Teaching Perspectives Among Introductory Computer Programming Faculty In Higher Education

by

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M.S., Robert Morris University, 2004

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Submitted to the Graduate Faculty of the

School of Information Systems and Communications

in partial fulfillment of the requirements for the degree of

Doctor of Science
in
Information Systems and Communications

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Barbara J. Levine, Ph.D., Dean July 19, 2011

Robert Morris University
2011

Abstract

This study identified the teaching beliefs, intentions, and actions of 80 introductory computer programming (CS1) faculty members from institutions of higher education in the United States using the Teacher Perspectives Inventory. Instruction method used inside the classroom, categorized by ACM CS1 curriculum guidelines, was also captured along with information to develop a demographic profile of respondents. Introductory computer programming faculty combined beliefs, intentions, and actions scores displayed a dominant trend within the apprenticeship perspective while indicating a general preference for the imperative-first instruction method. This result indicates possible misalignment regarding the underlying value of these teachers to simulate the experience of computer programming in comparison to their non-traditional instructional approach of lecture and textbook learning. The factors of teaching experience and first language were found to have significant influence on faculty particularly within the social reform perspective, indicating established faculty members possess the intent to change society for the better while instructors born outside of the U.S. are more likely to actually teach through this perspective.

I dedicate this dissertation to my family, especially to Emily for her patience, love, and support during this journey; to Mom and Dad for instilling the importance of hard work and higher education; to Lara and Aunt Sue for encouragement; my grandparents for inspiring me to always succeed.

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CHAPTER I

INTRODUCTION

Higher education systems in the United States are under a watchful eye as global competition forces the nation to look towards the next generation of students who will be expected to guide the future of the country. In his 2011 State of The Union address, U.S. President Barack Obama pushed for the United States to have the highest proportion of graduates worldwide by the year 2018. Due to projected investments in biomedical research and information technology, Obama (2011) also stressed the need for 100,000 new teachers in science, technology, engineering, and math known as STEM subjects.

The Presidents remarks were not unexpected as Obama (2010) stated the following in earlier commentary on higher education and the economy at the University of Texas at Austin:

> I want you to know we have been slipping. In a single generation, we've fallen from first place to twelfth place in college graduation rates for young adults…In one generation we went from number one to number twelve. Now that's unacceptable, but it's not irreversible. We can retake the lead… (p. 1).

Still, even before Obama's took the oath of office, the National Center for Public Policy in Higher Education reported in 2006 that the U.S. was no longer a "clear-cut, top-performer in participation and [college] completion rates" and how well the nation responds to the challenge set forth may determine the "competitiveness of its workforce" (Wagner, p. 4). Nowhere is the need for an increase in undergraduate completion rates more critical than in the discipline of computer science (CS).

According to the 2010-2011 edition of the U.S. Bureau of Labor Statistics Occupational Outlook Handbook (2009), approximately 72,000 new computing jobs will be created over the next decade in software engineering, networking, systems analysis, and support. While Adams (2010) notes that no other STEM discipline will see more than 10,000 new jobs created over ten years, computing vacancies are expected to outnumber CS graduates by a margin of approximately two-to-one between 2011 and 2018. Yet, according to Renee McCauley Owens (2011), board chair of the Association of Computing Machinery Special Interest Group on Computer Science Education (ACM SIGCSE), some CS degree programs are being cut or downgraded due to budget concerns and declining trends in student enrollment. For instance, Owens (2011) cites a report confirming that SIGCSE member institution Albion College terminated their computer science program without faculty consultation in 2010.

These trends are unsurprising considering undergraduate enrollment in CS has been cyclical between 2000 and 2011. For example, after the “dot-com” burst of 2001, student interest in CS as a major fell 60% from 2000 to 2004. The significant downward trend continued through the decade until 2007 when enrollment began to gradually increase (Vegso, 2005, Zweben, 2010). With expected demand for information technology workers on the rise, the challenge of attracting and retaining the next generation of incoming CS majors has become a significant concern for computing educators (Adams, 2010, Dann & Cooper, 2009).

A number of factors have been attributed to declining enrollment trends and dropout rates among the CS undergraduate population. These factors include lack of computer experience, poor math skills, low self-efficacy (one’s belief in his or her ability to accomplish a task), and the university environment itself (Bandura & Locke 2003, Moskal, Lurie & Cooper, 2004). Although some of the blame is shared between the university and its' students, a major cause for the decline of CS majors focuses on the ineffectiveness of computer programming instruction (Beaubouef & Mason, 2005). For example, a traditional programming course may consist of lectures, textbooks, and programming exercises with minimal guidance from the instructor. Although these methods are popular and facilitate the requirement toward a CS degree, Kirschner, Sweller & Clark (2006) find that direct instructional guidance or heavily guided instruction methods prove more effective and efficient because they correlate directly with human cognitive architecture also known as natural human learning tendencies. The debate over instruction methods has led to the question of how to best teach computer programming to students with no prior subject-matter knowledge.

As a tactic for measuring outcomes related to the success of students enrolled in introductory computer programming (CS1) courses, student achievement metrics are paramount in understanding the effects of instruction methodologies on their intended subjects. Student achievement is a measure of a school's overall success as analyzed by major stakeholders throughout the institution and is an important factor in earning and maintaining institutional accreditation. According to one such accrediting body, The Higher Learning Commission (2003) states student academic achievement is a linchpin factor in the process of attaining accreditation. This critical concept has been framed by several researchers attempting to better understand related factors (King & Kitchener, 1994, Perry, 1999). However, it is noted that this research has focused solely on the students and not the instructors responsible for their education.

Despite the substantial body of research surrounding undergraduate student achievement, several researchers have chosen to focus on faculty development and success. Kalivoda, Broder & Jackson (2003) argue formal training of post-secondary educators does not exist amongst many colleges and universities related to student evaluation, classroom management, and instruction methods. In a study on post-secondary CS1 instructor training, Beaubouef et al. (2005) highlights the need for further research related to the faculty development process. In addition, Pratt (2005) outlines that formal training does not occur among many faculty members.

Pratt's research in faculty development concluded in the development of the Teaching Perspectives Inventory (TPI), an instrument with the ability to quantify a teacher's perspective toward classroom education (Collins and Pratt, 2010). This instrument was utilized by Kehres (2008) in a study evaluating the intentions, beliefs and actions of faculty members in the occupational therapy profession. For the purposes of analyzing the issues related to a lack of general faculty self-reflection in CS1 education, the TPI was used in this study to quantify the variables of beliefs, intentions and actions in each teaching perspective and investigate their correlation to applied instruction techniques and experience.

Statement of Problem

Introductory computer programming faculty may have increased time demands. Due to their schedule demands, a professor may ignore their own teaching development (Wlodarsky & Walters, 2007). As cited by Kehres (2008), Murray and MacDonald (1997) note that disjunction can exist between faculty perceptions of teaching and their actions in the classroom environment (1997). Kinnunen, Meisalo & Malmi (2010) point out how teachers play a central role in the theater of computer science education. Illustrating the need for self-reflection, this study utilized the Teaching Perspectives Inventory (TPI) as a means of better understanding faculty intentions, beliefs and actions toward teaching. Developed by researcher Dr. Daniel D. Pratt in 1993, the TPI questionnaire consists of 45 survey questions designed to measure an individual faculty member's commitment to facilitate the learning process. According to Pratt, the TPI "yields five alternative points of view (perspectives) on teaching by asking structured questions about teachers' actions in the teaching setting, their intentions [on] how they organize the learning situation, and their beliefs about fundamental principles of teaching and learning" (Pratt & Collins, n.d.). Each of Pratt's five teaching perspectives are described in Appendix A.

Research Questions

In order to further explore the problem, this study will answer the following questions:

1. What are the expressed beliefs, intentions, and actions of introductory computer programming faculty in each of the five teaching perspectives as defined by Pratt?
2. Which of Pratt's five teaching perspective scores are considered dominant within each instructional method category?
3. Does an introductory computer programming faculty member's amount of overall teaching experience influence any of their five teaching perspective scores?
4. Does an introductory computer programming faculty members amount of professional experience outside the classroom influence any of their five teaching perspective scores?

Delimitations of the Study

Due to the scope and reach of this study, findings may not be generalizable across the population of all full-time introductory computer programming faculty employed at colleges and universities within the United States. Participants may skew the overall population as it should be noted that those who replied to the survey may be personally invested in this line of research.

Limitations of the Study

As noted in another study using the TPI (Kehres, 2008), the threat of internal validity exists in that Pratt (2005) describes the TPI as an instrument to guide in teacher self-reflection for improving personal teaching practices in higher education and not a measure of actual teaching practice. It has also been noted that studies involving usage of the TPI could be improved through confirming the actions of teachers in the classroom using independent third party observation.

Definition of Terms

Introductory Computer Programming Faculty – respondents who indicated that they have taught or currently teach an introductory computer programming course at the collegiate level in the United States.

Teaching Perspective – Pratt et al. (1998) define teacher perspectives as "an interrelated set of beliefs and intentions which give meaning and justification for actions" and the lens in which the teacher views the "world of teaching and learning" (p. 33).

Actions – techniques used in the classroom to engage learners in the content (Pratt et al., 1998, p. 17).

Intentions – defined by Pratt et al. (1998) as "an expression of what a person is trying to accomplish and, usually, an indication of role and responsibility in pursuit of that" (p. 18). It is "the teacher's statement of purpose, responsibility, and commitment directed towards learners, content, context, ideals, or some combination of these" (p. 18).

Beliefs – the core of an individual's value system and according to Pratt et al. (1998), the most stable and least flexible aspect of a person's perspective on teaching" (p. 21).

Instruction methodology – a framework or instructional model used to teach introductory computer programming. Seven models for the instruction of introductory computer programming are outlined by the Association of Computing Machinery (2001) as follows:

Algorithms-first - strategy that focuses on algorithms over syntax, and a hardware-first model that begins with circuits and then builds up through increasingly sophisticated layers in the abstract machine hierarchy (p. 24).

Breadth-first - provides a more holistic view of the computer science discipline as a whole introducing theoretical topics and math before diving into more traditional programming language instruction (p. 31).

Breadth-second – introduces a survey of the field of computer programming after a traditional programming language instruction is completed (p. 32).

Functional-first - introduces algorithmic concepts using a simple functional programming language such as 'Scheme' challenging students to think abstractly before learning a more mainstream programming language (p. 32).

Hardware-first – introduces computer science basics at the machine level before moving onto more abstract programming concepts (p. 33). This approach focuses first on the fundamentals of computer hardware prior to learning computer programming languages.

Imperative-first – the most traditional computer programming instruction model focusing on imperative language attributes first before moving on to more abstract concepts found in object-oriented programming (p. 29).

Objects-first – unlike traditional instruction models such as imperative-first the objects-first methodology introduces object-oriented programming at the very beginning before moving on to more traditional concepts such as algorithms, data structures and other mathematical procedures (p. 30).

Outline of the Study

In Chapter Two, a history of teaching practices was explored through a summary of research pertaining to theories of adult education in the United States. Research was then highlighted corresponding to the renewed awareness in the profession of teaching throughout the 1980's and 1990's. In addition, popular teaching perceptions, also known as conceptions, are reviewed along with Pratt's General Model for Teaching and Teacher Perspectives Inventory (TPI). Finally, an overview of undergraduate attrition in computer science is presented along with a description of literature on the teaching of introductory computer programming.

In Chapter Three, a design of the research preformed was outlined along with detail of the sample population. The TPI survey instrument is also further explained along with its use in this study. Additionally, data collection and analysis procedures are described.

Chapter Four includes a comprehensive review of the results from the TPI including frequency analysis, crosstabulations between teaching perspective dimensions and demographics and linear regression analysis. Chapter five consists of a discussion on results found including whether or not the results support the research questions posed. Finally, implications for practice and directions for further research are proposed.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

A careful review of the literature revealed there are different opinions on the topic of instruction in higher education. The research summarized below will outline a history of education perspectives from 20th century theorists as well as empirical research from the past 10 years. In addition, Pratt's General Model for Teaching is reviewed along with the background relating to Teacher Perspective Inventory (TPI) instrument chosen for this study. Finally, literature on undergraduate CS student attrition is presented and key authors in this space are reviewed.

Theoretical Literature

Before the 1960s, institutions throughout the United States held the belief that adult learning and instruction held the same values and principles as adolescent learning and instruction (Holmes & Abington-Cooper, 2000). This type of instruction is commonly described as Pedagogy, a term derived from the Greek words *paid* – "child" and *agogus* – "leader of". The origin of Pedagogy can be traced back to seventh century Europe and, directly translated, is the art and science of teaching children (Holmes et al., 2000, Knowles, 1973). According to Holmes and Abington-Cooper (2000), it was not until the mid 1960s that adult educators began to "question the validity of pedagogical assumptions" and the andragogical model began to take shape (p. 50).

Malcolm Shepherd Knowles (1973; 1980) is regarded as 'the' principle source on adult learning and education in the United States and his research went far to change the mindset around adult instruction. Through his work, Knowles popularized the term "andragogy", a term originally coined in the 1830s and derived from the Greek word *aner* taken from the stem *andra* meaning "man, not boy" or adult, and *agogus* meaning "leader of"(Holmes et al., p. 50). Knowles (1973) argued that the philosophy behind graduate education in colleges and universities, that of memorizing and attaining high scores on standardized tests like the SAT, was more than a "generation behind what we now know about learning". Knowles also agreed with Roman and Eastern educational traditions and ways of teaching; he asserted that teachers such as Jesus, Socrates, Plato and Aristotle among others, viewed learning as a "process of discovery by the learner" (1973, p. 42). When monastic schools of the seventh century thought this way of instruction to be pagan, the belief was held for centuries that children should be taught in the same manner as monks in order to control their development into "obedient, faithful and efficient servants of the church" (Knowles, 1973, p. 42). In other words, Knowles firmly believed the pedagogical framework used in adult learning was a paradox or a "contradiction in terms" (1973, p. 42).

Andragogical Theory

The following section summarizes Knowles' (1973) four main assumptions differentiating androgogy from pedagogy also known as andragogical theory.

Changes in self concept. According to Knowles, the transition between adolescence into adulthood is defined by an increase in self-directedness. The less a person depends on others, the more they develop a psychological desire to be viewed as a self-directing individual. This is an assumption in andragogical theory that helps to define the preferred learning experience of the adult. Knowles (1973) states that tension may occur when adults are deprived from being self-directing and this tension can cause a resentment and disruption in the learning process (p. 45).

The role of experience. Life experience plays a key role in andragogical theory in making the assumption that the more a person is exposed to life experiences such as holding a job, making financial decisions, and starting a family the more a person uses their experiences, as Knowles states, “as a resource for learning” (1973, p. 46). Moreover, Knowles adds that people define themselves as a sum total of their own personal experiences and therefore any learning situation that fails to recognize their experience can diminish their sense of being. In other words, he assumes that importance should be placed on a student’s level of experience when structuring a curriculum for adult learners.

Readiness to learn. A key difference between pedagogical and andragogical schools of thought lies in the motivation adults have to learn versus an adolescent’s motivation to learn. Social context for learning is an important concept for adults in that there is a perceived correlation in an adult’s need to learn and their evolving social role (Knowles, 1973, p. 46). For example, pedagogical thought dictates that a child’s readiness to learn is steered by their ‘biological and academic development’ whereas, according to Knowles (1973), the assumption is that adults will further their own learning when there is a need to elevate or adjust their role in society (p. 46). As he also states, this concept was first defined by McClelland’s (1970) ‘Achievement motives’ as a development strategy for adults.

Orientation to learning. Knowles (1973) final assumption about what separates andragogical thought from pedagogical thought is the way in which adults are conditioned to learn, being different than children. For example, children are conditioned to a more 'subject-centered orientation' meaning that education is centered around a broad range of topics for use toward a variety of yet to be determined applications (Knowles, 1973, p. 47). Timing is the key difference as adult learners will take more of a 'problem-centered orientation' to learning in that there is a more immediate need to apply the subject matter in order to use it in their field of experience.

Constructivist Theory

As Pratt (2002) states, the adoption rate of a constructivist learning perspective has grown among the general faculty population in North America and around the world. However, according to Ben-Ari (1998), computer science faculty members have been slow to adopt constructivist theories of learning.

As Pratt (2002) states, the constructivist theory of learning states that learning changes one of two things inside the brain:

> First, when a new experience fits with what someone already knows, it builds a stronger and more elaborate pathway to that knowledge. Second, if a new experience or new content doesn't fit the learner's current way of knowing, s/he must either change the old way of knowing or reject the new knowledge or experience. The goal is to change the way learners think, rather than increase their store of knowledge (p. 4).

The work of developmental psychologist and philosopher Jean Piaget (1954; 1971) helped to define constructivist theory. Through his research related to the ways in which children transfer knowledge, Piaget was able to theorize how knowledge grows within the mind and his findings conclude that knowledge is progressive with logical ideas built upon existing ideas over time (1954; 1971).

Ben-Ari (1998) argues that by taking into account two characteristics of constructivist theory, computer science faculty can aid students in their own cognitive model of computer science. As Ben-Ari (1998) states, these characteristics include; (1.) "A (beginning) CS student has no *effective* model of a computer" and (2.) "the computer forms an *accessible ontological reality*" (p. 259). In other words, Ben-Ari believes that students should be given experiences which stimulate the senses (effective models) such as hands on learning with computers and lecture based study, knowing that solutions are always accessible (accessible ontological reality). In addition, Ben-Ari's (1998) argument for constructivism in computer science education has been demonstrated in several additional studies (Van Gorp & Grissom, 2001; Hadjerrouit, 1999).

However, Pratt (2002) illustrates that faculty should resist the temptation to adopt a 'one size fits all' method of teaching. Pratt (2002) also notes self-reflection is most important in a faculty member's development and rather than adopt a specific approach, the faculty member should recognize their own dominant teaching perspective and reflect on "what they do, why they do it, and on what grounds those actions and intentions are justified" (p. 9).

Teaching Conceptions

The literature on teaching conceptions demonstrates a healthy consideration for how researchers value its association to positive student outcomes. According to Kember (1997), teaching conceptions and underlying beliefs are important to the measures related to the "quality of student learning" (p. 255). In a review of empirical research concerning beliefs and conceptions of university faculty, Kember (1997) found 13 independent studies examining the connection between faculty conceptions of teaching and student outcomes (Dall'Alba, 1991; Dunkin, 1990, 1991; Dunkin & Precians, 1992; Fox 1983; Gow & Kember, 1990, 1994; Martin & Balla, 1991; Martin & Ramsden, 1992; Pratt, 1992; Prosser, Trigwell, & Taylor, 1994; Samuelowicz & Bain, 1992; Trigwell, Prosser, & Taylor, 1994).

The relationship between intentions of university faculty and their strategies in the classroom were also found to be important in improving student learning (Trigwell & Prosser, 1996; Trigwell et al., 1994). Trigwell et al. (1996) argue that the focus of faculty development is centered on the improvement of instruction to increase the "quality of student learning" (p. 85). However, Trigwell et al. (1996) note that introducing new teaching strategies alone will not yield an improvement in student outcomes. Conceptual change leading to improvements in teaching is not achieved through short term training sessions but long term systematic approaches relying upon self-reflection (Trigwell et al, 1996). Self-reflection is defined, for the purposes of this study, as a faculty member's reflection of their own instruction methods and the outcomes related to those methods.

Furthermore, Putnam and Borko (1997) support self-reflection in teacher development asserting "Teachers should be treated as active learners who construct their own understandings" (p. 1225). McAlpine and Weston (2000) also agree stating "Fundamental changes to the quality of university teaching…are unlikely to happen without changes to professors' conceptions of teaching" (p. 377).

Yet, methods to investigate teacher conceptions in higher education are varied. This makes it very difficult, according to Murray et al. (1997), to make direct comparisons between findings. In addition, Pajares (1992) emphasizes the inconsistency in terminology used across studies to describe faculty beliefs such as orientations, conception, beliefs, approaches and intentions. Kember (1997) notes the word "conceptions" as the most common term found in literature between 1990 and 1994 and is defined by Pratt (1992) below:

> Conceptions are specific meanings attached to phenomena which then mediate our response to situations involving those phenomena. We form conceptions of virtually every aspect of our perceived world, and in so doing, use those abstract representations to delimit something from, and relate it to, other aspects of our world. In effect, we view the world through the lenses of our conceptions, interpreting and acting in accordance with our understanding of the world (p. 204).

Yet, Collins states that Pratt stopped using the term "conceptions" after his 1998 book, *Five Perspectives of Teaching in Adult and Higher Education*, appeared on shelves (personal communication, April 6, 2011).

In research conducted by Murray et al. (1997), a gap was found between expressed teaching intentions and expressed instructional methods. Through a qualitative analysis of business faculty member interviews investigating teaching intentions and expressed actions, Murray et al. (1997) concluded disjunction between intentions and actions may be the result of a lack in self-reflective development and training. Conversely, Kember & Kwan (2000) finds a close connection between conception and practice in research investigating 17 university lecturers across engineering, social science, and paramedical departments.

Zhang (2001) compared teaching approach to teaching conception using the Approaches to Teaching Inventory (Trigwell et al., 1996) and the Thinking Styles in Teaching Inventory (Grigorenko & Sternberg, 1993) along with questions related to participant perceptions of their work environment. Zhang (2001) found a significant relationship between teaching approaches and thinking styles. Investigations by Norton, Richardson, Hartley, Newstead, & Mayes (2005) into teaching beliefs and intentions across four institutions in the United Kingdom and found intentions reflected "a compromise between conceptions of teaching and their academic social contexts" (p. 537). Norton et al. (2005) also examined whether or not the level of a teachers experience inside the classroom had an impact on their beliefs, likewise, they categorized teachers into three categories: New, Experienced, and Established. Prosser, Ramsdent, Trigwell, & Martin (2003) found the "relationship between approaches to teaching and perceptions of the teaching context are consonant and coherent for more senior teachers" (p. 37). The positive correlation between approaches and perceptions were found in classes where "students report a higher quality learning experience" (Prosser et al., 2003, p. 37).

Teaching Perspectives

The term perspective is defined by Pratt (2002) as, "an inter-related set of beliefs and intentions that gives direction and justification to our actions" (p. 1). A faculty member may not be fully aware of their own beliefs, intentions and actions in the classroom because a perspective, according to Pratt (2002), is a lens in which a person looks through, not at. Pratt (1998) also states that a faculty member's beliefs, intentions and actions should align more and more as teaching experience increases. He further adds that more often than not, alignment between beliefs, intentions and actions are inconsistent and a faculty member's actions or instruction methods used inside the classroom may discourage their "noble aims" or their beliefs and intentions. Furthermore, Pratt (1998) states it is not only important to understand ones own personal perspective on teaching, it is equally important to consider other perspectives or ways of thinking in order to remain non-judgmental and open minded for assessing different points of view and perspectives of teaching, both good and bad.

To expand on his theory, Pratt's (1998) General Model of Teaching is presented in Figure 2.1. The model consists of five elements; teacher, learners, content, ideals and context. How each of these elements relate are signified by lines X (learner-context), Y (teacher-learner), and Z (teacher-context). To further describe the relationship between each of the elements, Pratt (1998) explains that line X relates to the means in which learners are engaged in the content, line Y relates to the way in which an instructor interacts with the learner or gives feedback to the learner, and line Z relates to an instructors content knowledge or expertise. Pratt (2010) notes that the General Model of Teaching does not signify best practices of teaching, but instead, it treats all elements as neutral, respecting the practice of instruction in adult and higher educational settings.

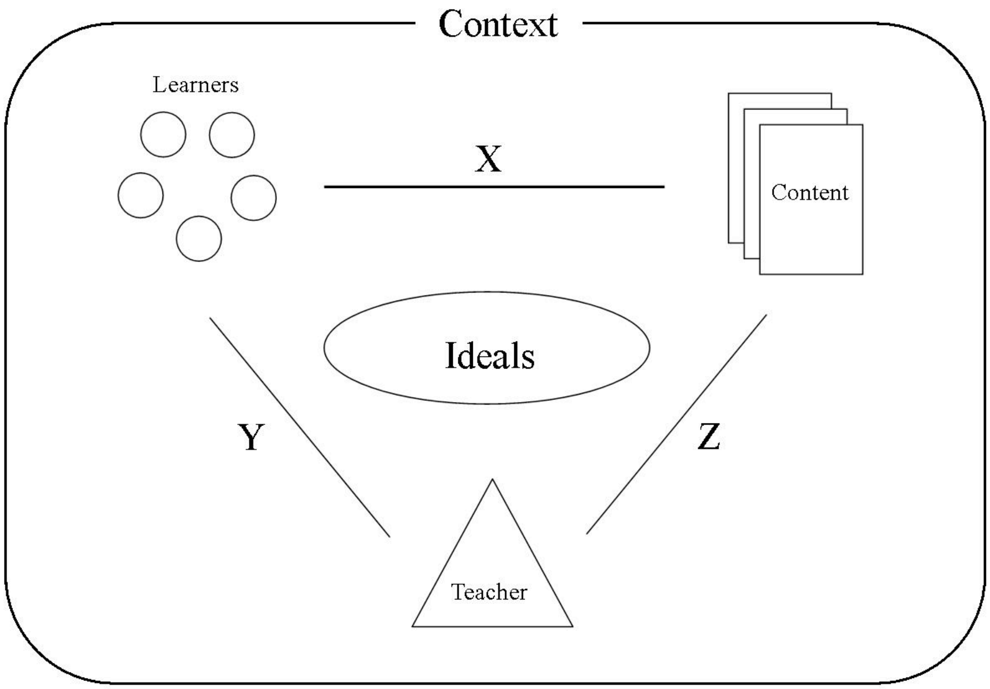

Figure 2.1 Pratt's (1998) General Model for Teaching

Within the model, faculty members may show greater or lesser commitment to some elements over others (Pratt, 1998). Pratt (1998) defines commitment as a sense of "loyalty, duty, responsibility, or obligation associated with one or more elements within the General Model of Teaching" (p. 7). Pratt (1998) also states that a teacher's commitment "is revealed through the way a person teaches (actions), what a person is trying to accomplish (intentions) and statements of why those actions and intentions are reasonable, important or justifiable (beliefs)" (p. 7). A stronger commitment towards one or more elements can help define a prominent view or perspective on teaching (Pratt, 1998).

Throughout 10 years of research observing and interviewing over 250 instructors in higher education, Pratt (1998) found a prevailing pattern of five different teacher perspectives; transmission, apprenticeship, development, nurturing, and social reform. The transmission perspective is described by Pratt (1998) as the "most traditional" and long standing perspective on teaching (p. 39) emphasizing the importance of course content. Figure 2. 2 models how faculty within this perspective view learning as a transmission of delivery directly from the teacher to the learner as indicated by the direction of the arrow. Pratt (1998) acknowledges that teachers who are dominant in this perspective view themselves as content experts. He further notes that teachers believe lessons are dependent upon subject matter previously covered with topics building upon one another throughout the course until skills are mastered.

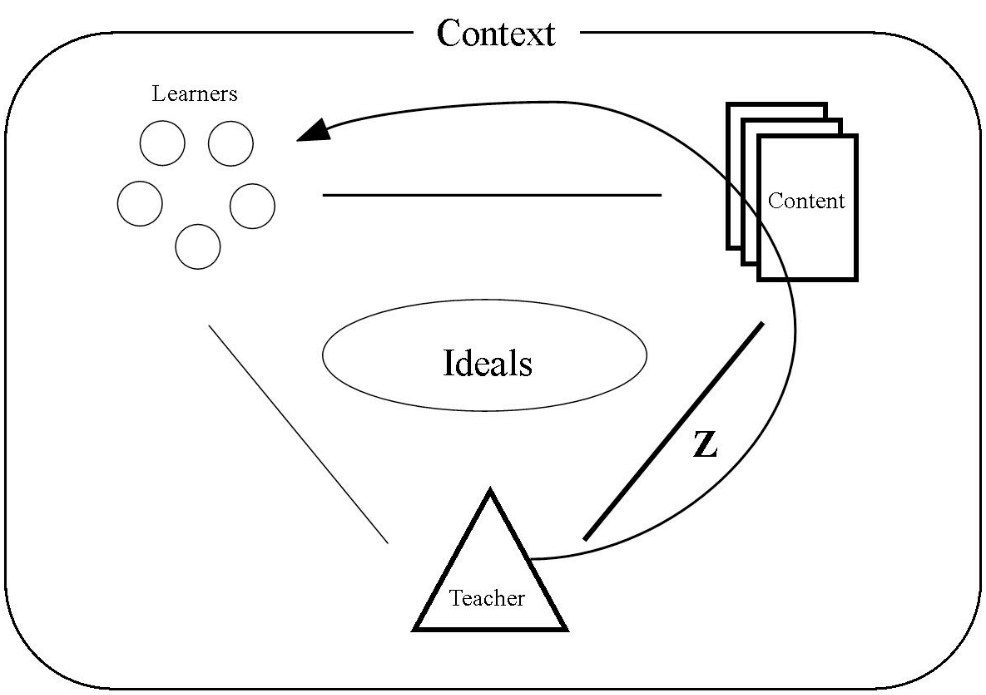

Figure 2.2 Transmission Perspective Model

Unlike the transmission perspective's separation between teacher and content, Pratt (1998) describes faculty within the apprenticeship perspective as being one with their content, understanding the importance of the community within their discipline. In other words, faculty are "an extension of the values and knowledge as lived or practiced within that community" and inseparable from the "context of the situation in which it was learned (p. 43). Indicated in Figure 2.3, teachers embody the content and stress the importance of learning within context. Pratt (1998) also states that an identity or role is formed through the authentic nature of the learning environment to a real community within the discipline.

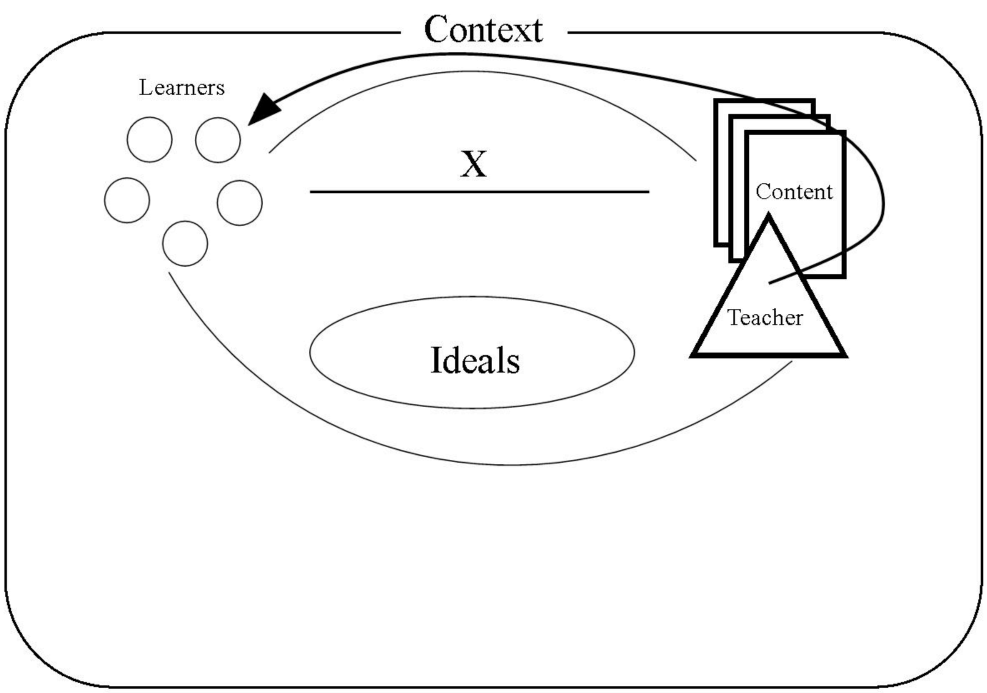

Figure 2.3 Apprenticeship Perspective Model

Holding an opposing view to the transmission and apprenticeship perspectives, the development perspective is modeled in Figure 2.4. Faculty members in this perspective, according to Pratt (1998), are committed to "learner-centered" teaching with a focus on the "change in the quality of ones thinking rather than a change in the quantity of ones knowledge" (p. 47). The developmental perspective models theories found in cognitive psychology of first disrupting the balance of the mind to alter the thought process. For example, faculty members who exemplify this perspective rarely give students a straight answer. Rather they demonstrate a way to obtain the answer which may therefore cultivate new ways of thinking (Pratt, 1998).

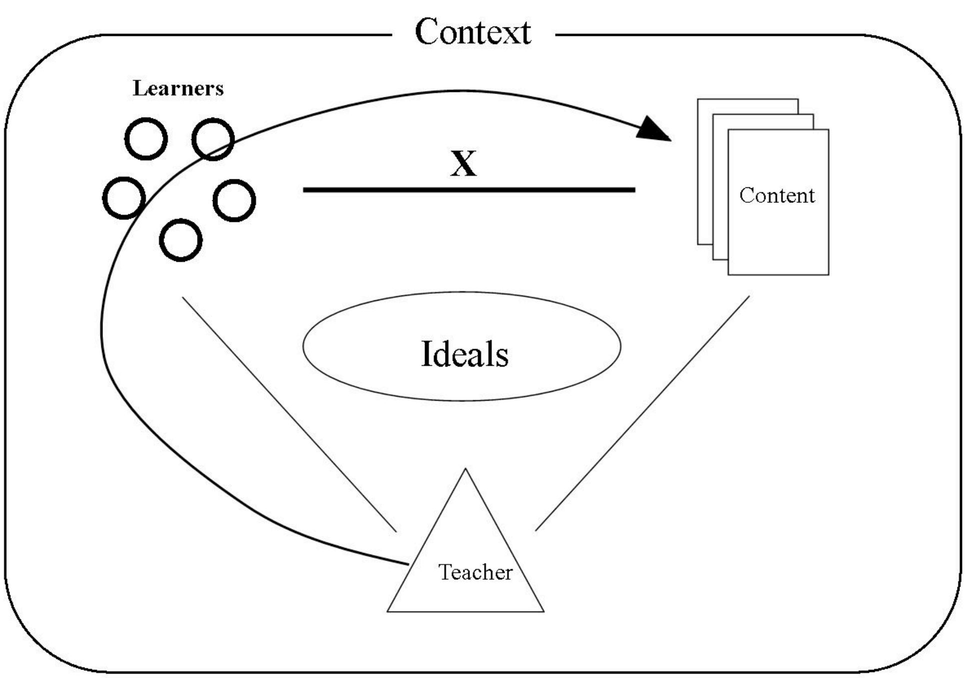

Figure 2.4 Developmental Perspective Model

Pratt (1998) describes the nurturing perspective , modeled in figure 2.5, as the view in which cultivating a student's positive self-efficacy or confidence in what they are learning is paramount. Faculty members who are dominant within the nurturing perspective are noted by Pratt to hold student learning development higher than institutional standards. This viewpoint is echoed in the work of Malcomn Knowles (1973; 1980) who stated the importance of the relationship between faculty and student leading to lifelong learning achievement.

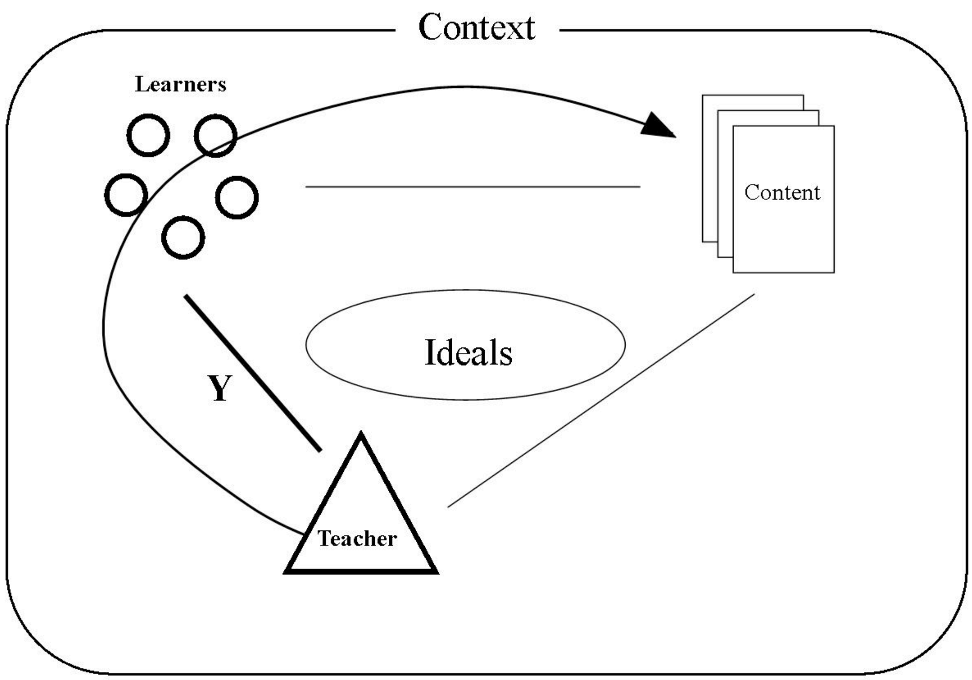

Figure 2.5 Nurturing Perspective Model

Faculty members who are dominant in the social reform perspective are firmly grounded in their ideals and overarching agenda to change society for the better (Pratt 1998). Figure 2.6 illustrates how a teacher within this perspective filters their connection with the student and knowledge through their ideals. Whereas other perspectives are concerned with the pursuit of knowledge or increasing student self-confidence, the social reform perspective is concerned with faculty imparting their moral beliefs on the student in an effort to improve the world.

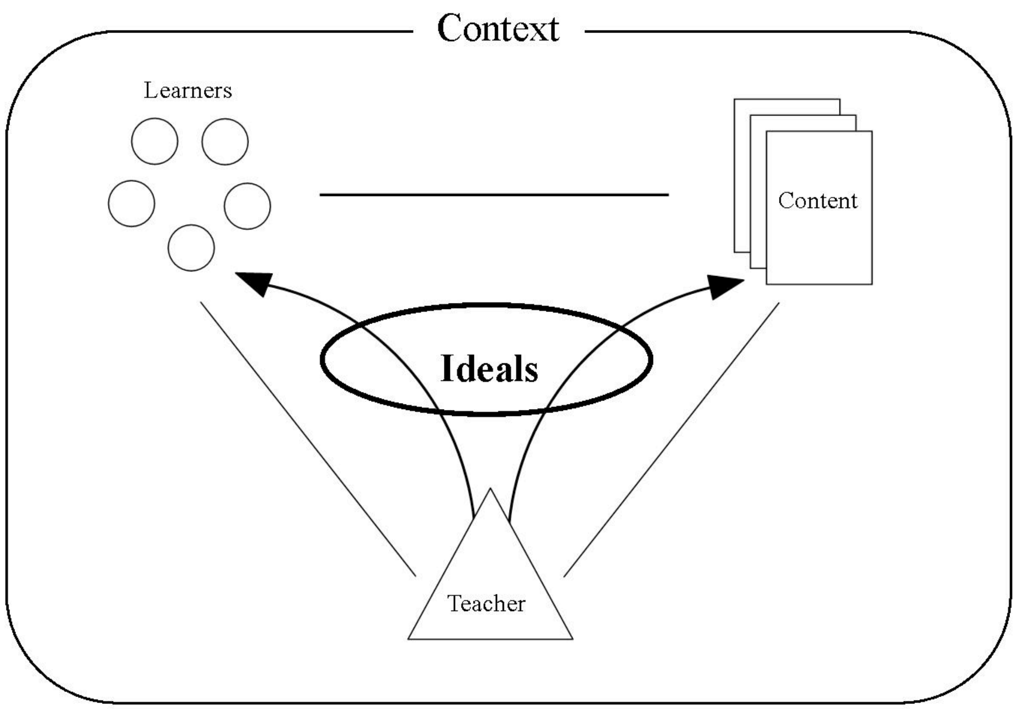

Figure 2.6 Social Reform Perspective Model

Teacher Perspectives Inventory

To streamline the process of interviewing instructors in order to arrive at thick description ultimately leading to an understanding of how teachers conceptualized their practice of instruction, a 45-question self-administering survey instrument was developed (Collins and Pratt, 2010). This survey instrument, known as the Teacher Perspectives Inventory (TPI), totals an individual's beliefs, intentions, and actions within each of the five perspectives previously described in Figures 2.1 through 2.6; transmission, apprenticeship, development, nurturing, and social reform (Pratt, 2002). A personalized profile report is produced rating an individual's affinity in one or more teaching perspectives.

Development of the TPI, described by Collins et al. (2010), began in the early 1991 when Daniel Pratt, Ph.D. and his team of graduate students analyzed notes and transcripts they had gathered from interviews with 253 adult educators across five countries including “the United States, Canada, Singapore, China, and (then) Hong Kong” (p. 3). Pratt (1998) provides an overview of his work in the text *Five Perspectives on Teaching in Adult and Higher Education*. Pratt, along with co-researcher John Collins, Ph.D., extracted five themes or perspectives of “what teachers of adult learners do and why” (Collins et al., p. 3, 2010). Aside from the differences in each perspective, Pratt (1998) also recorded differences in how faculty commitment was expressed in each perspective. According to Collins et al (2010), “different teachers held different *beliefs* about teaching, set themselves different *intentions* to accomplish, or undertook different *actions* in their instructional settings” (p. 3).

The TPI was introduced to a worldwide audience in 2001 when an on-line version of the self reporting survey was launched (Collins et al., 2010). Collins et al. (2010) report that over 100,000 people have completed the online survey found at www.teachingperspectives.com. The on-line TPI survey can be accessed at no cost and allows visitors to obtain an instant profile of their own perspectives by e-mail along with a guide to analyze their results. A sample of the TPI results profile can be found in Appendix B.

As noted by Collins et al. (2010), an individual’s TPI profile reveals a tiered configuration of one or two perspectives standing out with higher overall scores (e.g., Appendix B). The more predominant, higher scoring perspectives, according to Collins et al. (2010), ““are those which teachers often describe as “where I’m most ‘at-home’” or “how I most often see myself””(p. 10). These are labeled as “dominant” perspectives (Collins et al., 2010). Conversely, one perspective is lower than the other four which is noted to be the “recessive” perspective of the five.

The horizontal bars toward the middle of the profile (e.g. Appendix B), are each plus and minus one standard deviation away from the mean of all five scores and serve as boundaries separating dominant perspectives from recessive perspectives (Collins et al., 2010). Collins and Pratt (2010) further add that the scores between the two horizontal bars are one's "back-up" perspective and are "skills and strategies that can be called on when needed but that are not always at the forefront of one's instructional tool-kit" (p. 10). Among the sample of 116,621 teachers who took the online TPI survey from Aug 2001 to April 2009, Collins et al.(2010) reveals the most common dominant perspective to be nurturing (50%), apprenticeship (38%), developmental (18%), transmission (14%) and social reform (3%). Percentages total more than 100% due to almost a quarter of the sample possessing two or three dominant perspectives (Collins et al., 2010).

Self-reflecting upon thirty years of research into the field of teaching perspectives, Collins and Pratt (2010) argue that the importance of self-reflection among the education community is difficult to challenge. However, Kane, Sandretto, and Heath (2002) argue, in a critical review of the research on the relationship between teaching beliefs and instructional practices, only half of the story is being told. Kane et al. (2002) reveal that several studies (Dall'Alba, 1991; Dunkin, 1990, 1991; Dunkin & Precians, 1992; Fox 1983; Gow & Kember, 1990, 1994; Martin & Balla, 1991; Martin & Ramsden, 1992; Pratt, 1992; Prosser, Trigwell, & Taylor, 1994; Samuelowicz & Bain, 1992; Trigwell, Prosser, & Taylor, 1994) only investigate "espoused theories of action" without testing how faculty members actually teach inside the classroom. According to Messick (1989), "validity-in-the-abstract" is non-existent and a measuring instrument is only proven to be valid if it furthers action or decision making.

Yet, Pratt and Collins emphasize the far reaching implications of the TPI beyond a one-time exercise (Collins et al., 2010). The TPI is noted as a central part of faculty development within universities including University of California, The Davis School of Medicine, as an instructional tool at the University of Toronto School of Medicine, University of British Columbia, Strayer University, and Republic Polytechnic in Singapore (Collins et al., 2010). Furthermore, TPI is translated into seven languages including Spanish, French, Portuguese, German, Chinese, Korean and Japanese and , according to Collins et al. (2010), used across disciplines in numerous research projects (Clarke and Jarvis-Selinger, 2005, Jarvis-Selinger, 2002, Kehres, 2008, Lu, 2006, Panko, 2004, Ruan, 2004, Tiffin, 2008) all which vary in terms of "issues, learners, and contexts" (p. 17).

Computer Science Attrition in Higher Education

Computer science (CS) education dawned out of the 1960's "new math" movement (Siegle, 2009). In the 1960s, educating students in the area of problem solving techniques fell largely to mathematics educators who were the first to apply computer programming concepts to a curriculum. Traditional computer programming instruction evolved throughout the 1970's and 1980's to mold the early generation of programmers and systems analysts (Siegle, 2009; Newby & Marcoulides, 2008). Since the 1970s and 1980s, the rapid increase of technological advancements has not only grown the field of CS, it has also contributed to the way CS education is delivered in the classroom (Tucker, 1996). This sparked the upward trend of undergraduate interest in CS as a discipline; a trend that peaked in 1999 during a time of enormous venture capital funding for Internet companies also known as the dot com bubble (Vegso, 2005, Panko, 2008).

Enrollment trends in CS declined rapidly in 2000-2001 when overinvestment along with overconfidence in information technology and the World Wide Web suddenly collapsed (Panko, 2008). An annual survey conducted by the Computer Research Association represents that undergraduates declaring CS as a major declined by 60% from 2000 to 2004 (Vegso, 2005).

A study by Beaubouef et al. (2005) concerning attrition statistics after the “dot-com” bubble burst focused on the possible causes for continued CS attrition among U.S. colleges and universities. The study asks, “What happens between the time that a student decides to major in computer science and the time he or she drops out of the program?” (p. 103). The Beaubouef et al. (2005) study reports that 30% to 40% of undergraduate CS majors drop out of CS1 programs during their freshman and sophomore years due to the following reasons; poor advising before and during college, poor student math skills and problem solving abilities, poorly designed CS1 lab courses, lack of student practice and feedback, ineffectiveness of graduate student teachers, poor student project management skills, and the choice of objects-first approach versus objects-late approach in CS1 instruction (Beaubouef et al., 2005).

Predictions found in the US Bureau of Labor Statistics Handbook, as cited in Adams (2010), reveal that the number of CS graduates that are needed to fill computing positions between 2008 and 2018 are more than inadequate. Computing positions are expected to outgrow the number of computing graduates two-to-one by the year 2018 (Adams, 2010). This is most likely due to President Obama’s (2011) projected major investments in biomedical research and information technology.

Research into the Teaching of Introductory Programming

In 2007, Pears and several researchers collaborated to develop a report providing a comprehensive review of the existing literature surrounding introductory computer programming education. Their research included publications which they deemed to be relevant to the design of future introductory computer programming courses (CS1) in categories such as curricula, pedagogy, language choice, and tools for teaching. As noted by Pears et al. (2007), research conducted on the instruction of CS1 "has had limited effect on classroom practice" (p. 204). From a pool of 180 scholarly articles, Pears et al. selected 45 papers based on the criteria that each one is relevant and informative, represents the category, and provides "good coverage of appropriate scholarship from the literature on teaching and learning of introductory programming" (2007, p. 205).

Pears et al. (2007) state CS1 course designs may require agreement between several institutional officials including; committees, department chairs, university administrators, and government regulating bodies. Constraints placed upon the creation of a new course may include articulation agreements with community colleges and advanced placement curricula guidelines (Pears et al., 2007). Although the aforementioned external challenges and constraints place a burden on universities when considering a CS1 curriculum, internal debate over the fundamentals of computer programming may cause opposition.

Research, noted by Pears et al. (2007), reveals how underlying computational metaphor should be taken into serious consideration in CS1 curriculum design. Computation is defined as "a function from its inputs to its output (Stein, 1999, Turing, 1936, von Neumann, 1945) and according to Stein (1999), the computational metaphor is "an image of how computing works – or what computing is made of – that serves as the foundation for our understanding of all things computational" (p. 1). In Figure 2.7, Stein (1999) illustrates replacing the traditional metaphor "computation as calculation" with "computation as interaction" found in Figure 2.9 as the former may prevent the learner from understanding the complex, parallel interactions between users, hardware, software and networks.

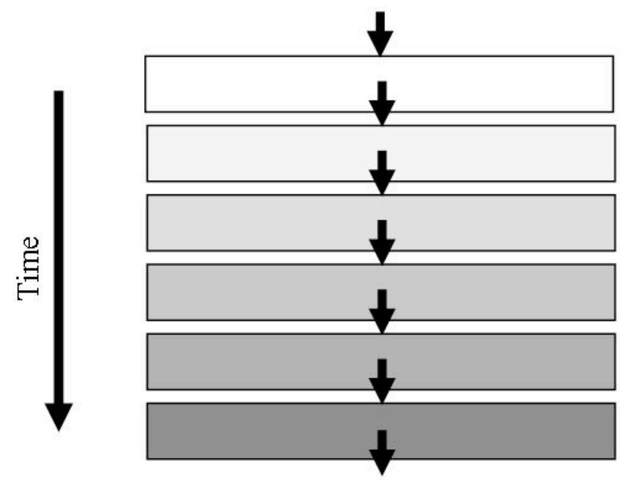

Figure 2.7 Sequential Computation as Calculation Model

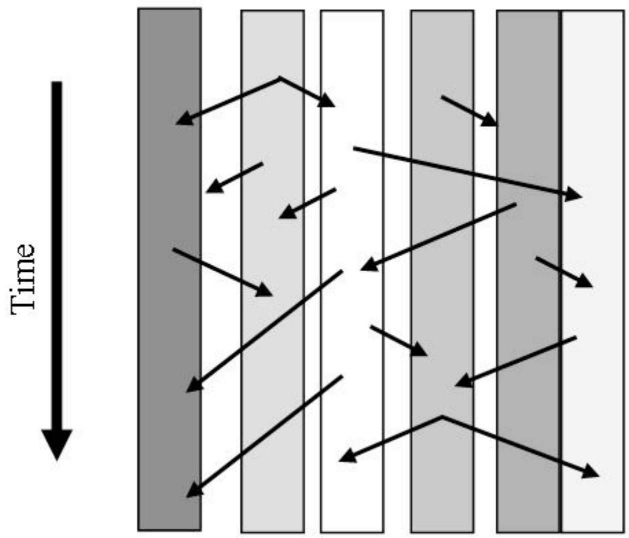

Figure 2.8 Computation as Interaction Model

Throughout most disciplines in higher education, curriculum guidelines are put into place by governing bodies to assist institutions in implementing standards appropriate for students. In the case of CS1 instruction, the Computer Society of the Institute for Electrical and Electronic Engineers (IEEE-CS) and the Association for Computing Machinery (ACM) have served on a joint task force since the late 1980's to form an undergraduate CS1 curriculum (Association of, 2001). The documented ACM curriculum update of 2001 (CS2001) serves as a significant baseline for CS1 instruction, and although slightly revised in 2008 to combat the public outcry to solve a decade of declining CS enrollment trends, it serves as a roadmap for computer programming curriculum design ten years later (Association of, 2008). The suggested curriculum in CS2001 spans varying disciplines within CS and also suggests seven CS1 instructional methodologies or approaches to teaching a first-year computer programming course including; algorithms-first instruction, breadth-first instruction, breadth-second instruction, functional-first instruction, hardware-first instruction, imperative-first instruction and objects-first instruction (Association of, 2001). Chapter 1 outlines each instructional methodology in further detail.

One particular CS1 instruction method, Objects-first instruction, takes the approach of first introducing students to concrete concepts that are visual, auditory, tactile, and kinesthetic before moving to those that are more abstract (Cooper, Dann, & Pausch, 2003). This approach is labeled non-traditional, as traditional computer programming instruction (imperative-first) does not introduce these concepts until further in the course.

This questioning has led to subjective research related to best practices in teaching computer programming to students with no existing subject-matter knowledge (Sheard, Simon, Hamilton, & Lönnberg, 2009). Reported research on the topic of computer programming education between 2005 and 2008 is summarized by Sheard (2009) and co-researchers into 11 themes.

Under the theme of "Teaching/learning/assessment techniques" there are studies promoting the favorable use of objects-first computer programming instruction for novices (Lahtinen, Ahoniemi & Salo, 2007; Lahtinen, Järvinen, & Melakoski-Vistbacka, 2007; Ma, Ferguson, Roper, Ross, & Wood, 2008; Ragonis & Ben-Ari, 2005) as well as studies examining the difficulty students encountered with objects-first computer programming instruction (Parsons & Holden, 2007; Nevalainen & Sajaniemi, 2006). In addition, Chen, Monge, & Simon (2006) found little difference in the deliverables between students taught through the objects-first approach and students taught through the objects-late approach.

Unlike the objects-first paradigm which introduces abstract concepts first before moving on to algorithms and other mathematical concepts and procedures, the functional-first programming paradigm embraces the use of a pseudo programming language (e.g. Scheme) to introduce algorithms and data structures first before moving to abstract concepts (Felleisen, Findler, Flatt & Krishnamurthi, 2004). Felleisen et al. (2004) argue, "schools employ programming technology that is intended for professional programmers" (p. 2). However, Forte and Guzdial (2005) contend student motivation should be taken into consideration when deciding to use functional-first instruction methods. According to Forte et al. (2005), undergraduate engineering students may lose interest quickly if they do not feel a pseudo programming language will give them the confidence and ability to "perform on the job" (p. 251). Forte et al. (2005) suggest further research is needed to understand how CS1 can remain attractive for both CS majors and non-CS majors alike.

Pears et al. (2007) note, research concerning the relationship between teaching perspectives and instructional approaches on student outcomes "is not directly relevant to teaching introductory programming nor is the research situated in the computing education research discourse" (p. 206). However, as a computer science faculty member, it is important to be aware of this literature (Pears et al., 2007).

Programming language choice is particularly a growing concern for curriculum designers in higher education because of the nature by which new programming languages are created and adopted by industry (Pears et al., 2007). The 2010-2011 edition of the U.S. Department of Labor Handbook states that information technology jobs are expected to grow 32% over the course of the upcoming decade (Bureau of Labor, 2009). Languages such as Java, Microsoft.NET, and C++ are noted as important industry standard programming languages (Taylor, 2010). The TIOBE Programming Community Index ranks the popularity of programming languages according to the number of hits the language receives among six popular search engines (Tiobe Software, 2011b). As of April 2011, the top four programming languages according to this ranking are Java, C, C++, and C# with Lua climbing into the top ten. Lua is gaining momentum as most smartphone application developers prefer this language (Tiobe Software, 2011a).

Pears et al. (2007) outlines several studies (de Raadt, Watson, & Toleman, 2002; 2004, & Dingle & Zander, 2000) which have found language choice among CS1 courses is influenced most by market appeal and student demand. However, Böszörményi (1998) argues, "The university should not try to teach ultimate wisdom; it should rather teach students to think about different possibilities" (p. 142). Pears et al (2007) adds, no single language will fit the goal of every university's CS1 curriculum.

In summary, this chapter has touched on theoretical opinions and background surrounding the body of research pertaining to education and the instruction of introductory computer programming in higher education. What remains is a description of the approach chosen to solve the problem of understanding the methodologies and related teaching perspectives of introductory computer programming faculty at the collegiate level. The next chapter will assist in answering the following research questions posed in Chapter 1 by giving an overview of the research design, participants selected for this study, information relating to the TPI survey instrument, strategy employed to collect the data, and analysis procedures:

1. What are the expressed beliefs, intentions, and actions of introductory computer programming faculty in each of the five teaching perspectives as defined by Pratt?
2. Which of Pratt's five teaching perspective scores are considered dominant within each instructional method category?
3. Does an introductory computer programming faculty member's amount of overall teaching experience influence any of their five teaching perspective scores?
4. Does an introductory computer programming faculty members amount of professional experience outside the classroom influence any of their five teaching perspective scores?

CHAPTER THREE

METHODOLOGY

The purpose of this study was to describe the beliefs, intentions and actions of higher education faculty employing various classroom methodologies in order to further the knowledge of faculty teaching trends in introductory computer programming instruction. However, in order to aid decision makers inside and outside the classroom in avoiding the design of a 'one size fits all' curriculum, this chapter outlines steps taken to collect faculty teaching perspectives along with demographic information such as years of teaching experience, and methodology used to answer the research questions. The findings of this study may aid decision makers inside and outside of the classroom in designing a curriculum not only based upon industry trends but tailored around faculty member approaches to teaching.

Research Design

In order to describe introductory computer programming faculty teaching perspectives and determine if there is a relationship between teaching perspectives and instructional methodology used in the classroom, this post-positivist study utilized a correlation research design. Pratt's (1998) General Model of Teaching used to describe the beliefs, intentions and actions related to each of the five teaching perspectives; transmission, apprenticeship, developmental, nurturing, and social reform. Correlation analysis was used to determine if a relationship exists between the two variables, teaching perspective and instruction methodology.

Participants

The population from which the sample was drawn in this study was comprised of faculty employed at universities and colleges throughout the United States. For the purposes of this study, the sampling frame consisted of 915 authors of articles admitted into the conference proceedings of three information systems education conferences, IACIS 2010, ISECON 2010, and CONISAR 2010. The sample was comprised of computer science faculty members employed by two-year and four-year degree granting institutions. The recruitment process consisted of e-mailing an initial request for participation to each of the 915 authors. Eligibility to participate was met by being an instructor of Introductory Computer Programming. Although it was assumed that each of the 915 authors was a working professional in field of computer science, a qualifying question asking if the author had ever taught an undergraduate introductory computer programming course at a college or university within the United States was needed to determine eligibility.

Instruments

The Teacher Perspectives Inventory (TPI) was used to gather information on the beliefs, intentions and actions of faculty relating to each of Pratt's (1998) five approaches to teaching. Additional survey questions were added to collect information on whether they currently teach introductory computer programming in the United States and which methodology they use.

The TPI survey asks a series of nine questions pertaining to each of the five teaching perspectives for a total of 45 questions. In each set of nine questions, three questions pertain to beliefs relating to teaching, three questions pertain to intentions relating to teaching, and three questions pertain to actions relating to teaching. Each subject was also asked to answer six demographic questions relating to gender, date of birth, name of institution, first language, years of overall experience teaching introductory computer programming and professional experience outside the classroom for a total of 51 questions taking less than 20 minutes to complete according to Pratt et al. (n.d.).

The TPI survey is divided into three sections consisting of 15 questions in each section. The first set of 15 questions relate to a participant's beliefs regarding instructing or teaching CS with each item measured on a 1-5 Likert scale, 1 indicating "strongly disagree" and 5 indicating "strongly agree." Each question directly relates to one of Pratt's (1998) five teaching perspectives, Transmission, Apprenticeship, Developmental, Nurturing, and Social Reform. The second set of 15 questions relate to a subject's intentions toward instructing or teaching (e.g. what he or she is trying to accomplish through teaching) with each question rated on a 1-5 frequency scale from "never" to "always." Each of the questions on intentions is also directly categorized into a specific teaching perspective. The third set of 15 questions relates to a subject's actions towards instructing or teaching (e.g. what they actually do when teaching) with each question rated on a 1-5 scale of frequency from "never" to "always". This set of questions is also categorized by teaching perspective. The score for beliefs, intentions, and actions in each teaching perspective can range from 3 to 15. The belief, intention, and action scores for each perspective are then totaled to obtain a cumulative score ranging from 9 to 45. The cumulative score in each perspective was analyzed on an individual basis by the authors of the TPI to determine dominant perspectives. An example of an individual perspective profile is included in Appendix A. Table 3.1 specifies the TPI question that is scored for each of the five perspective's beliefs, intentions and actions.

Table 3.1

Questions Related to Each Perspective by Dimension.

Dimension	Question #
Transmission	
Beliefs	1, 6, 11
Intentions	16, 21, 26
Actions	31, 36, 41
Apprenticeship	
Beliefs	2, 7, 12
Intentions	17, 22, 27
Actions	32, 37, 42
Developmental	
Beliefs	3, 8, 13
Intentions	18, 23, 28
Actions	33, 38, 43
Nurturing	
Beliefs	4, 9, 14
Intentions	19, 24, 29
Actions	34, 39, 44
Social Reform	
Beliefs	5, 10, 15
Intentions	20, 25, 30
Actions	35, 40, 45

In Table 3.2, sample items from the TPI are shown in each of the response contexts. A subject's action and intention were scored on a 5-point scale ranging from 'Never' to 'Always' and belief items were scored on a 5-point scale of 'Strongly Agree' to 'Strongly Disagree' (Pratt, 2001).

Table 3.2

Sample Items from the TPI

ACTIONS – What do you *do* when instructing or teaching?

I cover the required content accurately and in the allotted time.

I link the subject matter with real settings of practice or application.

I ask a lot of questions while teaching.

INTENTIONS – What do you *try to accomplish* in your instruction or teaching?

My goal is to demonstrate how to perform or work in real situations.

I expect people to master a lot of information related to the subject.

I want to make apparent what people take for granted about society.

BELIEFS – What do you *believe* about instructing or teaching?

To be an effective teacher, one must be an effective practitioner.

Teachers should be virtuoso performers of their subject matter.

Teaching should focus on developing qualitative changes in thinking.

The TPI, conceived in 1993 from a pool of more than one hundred questions, has been through several stages of streamlining and reliability testing (Pratt, 2001). According to Pratt, each item was reviewed by a panel of adult educators who judged each item according to how well it aligned to the five teaching perspectives. A 75-item, 6-point Likert-scale format emerged and was tested among 471 teachers of adult students attending night school. The test-retest reliability was proven to be high (.88) along with internal scale consistencies of alpha-.79 (Pratt, 2001). This format was further reduced to a 45-item, 5-point Likert-scale format when a new panel of 18adult educators classified them into each of the 5 teaching perspectives with 95% accuracy in 1997. Pratt (2002) further adds, “Their review indicated that the instrument could be further shortened without loss of precision” (p. 2).

The high rate of participation in that time frame can be attributed to several factors including the accessibility and speed of their free Internet survey platform and the immediacy of results displayed seconds after respondents click the submit button. The results are also automatically e-mailed to the respondent’s e-mail address provided at the beginning of the survey making it convenient to save information.

Data Collection Procedures

A recruitment letter, found in Appendix C, was sent by e-mail to the 1020 authors identified in the three conference proceedings outlining the purpose of the study, participant eligibility, survey description, time needed to complete the survey, link to the online survey and whom to contact for questions related to the study. Three follow up e-mails were sent four days, eight days, and twelve days after the initial recruitment letter was sent to remind participants to take the survey.

Vovici.com online survey software was used to manage the e-mail recruitment campaign, online survey creation, administration of the online survey and data collection. The Vovici.com survey management application combines survey design, email campaign management, data collection and analysis into one online interface. A free Vovici.com student license was obtained through Robert Morris University with permission from Christopher T. Davis, M.S.Ed., Director of the Educational Technology Center.

Data Analysis Procedures

To analyze the results of the survey, the survey responses were imported into SPSS 17.0 statistical analysis software from the Vovici.com online survey software. Responses were categorized in SPSS by beliefs, intentions, and actions in each of the five teaching perspectives in accordance with Table 3.2. Categorical data such as teaching status, gender, years of teaching experience, years of professional experience, first language and dominant teaching perspective was accounted for using frequency tables. The frequency of face-to-face contact with students was examined by extracting the number of respondents who met with students regularly, once or twice only, or through online distance learning. The frequency of instruction methodology used was explored by finding the number of respondents who chose one of the following ways to describe how their course is/was offered; algorithms-first instruction, breadth-first instruction, breadth-second instruction, functional-first instruction, hardware-first instruction, imperative-first instruction and objects-first instruction.

The relationship between years of teaching experience and instructional methodology was examined using cross tabulation as well as the relationship between dominant perspective and instruction methodology. An item reliability analysis using the Cronbach's Alpha statistic was performed to determine consistency among each set of three questions related to each dimension within each teaching perspective shown in Table 3.1 on page 40. TPI scores are described through a grouping table reporting the mean and standard deviations across beliefs, intentions, and actions of each teaching perspective. To answer research question three, which asks "Does an introductory computer programming faculty member's amount of overall teaching experience influence any of their five teaching perspective scores?", bivariate correlation analysis was used to evaluate the linear relationship between years of teaching experience and each teaching perspective dimension.

This chapter has outlined a quantitative methodology to collect and analyze the teaching perspectives of introductory computer programming faculty in higher education. The next chapter will provide a statistical analysis of the data and further describe the population in relation to the TPI survey instrument through the analysis described at the end of this chapter.

CHAPTER FOUR

RESULTS

The previous chapter explained the use of the TPI survey instrument in collecting demographic information and teaching perspective scores from introductory computer programming faculty teaching at the collegiate level throughout the United States. This chapter quantified the beliefs, intentions, and actions in each of Pratt's five teaching perspectives of 80 introductory computer programming faculty who currently teach or previously taught an undergraduate programming course.

A demographic depiction of participants is also revealed along with an item reliability analysis of questions relating to each of the belief, intention, and action dimensions of each perspective. Finally, methodological and experiential influences on teaching perspective dimension scores are summarized in order to answer the research questions posed for this study.

Overview

Results from faculty who completed the TPI survey were analyzed using SPSS 17.0. Of the 915 email requests sent, a total of 37 were returned due to an incorrect email address or terminated account. Out of the total pool of 878 participants who were sent a request, 178 clicked on the link to take the survey and 127 valid responses were returned for a response rate of 14.5%. Eighty of the valid responses indicated that they currently teach or had once taught an introductory computer programming course at a college or university within the United States. Table 4.1 indicates 46.3 percent or 37 faculty respondents indicated that they currently teach an introductory computer programming course while 53.8 percent of the faculty respondents indicated they did not currently teach introductory computer programming at the time they took the survey.

Table 4.1

Status of Respondents Currently Teaching Introductory Computer Programming

Teaching Status	Frequency	Percent
Currently Teach	37	46.3
Currently Do Not Teach	43	53.8
Total	80	100.0

Demographics of Sample

Of the 80 introductory computer programming faculty who replied to the request to complete the TPI, Table 4.2 indicates that males contributed to 78.8 percent of responses while females contributed to 20.0 percent of responses with one respondent choosing not to share their gender.

Table 4.2

Gender

	Frequency	Percent
Female	16	20.0
Male	63	78.8
No Response	1	1.3
Total	80	100.0

Figure 4.1 illustrates the age range of respondents in percent and of the 60 respondents who reported their date of birth, 30 percent were in the age range of 50 to 59 which constituted the majority. 30 of the respondents were split equally in the age ranges of 40 to 49 and 60 to 69 at 25 percent each. One respondent fell within the 20 to 29 age range and one respondent indicated that they fell within the 70 to 79 percent age range.

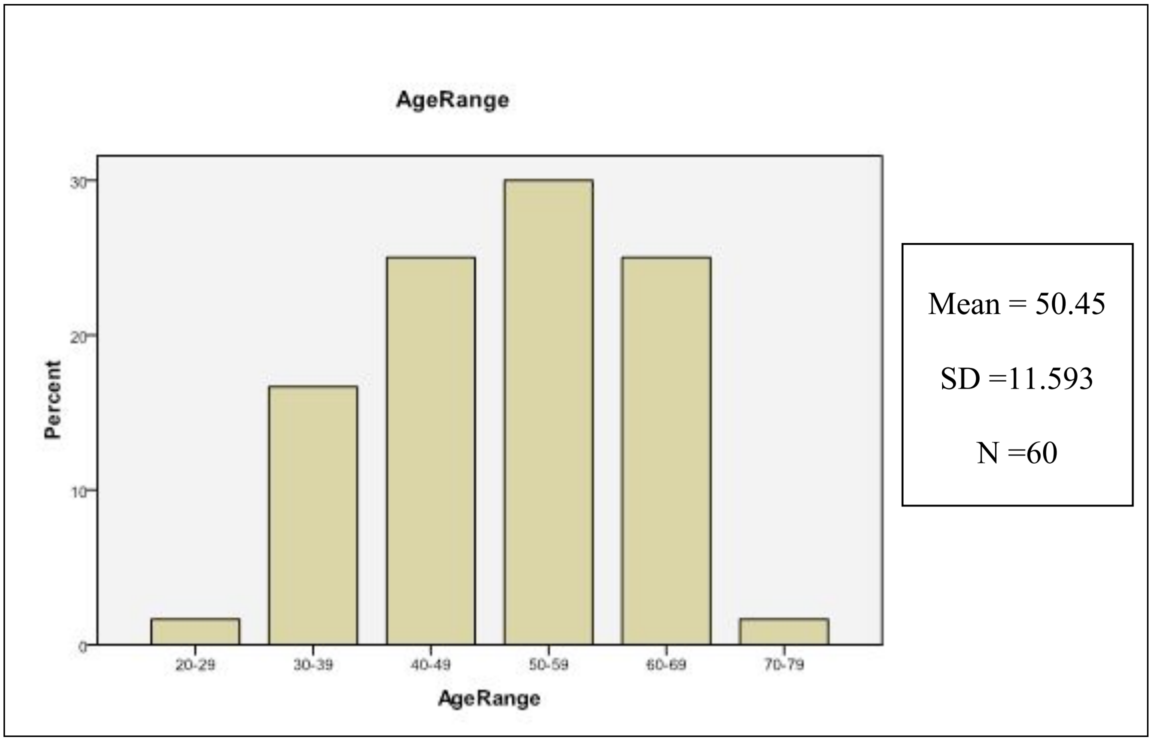

Figure 4.1 Age Range of Respondents

Constituting the majority of faculty respondents relating to years of teaching experience, Table 4.3 notes that 50 percent or 40 faculty respondents indicated they were experienced with 41.3 percent or 33 faculty respondents indicating that they were established with 20 years or more dedicated to teaching introductory computer programming. Table 4.3 also indicates 7.5 percent or 6 faculty respondents indicated they were new teachers.

Table 4.3

Years of Teaching Experience

Years of Teaching Experience	Frequency	Percent
No Experience	0	0.0
New (1 to 4)	6	7.5
Experienced (5 to 19)	40	50.0
Established (20 or more)	33	41.3
No Response	1	1.3
Total	80	100.0

As illustrated in Table 4.4, 43 faculty respondents indicated having 5 to 19 years of professional experience outside of the classroom at approximately 54 percent with approximately 23 percent or 18 respondents indicating 20 years of experience or more. Also noted, approximately 4 percent or 3 faculty respondents indicated they did not have any professional experience outside of the classroom

Table 4.4

Years of Professional Experience Outside the Classroom

Years of Professional Experience	Frequency	Percent
No Experience	3	3.8
New (1 to 4)	12	15.0
Experienced (5 to 19)	43	53.8
Established (20 or more)	18	22.5
No Response	4	5.0
Total	80	100.0

As Table 4.5 describes, 90 percent or 72 faculty respondents within the sample population indicated they meet regularly with students face to face over the course of several weeks.

Table 4.5

Frequency of Respondent Face-to-Face Contact with Students

	Frequency	Percent
Regularly, over several weeks	72	90.0
Regularly, but just a few times	4	5.0
Once or twice only	1	1.3
Distance learning network or website	1	1.3
No Response	2	2.5
Total	80	100.0

As Table 4.6 illustrates, 82.5 percent or 66 faculty respondents chose to indicate English as their first language with 17.5 percent or 14 respondents indicating learning another language first other than English.

Table 4.6

First Language

First Language	Frequency	Percent
English	66	82.5
Other	14	17.5
Total	80	100.0

Instructional Methodologies

Based on categories chosen from the list of seven ACM CC2008 curriculum guidelines, Table 4.7 reports the range of methodologies indicated by faculty respondents when asked to choose which instructional methodology best described the way their course is/was offered. As shown, 31.3 percent or 25 faculty respondents indicated that imperative-first instruction best describes the way their course is/was offered. The next most frequent methodology indicated by faculty is objects-first at 16.3 percent or 13 faculty respondents followed by breadth-first at 13.8 percent or 11 respondents and algorithms-first at 11.3 percent or 9 respondents. In addition, the percentage of faculty respondents who chose breadth-second and functional-first are the same in size at 10 percent in each category or 8 respondents. Approximately 4 percent or 3 faculty respondents chose hardware-first which was the least indicated choice out of all eight instructional methodologies. Finally, three faculty respondents indicated using instructional approaches outside of the eight categories.

Table 4.7

Type of Introductory Computer Programming Instruction Method Used of Respondents

Instruction Method	Frequency	Percent
Algorithms-first	9	11.3
Breadth-first	11	13.8
Breadth-second	8	10
Functional-first	8	10
Hardware-first	3	3.8
Imperative-first	25	31.3
Objects-first	13	16.3
Other	3	3.8
Total	80	100.0

As Table 4.8 depicts, each number represents the cross tabulation of introductory computer programming faculty who answered both in terms of their instruction method indicated and years of teaching experience. As shown in Table 4.8, approximately 50 percent or 40 respondents indicated they fell within the range of 5 to 19 years of teaching experience and the majority of these respondents chose the imperative-first instruction method as best describing the way their course is/was offered. Additionally, 41.7 percent or 33 respondents indicated having 20 or more years of teaching experience with 30.3 percent or 10 respondents choosing the imperative-first instruction method. The 12 respondents who indicated objects-first to best describe the way their course is/was offered was split evenly between experienced and established faculty members as indicated in Table 4.8.

Table 4.8

Years of Teaching Experience and Instruction Methodology Crosstabulation

	Years of Teaching Experience				
Instruction Method	No Experience	New (1 to 4)	Experienced (5 to 19)	Established (20 or More)	Total
Algorithms-first	0 (0.0%)	2 (33.4%)	3 (7.5%)	4 (12.1%)	9 (11.4%)
Breadth-first	0 (0.0%)	0 (0.0%)	8 (20.0%)	3 (9.1%)	11 (13.9%)
Breadth-second	0 (0.0%)	1 (16.7%)	4 (10.0%)	3 (9.1%)	8 (10.1%)
Functional-first	0 (0.0%)	1 (16.7%)	3 (7.5%)	4 (12.1%)	8 (10.1%)
Hardware-first	0 (0.0%)	1 (16.7%)	0 (0.0%)	2 (6.1%)	3 (3.8%)
Imperative-first	0 (0.0%)	0 (0.0%)	15 (37.5%)	10 (30.3%)	25 (31.7%)
Objects-first	0 (0.0%)	0 (0.0%)	6 (15.0%)	6 (18.2%)	12 (15.2%)
Other	0 (0.0%)	1 (16.7%)	1 (2.5%)	1 (3.0%)	3 (3.8%)
Total	0 (100.0%)	6 (100.0%)	40 (100.0%)	33 (100.0%)	79 (100.0%)
% of Total	0.0%	7.6%	50.0%	41.7%	100.0%

N = 79

A cross tabulation of instruction method and years of professional experience is presented in Table 4.9. As shown, 23.3 percent or 10 respondents who chose the imperative-first instruction method to best describe how their course is/was offered also indicated that they had 5 to 19 years of professional experience outside the classroom.

Table 4.9

Years of Professional Experience and Instruction Methodology Crosstabulation

	Years of Professional Experience				
Instruction Method	No Experience	New (1 to 4)	Experienced (5 to 19)	Established (20 or More)	Total
Algorithms-first	0 (0.0%)	2 (16.7%)	5 (11.6%)	1 (5.6%)	8 (10.5%)
Breadth-first	1 (33.3%)	0 (0.0%)	6 (14.0%)	3 (16.7%)	10 (13.2%)
Breadth-second	0 (0.0%)	1 (8.3%)	6 (14.0%)	1 (5.6%)	8 (10.5%)
Functional-first	0 (0.0%)	0 (0.0%)	6 (14.0%)	2 (11.2%)	8 (10.5%)
Hardware-first	0 (0.0%)	0 (0.0%)	2 (4.7%)	1 (5.6%)	3 (3.9%)
Imperative-first	2 (66.7%)	7 (58.3%)	10 (23.3%)	6 (33.3%)	25 (32.9%)
Objects-first	0 (0.0%)	1 (8.3%)	6 (14.0%)	4 (22.2%)	11 (14.5%)
Other	0 (0.0%)	1 (8.3%)	2 (4.7%)	0 (0.0%)	3 (3.9%)
Total	3 (100.0%)	12 (100.0%)	43 (100.0%)	18 (100.0%)	76 (100.0%)
% of Total	3.9%	15.8%	56.6%	23.7%	100.0%

N = 76

Item Reliability Analysis

Table 4.10 illustrates the internal consistencies found for each of the three questions corresponding to beliefs, intentions and actions across the five teaching perspectives; transmission, apprenticeship, developmental, nurturing, and social reform. An average internal consistency of .617 was found for the entire sample which is comparatively lower than average internal consistency of .77 found in a report by Collins et al. (2010).

Table 4.10

Item Reliability Analysis for Each Dimension of Each Perspective

	*Reliability Statistics		
Perspective	Beliefs	Intentions	Actions
Transmission	.440	.594	.600
Apprenticeship	.459	.762	.606
Developmental	.304	.600	.704
Nurturing	.474	.729	.677
Social Reform	.615	.844	.854

*Cronbach's Alpha; 3 Items Each

Research Questions

In order to address research question one, which asks "What are the expressed beliefs, intentions, and actions of introductory computer programming faculty in each of the five teaching perspectives as defined by Pratt?", means and standard deviations of TPI scores were calculated. A description of the overall sample mean scores and standard deviations for how each of the five teaching perspectives is expressed through the beliefs, intentions, and actions of respondents is presented in Table 4.11. The highest mean score in the transmission perspective was found in the actions dimension at 12.74 out of 15. The highest mean scores for the apprenticeship, developmental and nurturing perspectives were all found in the intentions dimension at 12.91, 12.25 and 11.25 out of 15 respectively. Finally the highest mean score in the social reform perspective was found in the beliefs dimension at 8.31 out of 15.

Table 4.11

Teaching Perspective Dimensions Among Respondents

	Dimension					
	Beliefs		Intentions		Actions	
Perspective	Mean	SD	Mean	SD	Mean	SD
Transmission	11.84	1.932	10.49	2.093	12.74	1.329
Apprenticeship	11.35	2.020	12.91	1.816	12.08	1.499
Developmental	10.51	1.903	12.25	1.825	11.06	2.16
Nurturing	10.64	1.989	11.25	2.426	9.29	2.372
Social Reform	8.31	2.126	7.65	2.663	7.51	2.624

In order to address research question two, which asks “Which of Pratt’s five teaching perspective scores are considered dominant within each instructional method category?” dominant perspectives scores were calculated with assistance of the John Collins, Ph.D, co-developer of the TPI survey instrument. Table 4.12 illustrates the frequency of dominant perspectives across the sample of 80 introductory computer programming faculty surveyed 60 percent or 48 respondent scores reported one dominant perspective score while 30 percent or 24 respondents reported having two dominant perspective scores while 10 percent or 8 respondent scores revealed no dominant perspective.

Table 4.12

Frequency of Dominant Perspective Scores for Respondents

	Frequency	Percent
Two Dominant Perspectives	24	30.0
One Dominant Perspectives	48	60.0
No Dominant Perspectives	8	10.0
Total	80	100.0

Table 4.13 shows that the highest percentage of respondents, 56.3 percent or 45 respondents, with a dominant perspective score were found in the apprenticeship perspective. Although a dominant score in one or more teaching perspectives does not indicate that the individual has only one or two orientations toward teaching and learning, it does indicate that a large percentage of introductory computer programming faculty respondents share a stronger affinity towards the apprenticeship teaching perspective than other perspectives.

Table 4.13

Dominant Teaching Perspectives for Respondents

Perspective	Frequency	Percent
Transmission	25	31.3
Apprenticeship	45	56.3
Developmental	17	21.3
Nurturing	9	11.3
Social Reform	0	0.0
None	8	10.0
Total	104*	130.2**

*Total does not equal 80 due to 40% of respondents with 0 or 2 dominant perspectives
**Total does not equal 100% due to 40% of respondents with 0 or 2 dominant perspectives

In order to answer research question two, which asks "Which of Pratt's five teaching perspective scores are considered dominant within each instructional method category?", a crosstab analysis of respondent dominant teaching perspectives by instruction method is summarized in Table 4.14. As shown, 26 percent or 25 respondents with one or more dominant teaching perspectives chose the imperative-first instruction method to best describe the way their course is/was offered. As also illustrated in Table 4.14, a majority of the dominant perspectives indicated by respondents, 47 percent or 45 dominant perspectives, were held in the Apprenticeship teaching perspective. It should also be noted that respondents who chose the objects-first instruction method showed the least amount of variance in terms of number of dominant teaching perspectives across the transmission, apprenticeship and developmental teaching perspectives at 4, 6, and 5 respectively.

Table 4.14

Frequency of Respondent Dominant Perspectives Related to Instruction Methodology

	Perspective					
Instruction Method	Trans.	**App.**	Dev.	Nurt.	SR.	Total
Algorithms-first	3	6	2	2	0	13 (13.5%)
Breadth-first	1	7	3	3	0	14 (14.6%)
Breadth-second	3	6	1	1	0	11 (11.5%)
Functional-first	3	5	1	1	0	10 (10.4%)
Hardware-first	1	2	0	0	0	3 (3.1%)
Imperative-first	8	12	4	1	0	25 (26.0%)
Objects-first	4	6	5	1	0	16 (16.7%)
Other	2	1	1	0	0	4 (4.2%)
Total	25 (26.1%)	45 (46.9%)	17 (17.7%)	9 (9.3%)	0 (0.0%)	96* (100.0%)

*Total does not equal 80 due to 40% of respondents with 0 or 2 dominant perspectives

To answer research question three, which asks "Does an introductory computer programming faculty member's amount of overall teaching experience influence any of their five teaching perspective scores?", correlation analysis was used. Pearson's correlation was used to determine the correlation coefficient(*r)* which measures the degree of linear correlation between years of teaching experience and teaching perspective dimension scores. Table 4.15 displays the correlation coefficient between years of teaching experience and each teaching perspective dimension.

An analysis of Pearson's correlation coefficient indicated that there is a significant relationship between years of teaching experience and the Social Reform Intentions dimension at the 0.05 level with a coefficient of .234. Therefore, teaching experience had significant influence on faculty intentions in the Social Reform perspective.

Table 4.15

Significance of Years of Teaching Experience on Teaching Perspective Dimension Scores for Respondents

	Years of Teaching Experience	
Teaching Perspective Dimension	*R*	*Sig.*
Transmission Beliefs	.094	.410
Transmission Intentions	.111	.328
Transmission Actions	-.045	.695
Apprenticeship Beliefs	-.189	.096
Apprenticeship Intentions	-.068	.549
Apprenticeship Actions	-.037	.747
Development Beliefs	.029	.797
Development Intentions	.136	.233
Development Actions	.114	.316
Nurturing Beliefs	.131	.251
Nurturing Intentions	.185	.103
Nurturing Actions	.085	.459
Social Ref Beliefs	.067	.555
Social Ref Intentions	.234*	.038
Social Ref Actions	.165	.146

*. Correlation is significant at the 0.05 level (2-tailed).

Pearson's correlation was also utilized to address research question four which asks "Does an introductory computer programming faculty member's amount of professional experience outside the classroom influence any of their five teaching perspective scores?" As described in Table 4.16, an analysis of Pearson's correlation coefficient indicated the relationship between professional experience and the beliefs dimension in the Social Reform perspective is approaching significance at the 0.05 level. However, there is no significant relationship between years of professional experience outside the classroom and any of the perspective dimensions as coefficients range from -0.144 to 0.216.

Table 4.16

Significance of Years of Professional Experience on Teaching Perspective Dimension Scores for Respondents

	Professional Experience	
Perspective	*r*	*Sig.*
Transmission Beliefs	.124	.286
Transmission Intentions	.099	.396
Transmission Actions	.092	.428
Apprenticeship Beliefs	.040	.734
Apprenticeship Intentions	.125	.282
Apprenticeship Actions	.050	.670
Development Beliefs	.076	.513
Development Intentions	.062	.595
Development Actions	-.144	.214
Nurturing Beliefs	.097	.403
Nurturing Intentions	.127	.274
Nurturing Actions	.115	.323
Social Ref Beliefs	.216	.061
Social Ref Intentions	.170	.143
Social Ref Actions	.165	.154

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Supplemental Analysis

Supplemental analysis was conducted to discover if a significant relationship existed between faculty respondents' first language and each of the teaching perspective dimensions. Represented in Table 4.17, significant relationships were found at the 0.01 alpha level in the actions dimension of both Nurturing and Social Reform perspectives with correlations of .293 and .376 respectively. In addition, significant relationships at the 0.05 alpha level were found in the actions dimension of both the Apprenticeship and Developmental perspectives with correlations of .242 and .247 respectively. Furthermore, significant relationships at the 0.05 alpha level were also found within the beliefs and intentions dimensions of the Social Reform perspective with correlations of .228 and .285 respectively. The actions dimension within the Social Reform perspective held the strongest relationship at 0.001 alpha. Therefore, language of origin had a significant influence on expressed actions overwhelmingly in the Social Reform actions dimension.

Table 4.17

Significance of First Language on Teaching Perspective Dimension Scores for Respondents

	Professional Experience	
Perspective	*R*	*Sig.*
Transmission Beliefs	.142	.210
Transmission Intentions	.177	.117
Transmission Actions	-.008	.943
Apprenticeship Beliefs	.116	.304
Apprenticeship Intentions	.205	.069
Apprenticeship Actions	.242*	.031
Development Beliefs	.171	.129
Development Intentions	.191	.091
Development Actions	.247*	.027
Nurturing Beliefs	.068	.550
Nurturing Intentions	.020	.857
Nurturing Actions	.293**	.008
Social Ref Beliefs	.228*	.042
Social Ref Intentions	.285*	.010
Social Ref Actions	.376**	.001

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

In comparing the mean scores in the Social Reform actions dimension of respondents who indicated English and Non-English as their first language, Table 4.18 illustrates a difference between means of 2.54. A higher mean score of 9.64 out of 15 was found in the Social Reform actions dimension for the 14 faculty respondents who indicated that English was not their first language.

Table 4.18

Comparison of Mean Scores Between First Language Groups in the Social Reform Actions Dimension

First Language	N	Mean	Std. Dev	Std. Error	Difference Between Groups
English	66	7.06	2.565	.316	-2.54
Other	14	9.64	1.737	.464	2.54
Total	80	7.51	2.624	.293	

The results of this chapter were tabulated in order to address the four research questions posed in this study. Data from a sample of 80 introductory computer programming faculty respondent surveys was explored using the methods outlined in chapter three including frequency analysis, cross tabulation and bivariate correlation. The next chapter will further interpret and discuss the findings of this study in order to draw conclusions and formulate recommendations for further research.

CHAPTER FIVE

DISCUSSION

This chapter of the research study reviews the research problem and summarizes the principle methods used in the study. A summary of the results and a discussion of their implications constitute the larger sections of this chapter.

As noted in chapter one, introductory computer programming (CS1) faculty have increased time demands and due to their schedule a professor may ignore their own teaching development (Wlodarsky et al., 2007). There may be certain instruction techniques they intend to use in the classroom, however; since the faculty members are focused on student education, and performing the administrative functions of their workday, time needed to self-reflect on their teaching beliefs; intentions and actions may be minimal at best. This study not only describes characteristics of computer programming faculty in higher education in comparison to their teaching beliefs, intentions and actions in the classroom, it also reveals dominant viewpoints held by computer programming faculty in relation to instructional methodologies used to educate students.

Relying on use of the Teaching Perspectives Inventory (TPI) survey developed by Pratt (1998), this study employs his model of the five teaching perspectives to uncover trends in the beliefs, intentions, and actions within a population of educators specializing in the discipline of introductory computer programming. The TPI survey instrument was chosen based on its primary use in higher education to aid in a faculty member's personal self-reflection. Available at www.TeachingPerspectives.com, the 45-question, self-administered, self-scoring assessment measures a faculty member on five contrasting views of what it means to "teach" (Collins et al., 2010) and provides instant feedback in the form of a results profile. Demographic questions accompanied the TPI survey in order to further categorize a sample of 80 introductory computer programming faculty by gender, age, first language, amount of face-to-face interaction with students, instruction method used in the classroom, years of overall teaching experience, and years of professional experience outside of the classroom.

The results from chapter four depict that the majority of respondents (78.8 percent or 63 respondents) were male and English speaking, with all 80 faculty indicating they had taught an introductory computer programming course within the United States at one time in their teaching career. Just over half (53.8 percent or 43 respondents) indicated that although they had once taught an introductory computer programming course in the United States, they currently do not teach a course in the subject. The average age of the sample population is approximately 50. Nearly the entire population (90 percent or 72 respondents) stated that they met regularly with their students over the course of several weeks with no online teaching interaction.

50 percent or 40 respondents revealed that their amount of teaching experience fell within the 5 to 19 year range with over 40 percent or 33 respondents indicating they had been teaching for 20 or more years. Also revealed, the larger portion of the faculty population (53.8 percent or 43 respondents) indicated that their professional experience outside the classroom fell within the 5 to 19 years of experience range. The skewed level of experience within the sample population is contributed to the seasoned faculty whose information was found within conference proceedings of three computer science conferences; IACIS 2010, ISECON 2010, and CONISAR 2010.

Of the seven instruction methodologies outlined in chapter one, the most popular method chosen to describe how courses are/were offered was the imperative-first instruction method at 31.3 percent or 25 respondents. No other method fell within 15 percent of this category except the objects-first instruction method at 16.3 percent or 13 respondents which made up the second most popular method chosen to define their CS1 course offering. Even distributions were found across algorithms-first instruction, breadth-first instruction, breadth-second instruction, and functional-first instruction with hardware-first instruction being the least popular instruction method at 3.8 percent or 3 respondents.

A cross tabulation of instruction method and years of teaching experience revealed that the most popular method, imperative-first instruction, was chosen by a large majority of faculty possessing 5 to 19 years of teaching experience (37.5 percent or 15 respondents). However, the group with a more established teaching career possessed a higher percentage overall within the objects-first instruction category at 18.2 percent or 6 respondents. It is interesting to note the more traditional based instruction methodology, imperative-first, was chosen more frequently by teachers with less teaching experience, as objects-first instruction is considered the most non-traditional instruction method out of the seven.

Scores calculated for each belief, intention and action dimension across each teaching perspective of the TPI make up an individual's overall viewpoint on teaching. However, it should be noted that Collins et al. (2010) caution against over-interpreting results that may categorize an individual or group as having only one dimension or one perspective towards teaching, just as it is difficult to categorize an instructor using a particular instruction method as each instructor is a unique individual. With this disclaimer in mind, the following summary of TPI group scores and dominant perspectives will serve as an exercise serving to uncover questions to guide further research.

One of the main objectives of this study is to uncover trends among the beliefs, intentions and actions in each of the five teaching perspectives of the faculty sample population. The results in Table 4.11on page 55 reveal several interesting trends. The highest mean score in the transmission perspective was found in the actions dimension at 12.74 out of 15 which indicates that introductory computer programming faculty members who are dominant in the transmission perspective likely engage students through this perspective on a daily basis. Pratt (1998) observes that faculty who are dominant in the transmission perspective consider themselves to be subject matter experts and engage learners systematically through lectures, answering questions, giving feedback, reviewing material and setting high standards of achievement.

The highest mean score in the apprenticeship perspective was found in the intentions dimension at 12.91 out of 15 and held the highest overall mean score out of all perspectives across each dimension. This indicates that a majority of introductory computer programming faculty who are dominant in the apprenticeship perspective intend to, or try to pursue, teaching as a role that changes throughout the course of a student's development. Pratt (1998) comments on teachers within the apprenticeship perspective becoming less and less dependent on directing students and putting the responsibility into the hands of the learners in an effort to make them more independent.

Higher mean scores in the intentions dimension was also found in the developmental and nurturing perspectives at 12.25 and 11.25 out of 15 respectively. This can be interpreted for the overall population as a pursuit of these perspectives more so than a belief or every day action and engagement of these perspectives. Faculty who are dominant in the developmental perspective conduct their course from the point of view of the learner and adapt their own knowledge to the knowledge level of the learner. Faculty who are dominant in the nurturing perspective strive for a persistent view that achievement comes from the heart and not the mind. However, from the scores shown in Table 4.11 on page 55, the population as a whole intends on using the developmental and nurturing perspectives more than taking action to engage students with perspectives in mind.

The highest mean score in the social reform perspective was found within the beliefs dimension at 8.31 out of 15 . Faculty who are dominant in the social reform perspective tend to challenge the status quo and encourage asking “why” in order to change society for the collective good rather than for individual gain. Yet, to generalize the population, those who are dominant in this perspective value it more than taking action to engage students through this view (Pratt, 1998).

According to the interpretation of the TPI survey data, well over half of faculty respondents have a dominant perspective on teaching at 60 percent or 48 respondents. In other words, they have a strong affinity towards one particular perspective over others. However, it should be noted that teachers share viewpoints in all five teaching perspectives and can express each one differently through their role as an educator. In addition, one-third or 24 faculty respondents show dominance towards two perspectives.

Finally, ten percent or 8 respondents showed no dominance towards one perspective over another. These trends mirror the overall trends of TPI respondent data collected from August 2001 to April 2009 (Collins et al., 2010).

However, findings indicate the CS1 faculty sample population differs greatly in comparison to the global population of TPI respondents across disciplines. Most notable is the difference in common dominant perspective between CS1 instructors and instructors world wide. A breakdown of dominant teaching perspectives for the CS1 faculty sample population, found in Table 4.13 on page 57, reveals over 55 percent or 45 of the dominant faculty teaching perspectives were found dominant in the apprenticeship perspective followed by approximately 31 percent or 25 dominant perspectives in the transmission perspective. Faculty dominant within the apprenticeship perspective, according to Pratt (1998), view teaching as a process of socializing students into behavioral norms and ways of working. This differs widely from the sample of 116,621 teachers who have taken the online TPI survey from Aug 2001 to April 2009. Collins et al.(2010) reveals the most common dominant perspectives to be nurturing (50%) followed by apprenticeship (38%), developmental (18%), transmission (14%) and social reform (3%). However, Collins et al. (2010) add "nurturing scores were higher for elementary and secondary teachers than for university-level instructors; conversely, developmental scores were highest for graduate level university instructors" (p. 14). Yet, Collins et al. (2010) further add that practitioner experience can predict a dominant view in the apprenticeship perspective. Thus, because of the high degree of professional experience found within the CS1 population, this trend could also be assumed for a greater population of CS1 educators.

Indicated in Table 4.14 on page 58, respondents who possessed a dominant view in the apprenticeship perspective, the highest concentration of these respondents (12) chose the most traditional instruction method, imperative-first, to best describe how their course is/was offered. A larger sample population is perhaps needed in order to generalize this relationship to the entire CS1 population. However, this finding indicates a need for further research into the impact of student retention rates for classrooms whose faculty possess dominance in the apprenticeship perspective and teach using traditional, imperative-first, introductory computer programming instruction techniques. While Pratt (1992) indicates there are good and bad ways of teaching through any of the five perspectives, on the surface it would seem likely that a more non-traditional instructional approach, such as functional-first (e.g. Scheme), would coincide with the apprenticeship mentality of developing a mental model or schema of what it means to be a computer programmer.

Nevertheless, respondents dominant in the development perspective indicated objects-first over imperative-first by approximately 6 percent. As Pratt (1998) states the development perspective represents a more "visual expression of an underlying set of beliefs a teacher brings to the learning environment", as this seems to coincide with the goal of objects-first instruction to introduce abstract concepts through visual learning tools such as the Alice 3D programming environment (Dann et al., 2009).

Norton et at. (2005) studied the impact of teaching experience on the beliefs of educators within various disciplines including science programs in higher education, however, found no significant relationship. Collins et al. (2010) mention professional experience as a predictor of dominance in the apprenticeship perspective. In this study, the relationship of years of teaching experience and professional experience outside the classroom to each perspective dimension revealed little to no correlation with the exception of teaching experience in the social reform intentions dimension. A deeper look into this significant relationship revealed the highest mean within the social reform intentions dimension was found among faculty with 20 or more years of teaching experience. Faculty who are dominant within the social reform perspective, according to Pratt (1998), "are most interested in creating a better society and view their teaching as contributing toward that end" (p. 173). Perhaps it can be hypothesized that more experienced faculty were witness to societal changes and this pursuit is engrained in their culture.

Furthermore, the strongest relationship is found between faculty member first language and the actions dimension of the social reform perspective. Respondents who indicated "other" when asked about their first language also noted a higher overall mean score in the social reform actions perspective. A phone interview with Collins confirmed this as a normal trend as he stated, "People whose mother tongue is not English tend to have a higher overall score than those who do" (personal communication, March 2, 2011). It may also be concluded that those born outside the United States have more motivation to help students change society through their own pursuit of a better position or circumstance. Still, it is not fully clear if those who indicated "other" for first language were born inside or outside the United States, just as it is unclear for those who selected English as a first language.

Implications for Practice

Faculty members who teach introductory computer programming may utilize the information found in this study in several ways including; analyzing personal teaching perspectives through self-directed assessment using the TPI, creation of a personal teaching philosophy through self-reflecting on a personalized TPI results profile, learning about instruction methods utilized to teach introductory programming in the United States, and reflecting on how well personal teaching perspectives coincide with a chosen instruction method. A faculty member's understanding of their own personal teaching perspective and how it coincides with their chosen instructional method may further lend to the discussion of how teachers influence student outcomes in the field of computer science.

Further Research

Exploring the relationship between faculty teaching perspective and instructional methodology uncovers interesting trends along with many more questions. Specifically, further research should be undertaken to investigate how teaching perspectives and chosen instruction method impact student outcomes relating to retention rates. Yet, this study reveals the potential for CS1 faculty members and curriculum designers to misalign instruction method with teaching perspective. Though several factors influence the type of instruction method used inside the classroom such as instructor preference, committee politics, and articulation agreements to name just a few, the TPI may assist decision makers in aligning methods with a central part of the learning process; the instructor perspective.

There is still potential for failure on the part of the faculty member no matter what method seems to coincide best with their teaching style or perspective, however; failure is also likely to occur if a "one-size-fits-all" curriculum is meant to be the solution. As student learning style is valued and heavily regarded as an important factor relating to student retention, so too should faculty perspective be taken into account as an equal partner if the goal of CS1 programs is to recruit and retain the technology workforce of the next generation.

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Appendix A

Summary of Five Perspectives on 'Good Teaching' from the TPI

Each of the paragraphs below represents a different perspective on 'good teaching,'. Together, they will help you understand and interpret your profile. Keep in mind that these five are not mutually exclusive perspectives. In our research involving thousands of teachers, the vast majority hold one or (sometimes) two dominant perspectives. Many hold an additional 'back-up' perspective that is high, although not dominant. This combination of dominant and back-up perspectives allows teachers to accommodate changes in context, content, and learners. Common sense requires that no one can operate from all five simultaneously, since they represent contrasting and sometimes competing views of teaching.

Transmission - *Effective teaching requires a substantial commitment to the content or subject matter.*
Good teaching means having mastery of the subject matter or content. Teachers' primary responsibilities are to represent the content accurately and efficiently. Learner's responsibilities are to learn that content in its authorized or legitimate forms. Good teachers take learners systematically through tasks leading to content mastery: providing clear objectives, adjusting the pace of lecturing, making efficient use of class time, clarifying misunderstandings, answering questions, providing timely feedback, correcting errors, providing reviews, summarizing what has been presented, directing students to appropriate resources, setting high standards for achievement and developing objective means of assessing learning. Good teachers are enthusiastic about their content and convey that enthusiasm to their students. For many learners, good transmission teachers are memorable presenters of their content.

Apprenticeship - *Effective teaching is a process of socializing students into new behavioral norms and ways of working.*
Good teachers are highly skilled practitioners of what they teach. Whether in classrooms or at work sites, they are recognized for their expertise. Teachers must reveal the inner workings of skilled performance and must translate it into accessible language and an ordered set of tasks which usually proceed from simple to complex, allowing for different points of entry depending upon the learner's capability. Good teachers know what their learners can do on their own and where they need guidance and direction; they engage learners within their 'zone of development'. As learners mature and become more competent, the teacher's role changes; they offer less direction and give more responsibility as students progress from dependent learners to independent workers.

Developmental - *Effective teaching must be planned and conducted "from the learner's point of view."*
Good teachers must understand how their learners think and reason about the content. The primary goal is to help learners develop increasingly complex and sophisticated cognitive structures for comprehending the content. The key to changing those structures lies in a combination of two skills: (1) effective questioning that challenges learners to

move from relatively simple to more complex forms of thinking, and (2) 'bridging knowledge' which provides examples that are meaningful to the learner. Questions, problems, cases, and examples form these bridges that teachers use to transport learners from simpler ways of thinking and reasoning to new, more complex and sophisticated forms of reasoning. Good teachers adapt their knowledge to learners' levels of understanding and ways of thinking.

Nurturing - *Effective teaching assumes that long-term, hard, persistent effort to achieve comes from the heart, not the head.*
People become motivated and productive learners when they are working on issues or problems without fear of failure. Learners are nurtured in knowing that (a) they can succeed at learning if they give it a good try; (b) their achievement is a product of their own effort and ability, rather than the benevolence of a teacher; and (c) their learning efforts will be supported by both teacher and peers. Good teachers care about their students and understand that some have histories of failure resulting in lowered self-confidence. However they make no excuses for learners. Rather, they encourage their efforts while challenging students to do their very best by promoting a climate of caring and trust, helping people set challenging but achievable goals, and supporting effort as well as achievement. Good teachers provide encouragement and support, along with clear expectations and reasonable goals for all learners but do not sacrifice self-efficacy or self-esteem for achievement. Their assessments of learning consider individual growth as well as absolute achievement.

**Social Reform - ***Effective teaching seeks to change society in substantive ways.*
From the Social Reform point of view, the object of teaching is the collective rather than the individual. Good teachers awaken students to values and ideologies that are embedded in texts and common practices within their disciplines. Good teachers challenge the status quo and encourage students to consider how learners are positioned and constructed in particular discourses and practices. To do so, they analyze and deconstruct common practices for ways in which such practices perpetuate conditions that are unacceptable. Class discussion is focused less on how knowledge has been created, and more by whom and for what purposes. Texts are interrogated for what is said and what is not said; what is included and what is excluded; who is represented and who is omitted from the dominant discourse. Students are encouraged to take critical stances to give them power to take social action to improve their own lives and the lives of others. Critical deconstruction, though central to this view, is not an end in itself.

To get a profile of your own view of teaching you are invited to take the Teaching Perspectives Inventory (TPI) at: www.TeachingPerspectives.com

A more detailed explanation of these perspectives can be found in:
Pratt, D.D. and Associates\(1998/2005). Five Perspectives on Teaching in Adult and Higher Education, Malabar, Florida:Krieger Publishing.

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Appendix B

Individual Teaching Perspectives Results Profile

Transmission	Apprenticeship	Developmental	Nurturing	Social Reform
Tr: **38**	Ap: **39**	Dv: **32**	Nu: **40**	SR: **26**
B:14, I:12, A:12	B:13, I:14, A:12	B:9, I:13, A:10	B:13, I:15, A:12	B:11, I:7, A:8
45	45	45	45	45
44	44	44	44	44
43	43	43	43	43
42	42	42	42	42
41	41	41	41	41
Your scores at or above this line (40) are your DOMINANT perspective(s).				
40	40	40	**• 40 •**	40
39	**• 39 •**	39	**• 39 •**	39
• 38 •	**• 38 •**	38	**• 38 •**	38
• 37 •	**• 37 •**	37	**• 37 •**	37
• 36 •	**• 36 •**	36	**• 36 •**	36
• 35 •	**• 35 •**	35	**• 35 •**	35
• 34 •	**• 34 •**	34	**• 34 •**	34
• 33 •	**• 33 •**	33	**• 33 •**	33
• 32 •	**• 32 •**	**• 32 •**	**• 32 •**	32
• 31 •	**• 31 •**	**• 31 •**	**• 31 •**	31
• 30 •	**• 30 •**	**• 30 •**	**• 30 •**	30
Your scores at or below this line (30) are your RECESSIVE perspective(s).				
• 29 •	**• 29 •**	**• 29 •**	**• 29 •**	29
• 28 •	**• 28 •**	**• 28 •**	**• 28 •**	28
• 27 •	**• 27 •**	**• 27 •**	**• 27 •**	27
• 26 •	**• 26 •**	**• 26 •**	**• 26 •**	**• 26 •**
• 25 •	**• 25 •**	**• 25 •**	**• 25 •**	**• 25 •**
• 24 •	**• 24 •**	**• 24 •**	**• 24 •**	**• 24 •**
• 23 •	**• 23 •**	**• 23 •**	**• 23 •**	**• 23 •**
• 22 •	**• 22 •**	**• 22 •**	**• 22 •**	**• 22 •**
• 21 •	**• 21 •**	**• 21 •**	**• 21 •**	**• 21 •**
• 20 •	**• 20 •**	**• 20 •**	**• 20 •**	**• 20 •**
• 19 •	**• 19 •**	**• 19 •**	**• 19 •**	**• 19 •**
• 18 •	**• 18 •**	**• 18 •**	**• 18 •**	**• 18 •**
• 17 •	**• 17 •**	**• 17 •**	**• 17 •**	**• 17 •**
• 16 •	**• 16 •**	**• 16 •**	**• 16 •**	**• 16 •**
• 15 •	**• 15 •**	**• 15 •**	**• 15 •**	**• 15 •**
• 14 •	**• 14 •**	**• 14 •**	**• 14 •**	**• 14 •**
• 13 •	**• 13 •**	**• 13 •**	**• 13 •**	**• 13 •**
• 12 •	**• 12 •**	**• 12 •**	**• 12 •**	**• 12 •**
• 11 •	**• 11 •**	**• 11 •**	**• 11 •**	**• 11 •**
• 10 •	**• 10 •**	**• 10 •**	**• 10 •**	**• 10 •**
• 9 •	**• 9 •**	**• 9 •**	**• 9 •**	**• 9 •**
Transmission	**Apprenticeship**	**Developmental**	**Nurturing**	**Social Reform**

Appendix C

Recruitment Letter

Introductory Computer Programming Teaching Perspectives Survey

Hello,

As a current doctoral student researching computer science instruction in higher education, your unique skills and perspectives are of interest to me. I look forward to the opportunity to expand the knowledge of the computer science education field through your involvement in this brief survey.

The purpose of my study is to examine teaching perspectives of introductory computer programming faculty members along with gathering information on the types of course instruction used. After answering a few general questions, the Teaching Perspectives Inventory (TPI) survey will be used to gather your perspectives on teaching.

The TPI is quick to complete - it usually takes no more than 10-15 minutes to answer all the questions.

Please be assured of the confidentiality of any information you supply. Also, please note that leaving items blank will cause the survey to calculate inaccurately.

Please click "**Next Page**" to begin the survey and thank you in advance for your participation.

Sincerely,

Michael Mainier
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Appendix D

Survey Questions

Part 1 of 5:

1)Have you ever taught an undergraduate introductory computer programming course at a college or university within the United States?

❍ Yes
❍ No

2) Which of the following best describes the way your course is/was offered? (The list is based on the ACM's CC2008 curriculum guidelines)

❍ Algorithms-first (i.e. use of pseudocode, no formal programming language).
❍ Breadth-first (i.e. provides a holistic view of the discipline with no programming involved)
❍ Breadth-second (i.e. students begin with a programming-based introduction followed by a holistic view of the discipline)
❍ Functional-first (i.e. uses a simple functional language such as Scheme.)
❍ Hardware-first (i.e. starts by establishing the hardware foundation before moving on to more abstract concepts)
❍ Imperative-first (i.e. objects-late or not at all, most traditional model)
❍ Objects-first (i.e. immediately begins with the notion of objects and inheritance before moving on to traditional control structures)
❍ Other (please specify)

If you selected other, please specify

____

Part 2 of 5: Educational BELIEFS:

4) For each statement, select the response that best represents your Agreement or Disagreement related to your beliefs about instructing or teaching an undergraduate introductory computer programming course.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Learning is enhanced by having predetermined objectives.	❍	❍	❍	❍	❍
To be an effective teacher, one must be an effective practitioner.	❍	❍	❍	❍	❍
Most of all, learning depends on what one already knows.	❍	❍	❍	❍	❍
It's important that I acknowledge learners' emotional reactions.	❍	❍	❍	❍	❍
My teaching focuses on societal change, not the individual learner.	❍	❍	❍	❍	❍
Teachers should be virtuoso performers of their subject matter.	❍	❍	❍	❍	❍
The best learning comes from working alongside good practitioners.	❍	❍	❍	❍	❍
Teaching should focus on developing qualitative changes in thinking.	❍	❍	❍	❍	❍
In my teaching, building self-confidence in learners is a priority.	❍	❍	❍	❍	❍
Individual learning without social change is not enough.	❍	❍	❍	❍	❍
Effective teachers must first be experts in their own subject areas.	❍	❍	❍	❍	❍
Knowledge and its application cannot be separated.	❍	❍	❍	❍	❍
Teaching should build upon what people already know.	❍	❍	❍	❍	❍
In learning, people's effort should be rewarded as much as achievement.	❍	❍	❍	❍	❍
For me, teaching is a moral act as much as an intellectual activity.	❍	❍	❍	❍	❍

Part 3 of 5: Educational INTENTIONS:

5) For each statement, select the response that best represents how OFTEN it corresponds to your educational intentions when teaching an undergraduate introductory computer programming course.

	Never	Rarely	Sometimes	Usually	Always
My intent is to prepare people for examinations.	❍	❍	❍	❍	❍
My intent is to demonstrate how to perform or work in real situations.	❍	❍	❍	❍	❍
My intent is to help people develop more complex ways of reasoning.	❍	❍	❍	❍	❍
My intent is to build people's self-confidence and self-esteem as learners.	❍	❍	❍	❍	❍
My intent is to challenge people to seriously reconsider their values.	❍	❍	❍	❍	❍
I expect people to master a lot of information related to the subject.	❍	❍	❍	❍	❍
I expect people to know how to apply the subject matter in real settings.	❍	❍	❍	❍	❍
I expect people to develop new ways of reasoning about the subject matter.	❍	❍	❍	❍	❍
I expect people to enhance their self-esteem through my teaching.	❍	❍	❍	❍	❍
I expect people to be committed to changing our society.	❍	❍	❍	❍	❍
I want people to score well on examinations as a result of my teaching.	❍	❍	❍	❍	❍
I want people to understand the realities of working in the real world.	❍	❍	❍	❍	❍
I want people to see how complex and inter-related things really are.	❍	❍	❍	❍	❍
I want to provide a balance between caring and challenging as I teach.	❍	❍	❍	❍	❍
I want to make apparent what people take for granted about society.	❍	❍	❍	❍	❍

Part 4 of 5: Educational ACTIONS:

6) For each statement, select the response that best represents how OFTEN you do that action when teaching an undergraduate introductory computer programming course.

	Never	Rarely	Sometimes	Usually	Always
I cover the required content accurately and in the allotted time.	❍	❍	❍	❍	❍
I link the subject matter with real settings of practice or application.	❍	❍	❍	❍	❍
I ask a lot of questions while teaching.	❍	❍	❍	❍	❍
I find something to compliment in everyone's work or contribution.	❍	❍	❍	❍	❍
I use the subject matter as a way to teach about higher ideals.	❍	❍	❍	❍	❍
My teaching is governed by the course objectives.	❍	❍	❍	❍	❍
I model the skills and methods of good practice.	❍	❍	❍	❍	❍
I challenge familiar ways of understanding the subject matter.	❍	❍	❍	❍	❍
I encourage expressions of feeling and emotion.	❍	❍	❍	❍	❍
I emphasize values more than knowledge in my teaching.	❍	❍	❍	❍	❍
I make it very clear to people what they are to learn.	❍	❍	❍	❍	❍
I see to it that novices learn from more experienced people.	❍	❍	❍	❍	❍
I encourage people to challenge each others' thinking.	❍	❍	❍	❍	❍
I share my own feelings and expect my learners to do the same.	❍	❍	❍	❍	❍
I link instructional goals to necessary changes in society.	❍	❍	❍	❍	❍

Part 5 of 5: Background

A few more questions about you and your educational responsibilities...

7) What is your gender?

- ❍ Female
- ❍ Male

8) What is your date of birth?

____

9) What is the name of your organizational or institutional affiliation?

____

10) What is your first language?

- ❍ Rather not say
- ❍ Chinese
- ❍ Japanese
- ❍ Russian
- ❍ English
- ❍ French
- ❍ German
- ❍ Spanish
- ❍ Danish
- ❍ Dutch
- ❍ Italian
- ❍ Greek
- ❍ Portuguese
- ❍ Hebrew
- ❍ Norwegian
- ❍ Swedish
- ❍ Korean
- ❍ Other
- ❍ Other (please specify)

If you selected other, please specify

____

11) Approximately how many years have you been instructing, educating, or teaching?

❍ 0
❍ 1
❍ 2
❍ 3-5
❍ 5-10
❍ 10-15
❍ 15-20
❍ 20-25
❍ 25-30
❍ 30-35
❍ 35-40
❍ 40-45
❍ 45-50
❍ 50+

12) In addition to any teaching, about how many years have you practiced your own specialty? (e.g., Some nursing instructors are also practicing nurses and some law instructors are practicing lawyers.)

❍ 0
❍ 1
❍ 2
❍ 3-5
❍ 5-10
❍ 10-15
❍ 15-20
❍ 20-25
❍ 25-30
❍ 30-35
❍ 35-40
❍ 40-45
❍ 45-50
❍ 50+

13) How often or how regularly do you meet with your undergraduate introductory computer programming students?

❍ Regularly, over several weeks
❍ Regularly, but just a few times
❍ Once or twice only
❍ Distance learning Network or Website

Please click 'Submit Survey' below to complete this survey. Thank you for your valuable contribution to this research.