or evaluation.

* See glossary

Center for Research on Education, Diversity & Excellence (CREDE)

Appendix 2

Licensure Group 1 Means and Standard Deviations for Nine Core Codes with Sub-codes Included; *N*=22 complete sets of data

Code	Course 1		Course 2		Course 3	
	M	*SD*	*M*	*SD*	*M*	*SD*
General Pedagogy	1.47	0.66	2.59	0.95	3.14	0.77
Ped. Assessment	0.14	0.47	3.09	1.9	2.73	1.8
Ped. Differentiation	1.5	1.54	1.82	1.5	3.55	1.14
Ped. Instruction	2.14	1.32	2.86	1.13	3.64	1.22
Social Justice and Equity	4.72	0.83	3.95	1.29	4.41	1.01
Collaboration	1.32	1.67	1.77	1.77	1.59	1.87
Inquiry	4.32	0.71	3.68	1.13	3.77	1.51
Total Teachers & Students	2.34	1.26	3.52	1.13	3.18	1.34
T&S Class Community	3.23	1.34	4.55	0.67	4.55	0.67
T&S Joint Production	1.36	1.53	2.55	2.02	2.14	1.83
Language and Literacy	0	0	3	1.9	2.05	1.91
Using Funds of Knowledge	3.95	1.29	3.77	1.19	4.09	1.38
Challenging Students	2.18	1.79	2.45	1.62	2.41	1.65
Instructional Conversation	1.13	1.36	1.5	1.65	1.59	1.47
Total Score	21.44	5.01	26.25	5.42	26.31	6.76

Licensure Group 2: Means and Standard Deviations for Nine Core Codes with Sub-codes Included; *N*=25 complete sets of data

Code	Pre		Course 1		Course 2	
	M	*SD*	*M*	*SD*	*M*	*SD*
General Pedagogy	0.71	0.66	0.93	0.87	1.76	0.99
Ped. Assessment	0.00	0.00	0.40	0.20	0.88	1.30
Ped. Differentiation	0.96	1.37	1.28	1.40	1.56	1.61
Ped. Instruction	1.28	1.27	1.61	1.57	2.98	1.53
Social Justice and Equity	2.12	1.36	4.92	0.40	4.08	1.04
Collaboration	0.96	1.51	0.76	1.42	1.48	1.78
Inquiry	2.08	1.87	4.32	0.63	4.24	0.52
Total Teachers & Students	0.92	0.90	1.72	1.33	4.08	0.98
T&S Class Community	1.56	1.36	2.28	1.49	5.00	0.00
T&S Joint Production	0.36	0.91	1.20	1.89	3.36	1.82
Language and Literacy	0.00	0.00	0.00	0.00	2.72	2.17
Using Funds of Knowledge	1.73	1.43	4.42	.76	4.23	1.21
Challenging Students	0.92	1.44	1.15	1.52	1.73	1.48
Instructional Conversation	0.20	0.50	0.96	1.27	2.12	1.90
Total Score	9.74	4.37	19.15	3.62	26.44	5.04