

# The Pragmatist in Context of a National Science Foundation Supported Grant Program Evaluation: Guidelines and Paradigms

This manuscript is based on a Roundtable discussion presented at the Annual Conference of American Educational Research Association, 2009 Annual Meeting, San Diego, CA.

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**Background:** The philosophical underpinnings of evaluation guidelines set forth by a funding agency can sometimes seem inconsistent with that of the intervention.

**Purpose:** Our purpose is to introduce questions pertaining to the contrast between the instructional program's underlying philosophical beliefs and assumptions and those underlying our evaluation approach. Drawing heavily on Scriven, we discuss these from a pragmatist evaluation stance in light of issues defined by Lincoln and Guba (2000).

The discussion is couched in the evaluation of an innovative approach to teaching computer science.

**Setting:** Auburn University, Auburn, AL

**Intervention:** The evaluation is designed to investigate the effects of a studio-based teaching approach in computer science education. The evaluation framework employs a rigorous design that seeks to provide evidence to support or refute

some assumed truth about the object (or construct) investigated. The program evaluated is steeped in a constructivist framework which assumes that no universal truth or reality exists, but rather, is constructed by the individual.

**Research Design:** Our evaluation design, to a good extent, reflects a post-positivist, quasi-experimental position. We also include a qualitative component using student interviews.

**Data Collection and Analysis:** Evidence of the effectiveness of the instructional approach for learning is assessed quantitatively using pre- and post-test and pre- and post-survey data group comparisons (mixed design ANOVA). Interviews provide the basis for qualitative theme analysis.

**Findings:** Quantitative results were somewhat weak but consistent in support of the studio-based teaching. Interview data suggest that most students did find working in groups enjoyable and a valuable experience.

Those engaging in program evaluation activities have a wide array of models with different underlying assumptions from which to choose, ranging from Tyler's (1942, 1966) objectives-oriented approach to more participatory approaches, such as empowerment evaluation (Fetterman, 2002; Fetterman & Wandersman, 2007), and appreciative evaluation (Preskill & Catsambas, 2006). Fitzpatrick, Sanders, and Worthen (2004) indicated almost 60 such theoretical approaches were developed during the decades from 1960 through 1990. House (1983) proposes that, whether explicit or not, evaluators operate on the basis of an underlying belief system or theory, or at least should do so, stating that "without [evaluation theory] ...to guide us we would not know how to act as evaluators" (p. 19).

At Auburn University (AU), we are conducting an evaluation of a National Science Foundation (NSF) supported project consistent with recommendations set forth by NSF-sponsored forums and Online Evaluation Resource Library (OREL) (National Science Foundation, n.d.). The online forums focus on the preparation of sound evaluation plans for project proposals, including both early implementation feedback to facilitate project refinement and improvement and end-of-program data to document program outcomes or effects. The evaluation framework indicates that the evaluation should be tied to program goals and objectives. In addition, the framework supports the use of a rigorous design that seeks to provide evidence to support or refute some assumed truth about the object (or construct) investigated. In contrast, the program evaluated, studio-based instruction and learning, is steeped in a constructivist framework which assumes that no

universal truth or reality exists, but rather, is constructed by the individual.

The purpose of the current manuscript is to examine the issues and tensions created by the contrasting underlying beliefs (paradigms) and philosophical underpinnings connected with the evaluation approach we developed, and the constructivist nature of the teaching approach evaluated. Through examining these issues, we hope to stimulate a dialogue that aids those who are conducting evaluation activities do so more effectively and plan evaluations that are based on theory...which can "tell us how to act as evaluators" (House, 1983, p. 19).

In the following sections of this manuscript, we first recap the context of the evaluation, including existing structures leading to our choice of evaluation methods and approaches, as well as the basis for the choice of the instructional method. Next, we outline AU's program evaluation approach, and introduce some dilemmas that could stem from differences in the evaluation paradigm and the instructional paradigm. Finally, we discuss paradigm philosophical inconsistencies and a pragmatist position on these issues.

## The Evaluation Context

### *Evaluation Methods*

As early as 2003, the United States government began identifying and addressing the need for high quality evaluations and recommended that the Division of Research, Evaluation, and Communication continue, and even expand, efforts to provide evaluation information and resources (National Science Foundation [NSF], 2003). In

response to the federal government's emphasis on accountability and high standards in k-12 education and in educational programs that address science, technology, engineering, and mathematics (STEM), the Academic Competitiveness Council (U.S. Department of Education, 2007) formed working groups to identify program implementation and evaluation issues and problems. Recommendations, based on the assessment of existing programs, included planning for "rigorous, independent evaluation, focusing on program goals and improving program implementation and evaluation through the use of "proven-effective, research-based instructional materials and methods" (p. 3).

We have defined goals, such as improving student motivation and learning. We also recognize that the constructivist approach to teaching is student-centered, and a student-centered approach implies that goals and objectives (and meaning) are developed by each individual student experiencing the intervention. Focusing on program goals in evaluation, as recommended by the work groups, is an objectives-based evaluation approach and, as such, it calls for program developers, implementers, or other stakeholders, as well as evaluators to define program and evaluation goals a priori.

### *NSF Evaluation Guidelines*

NSF evaluation guidelines (National Science Foundation Project Evaluation Guide, n.d.) stress designs that profess to test existing theory or relationships through quantitative methods, though some attention is also given to qualitative methods of investigation. NSF describes the experimental design as the "gold

standard" with quasi-experimental and the internal comparison designs as possible alternatives if the gold standard is not possible. In fact, the Pathways to Revitalized Undergraduate Computing Education (CPATH) program comes under the purview of the America Competes Act of 2007 ([http://science.house.gov/legislation/leg\\_highlights\\_detail.aspx?NewsID=1938](http://science.house.gov/legislation/leg_highlights_detail.aspx?NewsID=1938)), which mandates quasi-experimental designs for evaluation of educational projects funded by this program. Guidelines instruct the reader to describe the project, to outline the goals and objectives, and to then develop research questions and define measurable outcomes. The program evaluated is constructivist-based, representing a contrast to the recommended post-positivist evaluation approach. This contrast sets the stage for discussion of if and how the contrasting philosophies can be blended. We define the post-positivist as having a "deterministic philosophy in which causes probably determine effects or outcomes" (Creswell, 2003, p. 7) that can be researched through setting up hypotheses and testing them. The constructivist approach is discussed in the following section.

### *The Program and Philosophical Underpinnings*

Studio-based instruction stresses the construction of personally meaningful representations of computing concepts, or processes, and social interaction through an instructional approach in which students solve complex problems, present their solutions to the class, and participate in critical discussions. The framework, adapted from an architectural model (Boyer, 1996), is grounded in cognitive

and social constructivist learning theories (e.g. see Lave and Wenger, 1991). Social cognitive theorists believe that learning takes place through “reciprocal causation”, the interdependence among behavior, mental activity (e.g. expectations), and the environment. Cognitive constructivist theorists recognize the roles of both mental activity and experience and see these components as conduits to knowledge construction, stressing the cognitive activity of the learner (Eggen & Kauchak, 2007). Lave and Wenger’s (1991) socio-cultural theory of learning emphasizes the contextualized, or ‘situated’, aspects of learning. This theoretical framework conceives the learner as a participant in a learning community through which s/he gains content knowledge and understanding. The learner, similar to an apprentice, participates in the community as a novice learning from other more expert community members and through hands-on experience. Thus, a pedagogical approach based on a socio-cultural framework might include collaboration and ‘real-world’ projects or assignments in order to (a) foster a student sense of community and (b) increase motivation through the use of hands-on learning tasks, both of which are consistent with a studio-based approach to learning.

Several studies have been conducted that suggest that the studio-based approach to learning and instruction is effective in attitude improvement and learning (Carbone & Sheard, 2002; Docherty, Sutton, Brereton, & Kaplan, 2000; Woodley & Kamin, 2007). Hundhausen and colleagues (Hundhausen, 2002; Hundhausen & Brown, 2007; Hundhausen & Brown, 2008) concluded that the construction and discussion of visual representations by students improves their learning and

increases their sense of community, and attributed an increase in motivation and attention to this instructional approach. Hubscher-Younger and Narayanan (Hubscher-Younger, 2002; Habscher-Younger & Narayanan, 2003a, 2003b, 2003c) found that students learned more when constructing their own and critiquing others’ representations for explaining computing concepts.

### *The Auburn University Context*

A multi-site study of studio-based learning in computer science, funded by NSF, began in the fall of 2007. Consistent with NSF guidelines, we employ a goals and objectives-based evaluation approach as bases for evaluation activities. The goals help guide data collection as well as analysis and interpretation of results. Specific program objectives are to (a) improve student learning, including critical thinking and problem-solving (b) enhance student enthusiasm and engagement in computing (intrinsic motivation), and (c) build students’ sense of community (social interaction). At Auburn University, the studio-based model is implemented in Computer Science 2 (CS2) and Computer Science 3 (CS3), two sequential courses taken primarily by sophomores, juniors, and seniors. Implementation takes the form of (a) assigning meaningful problems that are amenable to multiple solutions, (b) working in pairs or larger groups to justify solutions in terms of efficiency and software considerations, and (c) critiques by peers, both in written and in oral presentation form (Hendrix, Myneni, Narayanan, and Ross, 2008; Myneni, Ross, Hendrix, & Narayanan, 2008).

## Choosing the Evaluation Approach

Pragmatically speaking, the various approaches to evaluation can serve different needs (Stufflebeam, 2001). Evaluators often draw from and successfully blend more than one approach in order to accommodate a variety of program evaluation needs and stakeholder values. We judged the consumer-oriented approach (Scriven, 1967, 1995, 1998b.; Scriven & Coryn, 2008; Stufflebeam & Skinkfield, 2007) to be a practical one for our needs in that it aligns well with evaluation guidelines set forth by NSF (n.d.). For instance, the tenets set forth by Scriven and the NSF guidelines are consistent in relation to the purpose of evaluation, assessing worth or merit, and both NSF and Scriven are receptive to using quantitative and qualitative methodologies. Further, Scriven's consumer-oriented conceptual frame, which includes concepts such as formative and summative evaluation, is particularly applicable. Although we rely a great deal on concepts and ideas proffered by Scriven (1967, 1991a), we do not strictly adhere to or advocate any one approach to evaluation. In the following section, we discuss our approach to the evaluation of Auburn University's NSF grant funded studio-based instructional program.

## Evaluation of the Studio-Based Model at Auburn University

### *Evaluation Overview*

A mixed methods approach was used to evaluate studio-based learning instruction implemented at AU. Quantitative methods utilizing pre- and post-tests were used to

address student learning, with studio-based instruction compared to the traditional lecture-only approach. Additionally, pre- and post-surveys were used to quantify motivation constructs, peer learning, and critical thinking. Qualitative methods consisted of end-of-semester interviews using open-ended questions. Selected evaluation components and philosophical underpinnings are addressed in detail in the following sections.

*Quality goals.* Scriven's major concern about purely objectives attainment approaches to evaluation is that attainment of objectives doesn't address the quality of objectives (Stufflebeam & Shinkfield, 2007). Constructivists posit that values play a role in all research. In this case, even post-positivists who endeavor to remain objective would be influenced by their own beliefs in choosing 'quality' goals and objectives. At AU, we have identified objectives based not only on theory about depth of learning using a studio-based approach, but also on previous research that suggests that student motivation, which we hypothesize to be associated with student learning depth and retention in computer classes, can be improved using a studio-based learning approach in computer science (Hundhausen, Narayanan, & Crosby, 2008). We consider increased motivation and learning laudable goals, though some may argue otherwise based on a different set of values. We agree with constructivists that our values dictate, at least to some extent, our evaluation objectives, however, by identifying and testing theory about learning and motivation we assume a causal relationship as do post-positivists.

*Objectivity and bias.* Scriven points out that evaluators can be biased toward favorable findings (1991), a concern of

both post-positivist and constructivist researchers. The post-positivist aims for complete objectivity whereas the constructivist researcher considers bias as unavoidable and directly addresses researcher bias. To minimize bias as well as optimize objectivity, the initial step in the evaluation process was to enlist the services of outside evaluators or evaluation consultants at all three project sites (Auburn University, Washington State University, University of Hawaii). We conduct regular multiple-site teleconferences and local meetings partly to identify implementation and outcome issues and concerns.

*Formative evaluation.* We consider the evaluation during the first year formative, in that a major purpose was to identify program process (Stufflebeam & Skinkfield, 2007) and evaluation issues and take corrective action. Program refinement issues identified during the formative year included lack of evidence, based on presentations and peer critiques, students were thinking critically. Corroborating evidence came from quantitative data. At the end of the Fall 2007 pilot semester, five students from the studio-learning class were interviewed and two of these expressed concern about the lack of quality in peer reviews. Therefore, in Spring, students were provided guidance in critiquing and discussing computer assignments through examples and modeling. Similarly, the CS2 instructor felt that students presenting their work at the end of an assignment, as was done in Fall of 2007, was less motivating than an alternate implementation, which was used in Spring of 2008. In the Spring of 2008, students presented their work mid-way through an assignment, thereby providing them with the opportunity to improve

their work based on feedback from the class.

A second formative issue was consistently defining and appropriately implementing the studio-based learning approach. Thus, we developed a definition for our purposes and delineated the components of the approach that must be incorporated into the classes. Three activities we considered fundamental to the studio-based approach are (a) student construction of artifacts representing solutions to meaningful computer science problems that can be solved in multiple ways, (b) student presentation of their work and reception of feedback or critiques from class members, and (c) students correction of or refining of their solutions based on the feedback they receive (Hendrix et al, 2008). To reiterate, formative evaluation and summative evaluation are used to support decision-making, and like positivists/post-positivists, we are testing hypotheses before making decisions about program implementation.

*Decision support.* Post-positivists tend to favor experimental, quantitative designs. In our opinion, strong decision support based on evaluation results (Scriven, 1993) is enhanced through the use of experimental or quasi-experimental designs that utilize comparison groups augmented by qualitative data. We have collected a variety of data (pre- and post-tests of content knowledge, pre-and post-surveys, and end-of-term student interviews) from students in CS2 and CS3 courses over a three year period (fall 2007 through spring 2010).

Integrity of the pre- and post-tests of knowledge to assess learning was addressed through mapping test item content against course goals and objectives. The tests include both knowledge and higher-order (e.g. critical

thinking, problem-solving) items. Five scales from the Motivated Strategies for Learning Questionnaire (MSLQ) were used to quantify self-reported intrinsic motivation, task value, peer learning activity, self-efficacy, and critical thinking, (Pintrich, Smith, Garcia, & McKeachie, 1991). The MSLQ measures six motivational constructs and nine learning strategy scales. Items are scored using a 7 point Likert-type scale with 1 = not at all true of me and 7 = very true of me. The authors used factor analysis procedures to provide validity evidence related to the hypothesized factor structure. See Table 1 for the reported path coefficients and reliability coefficients for the aforementioned MSLQ scales.

Table 1  
MSLQ Validity and Reliability Reported Statistics

Scale	Item Path Coefficient Range	Reliability
Intrinsic	.55 - .69 (n = 4)	.74
Task Value	.57 - .88 (n = 6)	.90
Peer Learning	.54 - .84 (n = 3)	.76
Self-Efficacy	.63 - .89 (n = 8)	.93
Critical Thinking	.49 - .76 (n = 5)	.80

The Sense of Community Scale was used to assess self-reported feelings of connectedness to other class members. The scale was adapted to assess classroom sense of community by McKinney, McKinney, Franiuk, and Schweitzer (2006) from the Sense of Community Scale developed by Schweitzer, Kim, and Mackin (1999). As reported by the authors, the latter scale was based on a literature review of definitions and studies related to community attachment, neighborhood attachment, residential attachment, and neighborhood cohesion.

The Sense of Community Scale is comprised of 33 items. The item response options range from 1, indicating the highest level of agreement with the item, to 7, indicating the lowest level of agreement. Averages across items that constitute a scale were computed for the scale scores. Sample specific reliabilities for all pre- and post-assessments were in the acceptable range (.66 - .96).

Analyses using the quantitative data from knowledge assessments and attitude scales were based on the two years of implementation after the initial formative year. For CS2, knowledge acquisition results were mixed. The mean on course exams, yielded statistically significant differences between the traditional and studio-based learning conditions favoring the studio-based approach,  $F(1,244) = 9.22, p = .003$ . However, neither the final exam nor the pre- and post-test group differences yielded statistical significance. Table 2 displays means and standard deviations for knowledge assessments. For CS3, knowledge assessment of differences across the studio-based and the traditional conditions did not produce statistical significance. See Table 3 for means and standard deviations.

Table 2  
CS2 Knowledge Assessment Means and Standard Deviations

Assessment	<i>M(SD)</i>	
Exams		
Studio (n=118)	75.10	(17.55)
Traditional (n=128)	68.35	(17.29)
Final		
Studio (n=118)	64.85	(20.06)
Traditional (n=128)	62.07	(18.31)
Pre/Post-Test	Pre	Post
Studio (n=113)	9.10 (7.51)	52.07 (11.49)
Traditional (n=127)	8.02 (7.77)	50.10 (11.88)

Six attitude scales were assessed using a Repeated Measures ANOVA with a within subject factor (pre- to post-survey) and between subject factors: intrinsic motivation, task value, peer learning, self-efficacy, and critical thinking.

**Table 3**  
CS3 Knowledge Assessment Means and Standard Deviations

Assessment	<i>M (SD)</i>	
Final Exam		
Studio (n=56)	63.90	(18.13)
Traditional (n=61)	61.67	(17.8)
Midterm		
Studio (n=56)	59.76	(16.82)
Traditional (n=61)	58.28	(15.33)
Pre/Post-Test	Pre	Post
Studio (n=56)	23.67 (6.82)	54.24 (13.74)
Traditional (n=61)	24.96 (7.13)	51.82 (12.50)

Group differences for the attitude scales were not statistically significant for either CS2 or CS3, though the pattern in mean differences from pre to post did slightly favor the studio-based learning condition for four of the six CS2 scales and all of the CS3 scales. Means and standard deviations are presented in Tables 4 and 5.

**Table 4**  
CS2 Attitude Scale Means and Standard Deviations

Scale	Pre <i>M (SD)</i>	Post <i>M (SD)</i>
Intrinsic Motivation*		
Studio (n=81)	4.93 (0.94)	5.04 (1.05)
Traditional (n=91)	5.12 (0.85)	4.94 (1.05)
Task Value*		
Studio (n=81)	5.99 (0.78)	5.85 (1.06)
Traditional (n=91)	5.93 (0.86)	5.70 (0.98)
Peer Learning		
Studio (n=81)	4.11 (1.34)	4.27 (1.49)

Scale	Pre <i>M (SD)</i>	Post <i>M (SD)</i>
Traditional (n=91)	4.08 (1.24)	4.42 (1.25)
Self-Efficacy*		
Studio (n=81)	5.40 (0.94)	5.26 (1.25)
Traditional (n=91)	5.41 (1.03)	5.20 (1.13)
Critical Thinking*		
Studio (n=81)	4.33 (1.04)	4.37 (1.18)
Traditional (n=91)	4.12 (1.09)	4.12 (1.29)

\*Pattern in mean differences from pre to post favors studio-based learning.

Two major themes emerged based on the qualitative analysis of the end-of-semester interviews: the motivational effect of the learning context and perceptions of student learning that resulted from interacting with others about projects. With respect to the motivational effect of the learning context, many students in studio-based learning courses related positive reactions to the studio-based components of the class, such as group work and interacting with peers about the group projects. One student, when asked about whether or not the course kept him/her interested said, "Yes, it did because I had to work in a group and working in a group, there's always one other or two other people motivating you to work." Another student responding to a question about working in pairs said, "It's...difficult to collaborate sometimes on projects. Um, but I enjoyed like having somebody to bounce ideas off and do it together."



**Table 5**  
CS3 Attitude Scale Means and Standard Deviations (SD)

Scale	Pre <i>M (SD)</i>	Post <i>M (SD)</i>
Intrinsic Motivation*		
Studio (n=44)	5.20 (0.86)	4.85 (1.04)
Traditional (n=52)	4.98 (0.97)	4.52 (0.96)
Task Value*		
Studio (n=44)	5.75 (1.04)	5.44 (1.19)
Traditional (n=52)	5.50 (0.96)	5.00 (1.22)
Peer Learning*		
Studio (n=44)	4.01 (1.38)	4.20 (1.49)
Traditional (n=52)	3.62 (1.38)	3.59 (1.57)
Self-Efficacy*		
Studio (n=44)	5.49 (0.99)	5.76 (1.24)
Traditional (n=52)	5.30 (0.95)	4.79 (1.07)
Critical Thinking*		
Studio (n=44)	4.56 (1.26)	4.47 (1.25)
Traditional (n=52)	4.58 (0.95)	4.27 (1.03)
**Community*		
Studio (n=44)	2.82 (0.57)	2.78 (0.84)
Traditional (n=52)	2.87 (0.52)	2.92 (0.58)

\*Pattern in mean differences from pre to post favors studio-based learning.

\*\*Lower values indicate stronger endorsement of sense of community.

Sample specific reliability coefficients are reported in Table 6.

**Table 6**  
Sample Specific Reliabilities

Scale	Pre	Post
Intrinsic Motivation		
CS2	.67	.76
CS3	.69	.59
Task Value		
CS2	.86	.91
CS3	.90	.81
Peer Learning		

Scale	Pre	Post
CS2	.79	.63
CS3	.75	.78
Self-Efficacy		
CS2	.92	.93
CS3	.93	.91
Critical Thinking		
CS2	.74	.84
CS3	.82	.82
Community		
CS2	.94	.96
CS3	.96	.94

However, not all students reacted positively to the group structure. Some felt that other members of their group did not do their fair share of the work on assigned projects. The following quote typifies discontent with the group structure.

The studio labs for the most part had some great ideas in it, but the group work part of it kind of led to one person doing all of the work. So one person gets really good while the other person just slacks off and winds up failing the course I guess from an extreme view, but...

Another student indicated that, though not all group members contributed equally to projects, that it was nonetheless a valuable experience saying,

It intrigued me because it's a reflection of the actual work force that I've been in for a while, since my first degree. So it's a reflection of how the world actually does work. In college you rarely ever, well I guess it depends on your profession, but for me, you rarely ever do work by yourself, you're always pulling someone else in.

In relation to the second major theme, perception of student learning that resulted from interacting with others

about projects, one student responding to a question about working in groups stated,

...it helps you to get to know people and I guess it also teaches you about teamwork. So it's...I guess, when you have a real job, you're not going to be working by yourself and you need to learn how to work with other people.

When asked about peer reviews, another component of studio-based learning, a student said,

...just reading the the different approaches that some, some other students take is helpful to have a second set of eyes on any given problem, so seeing where other students may have used a different strategy helped me to basically learn more strategies to solve the ...a given problem.

Another student responded to a question about the presentation component of studio-based learning saying,

...seeing other people's ideas you know sometimes they have different concepts altogether about how to handle things and it just sparks...you know new trains of thought.

Interview data suggest that most students did find working in groups enjoyable and a valuable experience. Some students did feel burdened because they felt that others in the group did not contribute their share to complete assignments. The data also suggests that students viewed the collaborative and interactive aspects of the course as contributing to their learning.

Statistical data provide weak evidence that the studio-based learning approach has attitudinal or learning advantages over the traditional approach, though not often at a statistically significant level.

Attitude scores decreased for all students in many cases, however, the decrease was slightly, but somewhat consistently, smaller for the studio-based learning group than the traditional group. For CS2, course exams suggest that short-term learning is influenced positively by the studio-based learning approach.

We believe that in weighting the advantages and disadvantages, practical significance as well as statistical significance should be considered. In education, even small but consistent differences in favor of an intervention may be valuable if little or no cost is associated with the implementation. Implementation of the studio-based learning approach in computer science courses costs nothing in monetary terms and qualitative data suggest that students did, for the most part, perceive the studio-based learning approach to be motivating and to have value. Instructors need to consider personal teaching-style preferences as well as the cost in terms of time and effort needed to implement a studio-based learning approach in courses given total workload.

*Unintended outcomes.* In our investigations and discussions, we try to identify unintended outcomes, both negative and positive. For example, one positive unintended outcome, identified from student interviews, is the spontaneous recognition by some older students with work experience that group assignments closely simulate "real world" cooperative work situations. One negative outcome was that in CS3 pilot studio implementation, some students objected to being assigned points by fellow students. Because we felt that this was a legitimate concern, the grade assignment was made the sole responsibility of the instructor in subsequent studio offerings of this course. Discovering unintended

outcomes seems to be an open-ended process in that we are not testing theory or relying on quantitative methods, and constructivists lean toward open-ended investigation methods.

In the following section we discuss paradigm differences as related to program evaluation. We want to stress that our purpose is to underscore philosophical differences for discussion purposes. We do not mean to imply that evaluators cannot or do not integrate evaluation approaches and methods to take into consideration different program purposes or differing worldviews of those involved with the program evaluated. Nor do we propose that by integrating evaluation approaches, the evaluators act inconsistently with their own philosophical underpinnings. We believe the philosophical differences can be unified in a cohesive manner, as presented in the discussion section.

## **Paradigms and Program Evaluation Issues**

Stufflebeam and Shinkfield (2007) indicate that "[s]ystematic evaluation was not unknown before 1930, but it was not a recognizable movement" (p. 32). In the early 1930s, program evaluation became recognized as a field, to a great extent based on the work and writings of Ralph Tyler (Madaus & Stufflebeam, 1989; McLaughlin & Phillips, 1991; Stufflebeam & Shinkfield, 2007; Tyler, 1991), and many evaluation models have emerged since the "Tylerian Age". In fact, Fitzpatrick, Sanders, and Worthen (2004) assert that "during the 1960–1990 era, nearly 60 different proposals for how evaluations should be conducted were developed and circulated" (p. 57) based on diverse philosophies and ideologies.

Some approaches to evaluation, such as the objectives-oriented approach, are methodologically more measurement-based than not, whereas others, such as the participant-oriented approaches, incorporate qualitative methods of inquiry. Given that inquiry or research methods are driven by the research questions or goals of the inquiry, which are determined, to some extent, by the implicit or explicit assumptions of the inquirer and the program stakeholders, we devote some attention to belief paradigms.

Denzin and Lincoln (2000) define a paradigm as a "basic set of beliefs that guide action" and include axiology (ethics, morals), epistemology (how one knows the world), ontology (the nature of reality), and methodology (the means through which one knows the world). Two major and contrasting paradigm camps are the post-positivist with a worldview which emphasizes the use of quantitative research methods in order to ascertain the laws or realities of social nature (perhaps difficult to discover or fully understand) and the constructivist camp with a worldview which emphasizes the use of qualitative research methods in order to examine the experience of an individual, case, or specified group. Smith (1983) points out that the quantitative-qualitative debate, as it relates to the social sciences, began in the mid to late 1800s with theorists such as Dilthey (in Smith, 1983) and Mill (1943) in opposition to positivists such as Rickert (1965) and Durkheim (1938); and this philosophical discussion persists today, in the 21<sup>st</sup> century (e.g. Howe, 1988; Lincoln and Guba, 2000; Onwuegbuzie, 2000; Onwuegbuzie, & Burke, 2004).

Smith (1983) outlines basic areas of disagreement between the post-positivist and the constructivist points of view. One

area of disagreement is related to ontological concerns. The post-positivist asserts that reality does exist and is separate from the researcher or those being researched whereas the constructivist stance is that reality only exists as it is experienced or constructed by the investigator or participants. Ontological belief influences how the investigator interprets findings. Are they universally applicable or applicable only in a specific way (time, place, culture)? Rigor required by NSF guidelines suggests a post-positivist approach to evaluation. The funding source, understandably, wants to ensure that resources benefit or generalize to the greatest number of participants possible. However, the constructivist foundation of the instructional approach suggests an interpretive framework to evaluation which narrows the scope of generalizations from findings, an issue related to the foundations of truth and knowledge (Lincoln & Guba, 2000). The generalizability issue seems important in light of judging the merit of a program. For whom does the program have merit (or not)? How does the interpretation of merit affect decisions about future funding? How does the interpretation of merit affect action in relation to whom the results should be disseminated?

Another area of disagreement is epistemological in nature (Smith, 1983). The post-positivist holds that the researcher can and should strive to be objective in investigations, which would only be possible if reality exists independent of the researcher. In contrast, the constructivist perspective holds that all research is value laden given that reality exists only as a construction of the individual. The post-positivist evaluator need not be as concerned as the constructivist about who is represented in

the evaluation as the interpretation of results is not value dependent. Is it possible for a post-positive interpretation of a constructivist approach to learning accurately reflect the “truth” about the approach or do the values (axiological beliefs) of the evaluators or investigators subconsciously bias the interpretation (or evaluation recommendations), as constructivists might suggest, without consideration of the beliefs of those affected by the instructional approach? This validity issue brings up more questions about whose voice should be trusted in making decisions about how the program is evaluated, and who is tasked with making recommendations and taking future action based on results (Lincoln & Guba, 2000).

## Discussion

Based on NSF guidelines, the approach to evaluation tends to lean towards a post-positivist philosophical position more than constructivist position, and the opposite is true of studio-based learning. Studio-based learning is a constructivist approach based on the theories of Piaget and Vygotsky (Eggen & Kauchak 2007). Constructivists believe that each person learns by constructing his/her own understanding of the world, as do those who take a subjective epistemological posture. Social constructivists such as Vygotsky, furthermore, contend that knowledge is constructed through social interaction and socio-cultural constructivists emphasize the role of cultural and historical contexts in learning (Gredler, 2008; Wallace, 1997). What do the paradigm contradictions between the teaching approach and the evaluation approach say about the underlying assumptions of those who implement the

program and the evaluators? Should a more constructivist approach to evaluation be used than is currently used in light of the constructivist approach to teaching?

Some recommend that the evaluation be conducted considering the theoretical framework of the program being evaluated (Chen, 2003, 2006; Christie & Alkin, 2003; Greene & McClintock, 1991). Although this approach may be practical for the evaluator, it does not address issues related to differences in worldviews that may exist between the evaluator(s) and the program advocates. If the evaluator's assumptions related to research are not considered then the evaluation takes on a "black box" quality (Scirven, 1999). Scirven does not suggest that this is entirely inappropriate and we, at least to some extent, agree with Scirven on this point. Perhaps conducting evaluation activities and reporting on program effectiveness is useful regardless of the underlying assumptions of either the program advocates/implementers or the evaluator. However, as suggested earlier in this manuscript, it seems that the philosophical stance of the evaluator would play a part in the interpretation and generalizability of results. For example, the evaluator that takes a constructivist position, even if his/her assumptions are implicit rather than explicit, may hesitate to assign merit or worth and leave this task to the 'audience', as generally advocated by qualitative researchers. We take the position, like Scirven (1994, 1998a, 1998b, 1999, 2007), that the evaluator should participate in assessing program merit and making recommendations, perhaps through reports, presentations, or publications, with the supposition that the recommendations will be acted upon by a

wider audience than those involved directly with the program.

In addition, assigning merit or worth is inconsistent with a post-positivist axiological position that advocates objectivity over values. Values inevitably play a role in assigning merit and worth. Neither is it consistent with a constructivist stance if you accept that it is possible (even desirable) evaluators can objectively design and conduct evaluation then, based on findings, systematically assess program merit (value) (Scirven, 1994). Assigning merit may be influenced by society's values; this does not imply that values have no basis in an objective reality apart from the individual, even if the reality is bound by time and place or reflects only one facet of a "very rich one that cannot be exhaustively described" (Scirven, 2000, p. 259). In our evaluation, we strive for objectivity when deciding what data to gather, but also believe that it is appropriate to make a value judgment about the studio-based learning instructional approach in teaching computer science.

Given that our contention is that some objective reality exists (however multifaceted or obscure) and that it is our job to assign merit (value) in some sense, we must clarify our position in relation to blending the post-positivist and the constructivist frameworks. Some, such as Guba (1987), have insisted that the two stances cannot be blended but that "it is absurd to suggest that evaluators whose paradigm of orientation is the conventional [positivist] are limited to quantitative methods, or that evaluators whose paradigm of orientation is the naturalistic [constructivist] are limited to qualitative methods" (p. 31). Others, taking a more post-positivist stance (Scirven, 2005, 1991), agree that mixed methods research is appropriate for

evaluation. Thus, it seems that constructivist and post-positivist researchers should not have problems working together even though they see the world through different paradigms. It may be true that there are purists that disagree that a mix of methods and/or models is acceptable, but we, as a research team, do not disagree. Thus, we, along with many evaluators, do not consider mixed methods research a problem and strategies for conducting evaluation using mixed methods have been proposed (Greene & McClintock, 2001). In our evaluation of the studio-based learning instructional approach, we gathered and analyzed both quantitative and qualitative data. Other (and perhaps larger) issues do exist, however, when conceptualizing if and how to blend the two research philosophies.

Perla and Carifio (2009) argue that a unified view and theory of research and evaluation is needed. Onwuegbuzie (2000) and I. Newman (personal communication, February 28, 2009) contend that the “quantitative and qualitative paradigms should be reconceptualized as lying on continua” (Onwuegbuzie, 2000, p. 12). If paradigms are seen as lying on continua, then one’s philosophy is based on the lens through which the researcher views the world. Hence, researchers (and evaluators) could just admit they view the world differently and co-exist if not agree. Lincoln and Guba (2000) on the other hand, delineate issues they believe must be considered in the debate about paradigm inbreeding, including axiology, foundations of reality, action, control, voice, and validity.

### *Axiology and Foundations of Reality*

As stated previously, our position is that some objective reality does exist, even if it cannot be completely understood or it is multifaceted and ambiguous. We do not, however, believe that it is impossible to take the axiological position that values should be altogether avoided in any discussion of research or evaluation. It has been pointed out that values feed into many decisions about research, including choice of the research problem or question and framing the investigative process (Lincoln & Guba, 2000; Perla & Carifio, 2009). Perla and Carifio extensively discuss discovery versus justification research frames. Do we build or discover theory as constructivist researchers suggest or do we test or justify existing theory as do post-positivist? Our belief that some reality does exist puts us in the positivist camp and our belief that values are critical to research and evaluation puts us in a constructivist camp. We value quality education, but our research centers on the a priori theory that collaboration and problem solving motivate students and lead to a higher level of learning than does the traditional approach to teaching computer science. It seems that the very fact that there exists a theory that people construct knowledge, or that knowledge is relative to the individual’s perceptions of it, is contrary to tenets of the theory. As Scriven states “[t]he concept of relativism is self-refuting; if everything is relative, then the assertion that everything is relative cannot itself be known to be true” (Scriven, 2000, p. 259).

### *Action*

Lincoln and Guba (2000) state that “positivist and post-positivist adherents...view action as a form of contamination of research results and processes, and the interpretivists...see action on research results as a meaningful and important outcome of inquiry processes” (p. 174). This issue seems to have axiological underpinnings in that taking action would mean the research outcome tells us something valuable about how to use them. To reiterate, we do value quality education and plan to disseminate what we learn from the evaluation of the program, and consider this to be taking action. Our actions will also include recommendations about using a studio-based learning approach to teaching and building a community of computer science instructors interested in computer science teaching and learning approaches. Being as objective as possible in the way we conduct the research is still a valuable goal to aspire to, but once results are available, some action is, in our opinion, appropriate. If we find that something is beneficial or detrimental, it would seem unethical not to take some action, even if just to inform others.

### *Control and Voice*

Control and voice address questions of the “who”. Who questions might include who should be involved in designing the study, assessing the results, or making decisions based on results. Constructivists would place a high value on participants’ voices based on the belief that reality is individually constructed. However, our position is that evaluation can address a general reality based purpose and still be cognizant of the needs of participants.

Scriven’s consumer approach to evaluation is not a participatory one, but the statement that the results must be examined “in terms of how effectively and efficiently they are serving those they impact” (1994 p. 161) attests to his attention to the needs of all stakeholders. We are testing the efficacy of a teaching approach in the context of computer science courses. Student voices are given credence through end-of-semester interviews. However, much (not all) of our evaluation effort is quantitative and designed to provide support for NSF to make a summative decision about funding and support of decisions about instruction. Nonetheless, based on the assumption that motivation and learning are important or valuable, we believe we do consider the students’ needs through assessing the effects of studio-based-learning on these constructs.

### *Validity*

The validity issue is a complex one and in this manuscript we do not discuss all paradigm aspects, implications, and concerns. We refer the reader to Lincoln and Guba (2000) for a more in-depth discussion of this issue. Suffice it to say that, like Scriven (2000), we do adhere to the belief that some reality exists even if from multiple perspectives. Based on the assumption that some larger reality exists, we do believe that research rigor can produce sufficiently authentic results for most and hence our interpretations can be generalized to many similar situations.

### *Conclusion*

We have blended post-positivist and constructivist philosophies. Some would consider this avoidance of issues. We have

tried to explain our philosophical positions, which we view as a pragmatist stance. Some might believe that pragmatists aren't committed to a particular philosophy. However, several researchers have seriously thought about the pragmatist position and philosophy.

Perla and Carifio (2009) state that "there is a need for a more general and unified view and theory of research and evaluation" (p. 39). Others have also called for an integrated framework for research and evaluation (Greene & McClintock, 2001; Melvin, Henry & Julnes, 1999). Onwuegbuzie and Burke (2004) outline a pragmatist philosophical position that rejects dualism. They argue, for example, that it is not inconsistent to posit reality can be "both constructed and based on the reality of the world we experience *and* live in" (p. 18) considering this a function of the organism-environment transaction. Scriven, specifically addressing evaluation, also blends constructivist and post-positivist positions when asserting that reality (2000) and values (1983) are elements of sound evaluation and research philosophy. In our approach to evaluation of the NSF funded studio-based-learning, consistent with Scriven tenets, we blend paradigm positions and take the stance that a unified theory is not only possible, but desirable.

## Acknowledgments

This paper is based on work done at Auburn University as part of a multi-university research project involving researchers from Auburn, the University of Hawaii, and Washington State University (M. Crosby, D. Hendrix, C. Hundhausen, H. Narayanan, M. Ross, M. Trevisan, and R. Vick). The work at

Auburn is supported by the National Science Foundation under CPATH Grant No. CNS-0721927. Any opinions, findings, and conclusions expressed are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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