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Investigating the Impact of Formal Reflective Activities on Skill Adaptation in a Work-Related Instrumental Learning Setting

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INVESTIGATING THE IMPACT OF FORMAL REFLECTIVE ACTIVITIES ON
SKILL ADAPTATION IN A WORK-RELATED INSTRUMENTAL LEARNING
SETTING

by

Kevin M. Roessger

A Dissertation Submitted in
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ABSTRACT
INVESTIGATING THE IMPACT OF FORMAL REFLECTIVE ACTIVITIES ON
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Kevin M. Roessger

The University of Wisconsin-Milwaukee, 2013
Under the Supervision of Professor Barbara J. Daley

In work-related, instrumental learning contexts the role of reflective activities is unclear. Kolb's (1985) experiential learning theory and Mezirow's transformative learning theory (2000) predict skill-adaptation as a possible outcome. This prediction was experimentally explored by manipulating reflective activities and assessing participants' response and error rates when an instrumentally learned skill is applied in a novel way (skill-adaptation). Participants were randomly assigned to three conditions (interference, reflection, or critical reflection) using three blocking variables: (a) gender, (b) age, and (c) reflective propensity. Participants then completed a behavioral skills training program with embedded reflective activities. Afterwards, participants were asked to complete a novel application task. ANOVAs neither revealed: differences in response or error rates between reflective activity groups, even when accounting for reflective propensity, nor a significant interaction between reflective activity and reflective propensity on response rate. A significant interaction, however, was found between reflective activity and reflective propensity on error rate. In the critical reflection condition, non-reflective learners had higher error rates than reflective learners. Four conclusions based on these findings are offered, along with implications for teaching, practice, and research.

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To the two most important women in my life:
my mother, Susan Busack, and my partner, Rebecca Ohmen.
Each has made this work possible – in her own sweet way.

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“What can be asserted without evidence can be dismissed without evidence.”

--Christopher Hitchens

CHAPTER 1

Introduction

Statement of the Problem

Over the past two decades perhaps no other approach to learning has captured the interest of work-related adult education as much as reflective practice. It has been described as an indispensable methodology of professional development (Brookfield, 1995; Schön, 1983, 1987), an innovative and beneficial addition to competency-based employee training (James & Mulcahy, 2000), and a core component of constructivist pedagogy in career and technical education (Doolittle & Camp, 1999). In fields such as nursing education, it has been termed an education panacea (Burton, 2000) and an accepted and institutionalized process (Mackintosh, 1998). In teacher and adult education, it has been described as an approach so fashionable that courses not including elements of reflective practice are viewed as operating outside the educational mainstream (Cornford, 2002). Formal reflective activities thought to occasion reflective practice are now commonplace in continuing professional education courses and workshops (Boud, 2010; Boud & Walker, 1998; Fook, 2010), initial in-service professional education courses (Warhurst, 2008), and a host of career and technical education settings for novice learners (Cooper, 2006; Hegarty, 2011; Kozolanka, 1995; Reese, 2011).

For readers unfamiliar with reflection and its variants, the following definitions are offered in advance of a more thorough discussion. Reflection is a cognitive process using various analytic and/or meta-cognitive strategies for problem solving and the creation of meaning. Critical reflection is a dialogic process of identifying, analyzing, and

challenging epistemic, sociocultural, and psychic distortions underlying prior learning. Reflective practice is the application of reflection and/or critical reflection to professional practice for the purpose of improving one's professional behavior. Formal reflective activities are structured pedagogical events that take place within the educational setting to occasion reflection and/or critical reflection. Reflective propensity refers to a learner's preference for reflective or non-reflective learning. Learners with high reflective propensity are considered reflective learners, learners with low reflective propensity, non-reflective learners.

Aside from a common partiality for reflection and its variants, work-related learning contexts frequently share a focus on skills-based or competency-based curriculum. Consider these examples: hands-on practical workshops and clinical updates in chiropractic medicine (Bolton, 2002), continuing medical education for surgical techniques (Perera, LoGerfo, Shulenberger, Ylvisaker, & Kirz, 1983; Rogers, Elstein, & Bordage, 2001), skills-based continuing education for the construction trades (see <http://www.utah.gov/ce-public/>), and standardized skills-based career and technical education for employment and lifelong learning (Waters, et al., 2004).

Mezirow (1990, 1991, 2000) has asserted that this type of learning—how to do something or how to perform—involves a unique learning process he terms *instrumental learning*. When engaged in this process, learners use hypothetical-deductive reasoning (i.e., hypothesis testing and empirical measurement) to generate knowledge. They test and re-test theories pertaining to this knowledge in an effort to solve problems and improve performance. Mezirow (2009) maintains that instrumental learning is necessary for learning various demonstrable work-related skills, including “learning to design

automobiles, build bridges, diagnose diseases, fill teeth, forecast the weather and do accounting, and in scientific and mathematical inquiry” (p. 91). He differentiates this process from what he terms *communicative learning* (analogic-abductive reasoning), the process by which learners seek to understand the meaning of what others communicate, “concerning values, ideals, feelings, moral decisions, and such concepts such as freedom, justice, love, labour, autonomy, commitment, and democracy” (Mezirow, 1990, p. 7).

Mezirow’s binary conceptualization of learning borrows heavily from Habermas’ (1971) knowledge-constitutive interest theory, which delineates three basic human interests: (a) instrumental, (b) communicative, and (c) emancipatory. Habermas, too, argues that individuals possess a technical interest (instrumental) through which they seek to predict, control, and manipulate their physical and social environments. This interest is developed largely through the process of work, which provides the conditions for an empirical-analytic approach to knowledge generation. Habermas suggests that knowledge in some domains, particularly the natural sciences, may rightly be constructed in this manner. He does not, however, unconditionally reject instrumental learning’s relevance to other disciplines, rather its applicability to all forms of knowledge across disciplines. Similarly, Crick and Joldersma (2007) note that some degree of instrumental rationality in any curriculum is legitimate. Newman (2012), too, argues that the instrumental aspect of adult learning is a necessary part of what he terms “good learning.”

Although researchers have established a variety of benefits and outcomes associated with reflective activities in work-related *communicative learning* contexts (see Fook & Garder, 2007; Ruth-Sahd, 2003), few studies have empirically demonstrated the

benefits and outcomes of reflective activities in work-related *instrumental* learning contexts. If, indeed, adults use unique reasoning strategies in such situations, what is the impact of reflective activities on their ability to do so? Are learners better able to test and re-test their theories in new situations, generating new knowledge and subsequently improving performance? Can reflective activities assist learners in meeting core competencies aligned with instrumental learning?

Contradictory and largely conceptual suppositions abound. Moon (1999) has noted the disagreements within the literature concerning the necessity of reflective practice's inclusion in interpretive or instrumental investigations. Mezirow (2000), for example, asserts that critically reflecting on instrumental learning processes or content can lead to improved performance. Van Woerkom (2004), too, has suggested that critical reflection in workplace learning may lead to more flexible applications of instrumentally learned skills and knowledge. Boud (2010), on the other hand, has argued that one should perhaps reject the use of reflection entirely in instrumental or exclusively procedural settings. In contexts where the focus is on cognitively-oriented examinations—such as those often used to assess procedural skills or technical knowledge—Boud and Walker (1998) have argued that reflective activities may produce few useful outcomes, adding that the link between planned reflective processes and learning is tenuous. Similarly, Van Manen (1977) has detailed three hierarchical levels of curriculum development and their applicability to reflective activities. At the first level, curriculum is instrumental, concerned with economy, efficiency and effectiveness, and is inherently *not* reflective.

Given the rising interest in and demand for competency-based work-related education (see Frank et al., 2010; Scott Tilley, 2008; Sluijsmans, Straetmans, & Van

Marrieboer, 2008), such inconsistent conceptual positions become increasingly problematic for stakeholders utilizing reflective activities. A paradox emerges: How can one adhere to a pedagogical framework that aims to establish learning evidences (i.e., competencies) while simultaneously incorporating an educational activity that itself has little evidentiary support within this learning domain? Further investigation, therefore, is needed to illuminate the benefits and outcomes associated with formal reflective activities in work-related instrumental learning settings—specifically, so that educators, instructional designers, and program planners may better choose effective pedagogic activities. A greater understanding may also help decision-makers identify the immediate and long-term benefits of using these activities in their courses. In turn, this may lead to more effective courses and workshops for adults seeking specific, demonstrable occupational skills. This is particularly important when learners' ability to perform such skills have considerable consequences for themselves, their organizations, and their clients and/or customers.

This dissertation extends research on reflective activities and instrumental learning by using an experimental design to identify the impact of formal reflective activities on adult learners' abilities to adapt an instrumentally learned skill (i.e., installing concrete pavers in a 90 degree herringbone pattern) to a novel application (i.e., installing concrete pavers in a 45 degree herringbone pattern). The ability to adapt has been suggested as a benefit or outcome of reflection/critical reflection in skills-based learning (see Kolb, 1984; Mezirow, 2000). Hackett (2001), for instance, has identified a current aim of competency-based workplace education as increasing learners' ability to adapt to changed or changing circumstances. He notes that some have questioned the

field's current ability to accomplish this given its historical focus on teaching observable behaviors. To address this concern, Hackett proposed that competency-based skills training and reflective activities be combined to facilitate mental "connections" between disparate activities, skills, and contexts. He suggests that by doing so learners will be better able to act and reflect immediately in novel contexts and applications. Lesnick (2005), too, has argued that a postmodern redefinition of reflective practice should consider adaptive evidences (e.g., flexibility, agility, and mobility) as successes or outcomes.

Two prominent theories of adult learning will be employed to explain and evaluate the relationship between reflective activities and instrumental learning. Kang (2007) identified each as representative of what he termed the "how" adjective-plus adult learning theories. Kang suggests that predominate descriptions of adult learning are identified according to the preceding adjective that describes some aspect of learning. He designated two primary groupings of adult learning theories in terms of *how* the learner processes experience and *where* that experience is processed. Central to *how* adjective-plus learning theories is reflection; central to *where* learning theories is context. The two most representative learning theories of the reflective grouping were Kolb's (1984) experiential learning theory and Mezirow's (1990, 1991, 2000) transformative learning theory. A discussion elucidating each theory's espoused claims regarding the relationship between reflection, critical reflection, and skill and knowledge adaptation will follow.

The skill of interest in this study was selected because it represents an authentic occupational skill featured in courses for beginners and experienced hardscape professionals (see Interlocking Concrete Pavement Institute, 2010a; School for Advanced

Segmental Paving, 2012). The novel application of this skill was selected because it represents an authentic, and often difficult, adaptation that learners may be faced with outside the educational context. The rationale for using an experimental design is that it permits assessing causation between putative independent and dependent variables (Creswell, 2005).

Purpose of the Study

The purpose of this experiment is to examine the impact of formal reflective activities on skill adaptation in adult work-related instrumental learning settings. This will be accomplished by collecting behavioral observation data following educational and reflective activities, then comparing that data—when applicable—against existing industry standards set by the Interlocking Concrete Pavement Institute (see Interlocking Concrete Pavement Institute, 2010b). Behavioral observation data will be categorized as either response or error rate. Response rate refers to the number of individual units installed per 25-minute novel application task, and it will be indicative of a learner's ability to *efficiently* adapt an instrumentally learned skill to a novel application. Error rate refers to the number of errors committed per individual unit installed, and it will be indicative of a learner's ability to *effectively* adapt an instrumentally learned skill to a novel application. An exclusive improvement by the experimental conditions in either area will demonstrate a clear outcome or benefit attributable to participation in formal reflective activities.

Research Questions

Four research questions guide this investigation:

1. How do formal reflective activities affect a participant's response rate during a novel application of an instrumentally learned skill?
2. How do formal reflective activities affect a participant's error rate during a novel application of an instrumentally learned skill?
3. Is there an interaction effect between formal reflective activities and reflective propensity on response rate?
4. Is there an interaction effect between formal reflective activities and reflective propensity on error rate?

Research Hypotheses

Eight hypotheses are proposed:

- 1a. Participants in formal reflective activities with a reflection focus will have higher response rates on a novel application task than participants in critical reflection and non-reflection activities.
- 1b. Participants in formal reflective activities with a critical reflection focus will have higher response rates on a novel application task than those in non-reflective activities but lower than those in activities with a reflection focus.
- 2a. Participants in formal reflective activities with a reflection focus will have lower error rates on a novel application task than participants in critical reflection and non-reflection activities.
- 2b. Participants in formal reflective activities with a critical reflection focus will have lower error rates on a novel application task than those in non-reflective activities but higher than participants in activities with a reflection focus.

3a. Reflective activities with a reflection focus will impact the response rates of reflective participants differently than non-reflective participants.

3b. Reflective activities with a critical reflection focus will impact the response rates of reflective participants differently than non-reflective participants.

4a. Reflective activities with a reflection focus will impact the error rates of reflective participants differently than non-reflective participants.

4b. Reflective activities with a critical reflection focus will impact the error rates of reflective participants differently than non-reflective participants.

Need for the Study

Besides addressing the immediate needs of stakeholders for effective practices, this study fulfills a growing need repeatedly cited within the literature for greater empirical support for reflective activities' impact on learning outcomes and practice. Some notable requests can be heard from researchers in the areas of physician education (Mamede, Schmidt, & Cesar Penaforte, 2008; Mamende, Schmidt, & Rikers, 2006), K-12 teacher education (Borko, Michalec, Timmons, & Siddle, 1997; Cornford, 2002), adult and post-secondary professional education (Malkki & Lindblom-Ylanne, 2012; McAlpine & Weston, 2002; Warhurst, 2008), nursing education (Burton, 2000; Carroll et al., 2002; Hannigan, 2001; Mann, Gordon, & MacLeod, 2009; Mackintosh, 1998; Ruth-Sahd, 2003), career and technical adult education with a motor learning focus (Roessger, 2012a), and continuing professional development (Roessger, in press). Although reflective practice activities have been linked to a variety of tangential learning benefits associated with communicative learning processes—e.g., improved self-awareness, emotional support, professionalism, collegiality, organizational learning, more informed

practice (Fook & Gardner, 2007); enhanced critical thinking in complex situations (Brookfield, 2000a; Clouder, 2000; Coombs, 2001); affective development (Hill, 2005; Parsons & Stephenson, 2005); increased self-esteem (Heinrich, 1992); and improved political and social emancipation (Taylor, 2001)—there remains little evidence demonstrating reflective activities’ impact on skills-based learning outcomes and performance.

It is necessary, then, to complete this study to address the needs of stakeholders and the research community. Adult education as a discipline has historically been pragmatic in addressing both theoretical and practical concerns. At the heart of this effort is the necessity that theory works out in practice (Jarvis, 2004). By testing prominent adult learning theory claims and, thereby, establishing an evidentiary base from which theory may be further shaped toward what “works,” this study fulfills a broader need in advancing the field toward its historically pragmatic aim.

Significance of the Study

The information gathered in this study will be particularly useful to stakeholders within construction education, which is experiencing a growing advocacy for reflective activities in its learning settings (see Boyd, 2012; Hayles & Holdsworth, 2008; Kozolanka, 1995; Lee, 2010; Mills, Wingrove, & McLaughlin, 2010; Monson & Hauck, 2012; Selman & Westcott, 2005). These appeals, however, are largely without empirical support, an omission at odds with the field’s traditional focus on evidence-based learning outcomes. Learners participating in trades-based courses are required to master specific skills and knowledge to gain access to professional communities of practice. Well-defined competencies are used to assess a learner’s ability to perform these skills and to

identify the procedural and technical knowledge underlying these skills. The role of reflective activities in this process remains unclear. Further, how these activities impact a learner's ability to meet these competencies is largely unknown. This study will make a significant contribution by generating empirical evidence that addresses these uncertainties.

A greater understanding of this issue may be most useful to learners themselves. Although learners are not this study's primary audience, the inclusion of effective learning activities, or the removal of ineffective ones, can improve courses focusing on specific, demonstrable occupational skills. This is particularly important when learners' abilities to perform such skills have considerable consequences for themselves, their organizations, and their clients and/or customers. Occupations relying heavily on both systematic and adaptable performances of complex occupational tasks (e.g., plumbers, surgeons, bricklayers, computer programmers, or airline pilots) are especially pertinent. In addition, findings may help adults seeking work-related skills and knowledge through informal educational avenues.

Definition of Terms

Adult learners are those 24 and older (Kazis et al., 2007). Paterson (2010), in his seminal analytic essay "Adulthood and Education," (2010) describes adulthood as the result of the passage from a stage of childhood or adolescence to a stage of adulthood. This passage imparts a status that becomes significant only in its contrast with the status of a child. He argues that, although age as a criterion possesses a degree of arbitrariness, it is the most effective standard for delineating this passage:

The choice of age as such is completely in tune with what we intuitively perceive to be the permanent human realities underlying and underwriting the concept of an adult. If it is on grounds of age that we rightly form one set of expectations of the father and a different, more limited, and less demanding set of expectations of his son, ascribing to one the status of adult and to the other the status of child, this is because we correctly deem their difference of age to have *in itself* [original emphasis] the greatest ethical and existential relevance. (p. 7).

Skill adaptation is a teleonomic process involving the continual adjustment of behavior toward a functional relationship with the environment (Araújo & Davids, 2011). It is similar to the behavior analytic term *stimulus generalization*, which Pierce and Cheney (2008) define as a phenomena occurring when a learned behavior reinforced in the presence of a specific stimulus is also emitted in the presence of other stimuli. A potentially more relevant behavioral term is *contingency adduction*, which describes the process by which a novel stimulus occasions previously learned behaviors that now serve a different or new function (Andronis, Layng, & Goldiamond, 1997). In common language, skill adaptation may be synonymous with the word “flexibility,” which is often used to refer to the ability to modify previously learned skills and knowledge to novel contexts or applications.

Reflection is a “process with purpose and/or outcome in which manipulation of meaning is applied to relatively complicated or unstructured ideas in learning or to problems for which there is no obvious solution” (Moon, 1999, p. 161). Dewey (1933) has noted that reflection “is closely related to critical thinking; it is the turning over of a subject in the mind and giving it serious and consecutive consideration” (p. 3). He

differentiates the two, however, in that reflection involves drawing connections between current and past experience to create meaning, whereas critical thinking does not.

Reflection may involve asking and answering questions pertaining to the meaning of specific skills and knowledge, such as “What does this mean to me,” “What is the purpose of this information,” “How does this relate to events in my own life,” or “What is its value to myself or others?”

Critical thinking is “the ability to explore a problem, question, or situation; integrate all the available information about it; arrive a solution or hypothesis; and justify one’s position” (Warnick & Inch, 1994, p. 11). Critical thinking differs from reflection in that while engaged in critical thinking learners do not necessarily evaluate personal or social meaning. Rather, they use observation, experience, analysis, evaluation, and inference to determine the legitimacy or effectiveness of a belief or action. Therefore, reflection may incorporate all elements of critical thinking, but critical thinking does not incorporate all elements of reflection.

Critical reflection is a dialogic process of identifying, analyzing, and challenging epistemic, sociocultural, and psychic distortions underlying prior learning. Throughout this process, emotional, felt, and intuitive responses may interact with and impact rational analysis.

Reflective practice “is a mode that integrates or links thought and action with reflection. It involves thinking about and critically analyzing one’s actions with the goal of improving one’s professional practice. Engaging in reflective practice requires individuals to assume the perspective of an external observer to identify the assumptions

and feelings underlying their practice and then to speculate about how these assumptions and feelings affect practice” (Imel, 1992, p. 1).

Formal reflective activities are structured pedagogical events that take place within the educational setting intended to occasion reflection and/or critical reflection. Such activities may include the following: log, diary, and journal writing (Bolton, 2005; Clegg, Tan, & Saeidi, 2002; Kozolanka, 1995; Moon, 2001); videotape self-analysis (Broyles, Epler, & Waknine, 2011; Marita, Leena, & Tarja, 1999; Welsch & Devlin, 2006); dialogue (Fazio, 2009; Graves & Jones, 2008; Moon, 2001; Nyaumwe & Mtetwa, 2011; Zarezah, Pearson, & Dickinson, 2009); imaginative self-spectatorship (Collier, 2010); qualitative research (Lesnick, 2005); or spiritual analysis (Hunt, 2010; 1998).

Reflective propensity is a learner’s preference for reflective learning. Those who prefer reflective learning are coined reflective learners; those who do not are non-reflective learners. Reflective propensity is measured using the Kolb Learning Style Inventory (KLSI) 3.0. The KLSI 3.0 evaluates a learner’s preference towards one of four learning styles: (a) diverging (introverted/feeling), (b) assimilating (introverted/intuition), (c) converging (extraverted/thinking), and (d) accommodating (extraverted/sensation). Divergent and assimilative learners are thought to use reflection more often in learning than accommodative and convergent learners. These learners are coined reflective learners with high reflective propensity. Convergent and accommodative learners are considered non-reflective learners with low reflective propensity.

Instrumental learning is task-oriented problem solving using hypothetical-deductive reasoning and environmental manipulation to increase performance and prediction (Mezirow, 2009). Instrumental learning is commonly used in a variety of

closely related, and largely synonymous, approaches to adult learning, such as skills-based education, competency-based education, performance-based education, outcome-based education, and behavioral skills training (BST).

Skills-based education is a pedagogical framework that emphasizes learning specific, well-defined, and demonstrable skills.

Competency-based education is a pedagogical framework that aims to ensure that individuals learn the accepted skills of their profession by reaching established standards (Hackett, 2001). These standards may also include the ability to identify specific procedural and technical knowledge underlying these skills.

Performance-based education is a pedagogical framework that seeks to verify that a learner has reached a given competency or set of competencies (Voorhees, 2001).

Outcome-based education is a pedagogical framework “in which decisions about the curriculum are driven by the exit learning outcomes that the students should display at the end of the course” (Davis, 2003, p. 227).

Behavioral skills training is a pedagogical framework that aims to effect change through the reduction or acquisition of behaviors (Miller, 2009) using four learning procedures: (a) instruction, (b) modeling, (c) rehearsal (practice), and (d) feedback.

Work-related learning is any planned activity “that use[s] the context of work to develop knowledge, skills and understanding useful in work, including learning through the experience of work, learning about work and working practices, and learning the skills for work” (Qualifications and Curriculum Authority, 2003, p. 2). Work-related learning encompasses three educational contexts centered on developing skills and

knowledge related to work: (a) career and technical education, (b) employee training and development, and (c) continuing professional education.

Limitations

The following may be limitations of this study:

1. Because this study's participants are drawn from a specific urban Midwestern two-year technical college, they may possess behavioral repertoires predisposing them to unique outcomes. Therefore, it may be difficult to generalize these findings to disparate populations.
2. Because this study's instrumentally learned skill is unique to a specific occupation, it may be difficult to generalize findings to other fields. In instances where tools, materials, visual stimuli, and behaviors are shared, findings may prove generalizable. In contexts with few shared elements, they may not.
3. Because a convenience sample will be used, it may not be representative of the population from which it was derived (Creswell, 2005).
4. Others may interpret this study's quantitative approach as contradictory or inapplicable to the philosophical foundation of reflection or critical reflection (Cranton, 2000; Duke & Appleton, 2000). Such a view is not universally accepted, however, as evidenced in the "Significance of the Study" section of this proposal, which details repeated calls for empirical evidence demonstrating reflective activities' impact on learning outcomes and performance.
5. Outcomes associated with formal reflective activities in the experimental context may not transfer to the workplace. Some have suggested a questionable link between various

types of work-related learning and workplace performance (Cervero, 1988; Eraut, 1994; Singer & Edmondson, 2008).

Conclusion

This chapter has highlighted the need for adult education researchers to empirically demonstrate the benefits and outcomes of formal reflective activities in work-related instrumental learning contexts. In response to this need, a study was proposed to empirically investigate how formal reflective activities impact skill adaptation in these settings. The following chapter reviews the empirical and conceptual literature on reflective activities and instrumental learning outcomes to bolster the rationale for the research questions and hypotheses guiding this investigation.

CHAPTER 2

Review of the Literature

The literature has identified a variety of learning benefits associated with reflective activities in communicative learning contexts (see Fook & Gardner, 2007; Ruth-Sahd, 2003). There is little evidence, however, of their impact on skills-based learning outcomes and performance. This review, therefore, focuses exclusively on studies examining the relationship between reflective activities and instrumental learning outcomes. Such outcomes may include (a) written or verbal assessment scores identifying discriminations between pre-determined correct and incorrect responses pertaining to procedural or technical knowledge, (b) written or verbal assessment scores identifying the ability to produce pre-determined correct responses pertaining to procedural or technical knowledge, (c) skills-based assessments identifying the ability to physically perform procedurally based skills, or (d) workplace and/or educational performance related to procedural skills and technical knowledge. In addition, skill-adaptation will be examined independently because it has been suggested as a possible and/or desirable outcome of reflection and/or critical reflection in skills-based learning contexts (see Burke, Scheuer, Meredity, 2007; Hackett, 2001; Kolb, 1984; Lesnick, 2005; Mezirow, 2000; Wiedow & Konradt, 2011).

The review has six sections: (a) conceptualizations of instrumental learning; (b) conceptualizations of reflection, reflective practice, and critical reflection; (c) the impact of reflective activities on instrumental learning outcomes; (d) theoretical perspectives examining the impact of reflection/critical reflection on instrumental learning outcomes; (e) empirical research examining skill-adaptation as an outcome of reflection/critical

reflection in instrumental learning contexts; and (f) summary, implications, and discussions.

Sources were retrieved through searches of five databases: (a) Educational Research Complete, (b) Education Full Text, (c) ERIC, (d) Google Scholar, and (e) PsychINFO. Search terms included: *reflection, critical reflection, reflective activities, reflective practice, instrumental learning, skills-based learning, competency-based learning, outcomes, skill-adaptation, and adaptability*. Additional references were retrieved by examining reference lists of pertinent articles. The criteria used to determine an empirical source's inclusion in this review were: (a) the study empirically examined the relationship between reflection/critical reflection and instrumental learning outcomes in adult learners and/or (b) the study empirically examined the relationship between reflection/critical reflection and skill adaptation in adult learners. Only studies published after 1998 were reviewed because most studies of reflection and adult learning have been published during this period.

The search yielded 29 academic journal articles. After an initial reading, three were omitted for not meeting inclusion criteria. Of the 26 reviewed sources, six stemmed from health professional education, four from educational psychology, four from work-related learning and psychology, three from physician education, two from teacher education, two from small-group learning, one from adult education, one from educational technology, and one from environmental education. The review process involved a complete reading of each source.

Conceptualizations of Instrumental Learning

In adult education literature, treatments of instrumental learning stem primarily from the conceptual writings of Habermas (1971, 1984) and Mezirow (1991, 2000, 2003, 2009). Their conceptualizations should be distinguished from behavior-analytic interpretations, which equate instrumental learning synonymously with operant learning—that is, a change in an operant response as a result of the consequences that follow it (Pierce & Cheney, 2008). Habermas (1971, 1984) and Mezirow's (1991, 2000, 2003, 2009) conceptualizations depart from these in that they are descriptive rather than functional, focusing on the development of a structural typology of adult learning rather than an investigation of possible causal relations.

Habermas (1971) first identified instrumental learning as a component of his knowledge-constitutive interest theory, which delineates three basic human interests: (a) instrumental, (b) communicative, and (c) emancipatory. He argued that individuals possess a technical interest (instrumental) through which they seek to predict, control, and manipulate their physical and social environments. This interest is developed largely through the process of work, which provides the conditions for an empirical-analytic approach to knowledge generation. Habermas suggested that knowledge in some domains, particularly the natural sciences, might rightly be constructed in this manner. He did not, however, reject its relevance to other disciplines, rather its applicability to all forms of knowledge across disciplines.

Mezirow (1991, 2000, 2003, 2009) expounded on Habermas' conceptualization in his transformative learning theory. He argued that adult learning can be classified as instrumental or communicative. Emancipatory learning, the remaining component of Habermas' theory that Mezirow omitted, is achieved when learners critically reflect on

the presuppositions underlying both forms of learning. Mezirow described instrumental learning as task-oriented problem solving that focuses on how to do something or how to perform. Central is a learner's interest in controlling or manipulating the environment and improving performance or prediction. He differentiated this process from communicative learning, the process by which learners seek to understand the meaning of what others communicate, "concerning values, ideals, feelings, moral decisions, and such concepts such as freedom, justice, love, labour, autonomy, commitment, and democracy" (Mezirow 1990, 7).

Although Mezirow ignored causal explanations for either form of learning, he did suggest that their defining characteristics were not merely topical (i.e., based solely on subject content or instructional design). Instrumental learning, he argued, entails a unique process of problem solving characterized by hypothesis testing and empirical measurement (hypothetical-deductive logic), whereas communicative learning relies on reflective discourse as a means of progressing from concrete to abstract conceptualization (analogic-abductive logic).

Others have elaborated on Habermas and Mezirow's conceptualizations. Cranton (1996) identified a similar process at the group level, which she described as cooperative learning. In this form of group learning, learners work together to acquire procedural and technical knowledge using hypothetical-deductive reasoning. The group's primary focus is subject matter rather than social processes that may underlie mutual understanding and acceptance of group conclusions. Newman (2012), in his discussion of what he terms "good learning," has identified instrumental learning—which he describes as learning to manage material or social environments perceived to be inanimate and thereby subject to

cause and effect reasoning—as one of nine necessary aspects of a singular learning phenomenon. He has suggested that different learning acts will require certain aspects be emphasized, but *good* learning involves the presence of all nine.

In a unique conceptualization, Ottewille (2003) has argued that instrumental learning is defined by the presence of what he terms “extrinsic motivation.” Learners motivated by external goals (e.g., money, promotions, prestige), he contends, engage in instrumental learning regardless of subject area or reasoning process. He does not identify a domain or problem solving process unique to instrumental learning; rather, he isolates certain behaviors as representative of “symptoms of instrumentality” (e.g., boredom, antipathy toward certain subjects). Such behaviors are then interpreted to mean that a student views learning as a means to an end rather than an end in-and-of itself. As a result, these learners are classified as “instrumental students” (p. 191).

The adult education literature largely portrays instrumental learning in accord with Mezirow’s interpretation. Ottewille’s (2003) definition stands in contrast. For this reason, and because the overarching philosophy of this study rejects mentalistic internal-external motivational dichotomies, Ottewille’s interpretation will not figure in this study’s conceptualization. Instrumental learning will be understood as a distinct process of adult learning characterized by the use of task-oriented problem solving, hypothetical-deductive reasoning, and environmental manipulation to increase performance and prediction (Mezirow, 2009). Such learning is common in educational contexts identifying as skills-based, competency-based, performance-based, outcome-based, or behavioral skills training.

Conceptualizations of Reflection, Reflective Practice, & Critical Reflection

There is no agreed upon definition of reflection or its variants. Cornford (2002) asserted that because of the divergent epistemological and theoretical positions from which reflection is discussed, it is impossible to operationalize it into something easily translated into practice. Mackintosh (1998) similarly notes that discrepancies between prominent theorists have left practitioners with myriad confusing terms, such as reflective thinking, reflectivity, reflexivity, and reflective practice. Despite such opinions, there are prominent and formative usages of the term and its variants important to the current analysis.

The three variants of reflection discussed here (reflection, reflective practice, and critical reflection) share common features, and each is traditionally identified as a process rather than a specific pedagogical activity. Researchers and practitioners, however, commonly attempt to occasion these processes through a variety of classroom activities: log, diary, and journal writing (Bolton 2005; Clegg, Tan, and Saeidi 2002; Moon 2001); videotape self-analysis (Broyles, Epler, and Waknine 2011; Marita, Leena, and Tarja 1999; Welsch and Devlin 2006); dialogue (Fazio 2009; Graves and Jones 2008; Nyaumwe and Mtetwa 2011); imaginative self-spectatorship (Collier 2010); or spiritual analysis (Hunt 2010).

Seminal Conceptualizations of Reflection. John Dewey (1933), one of the earliest proponents of reflection, conceptualized reflection as a pausing of action, or a stop to impulsive thought. He described it as the “active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends” (p. 9). When one reflects, he argued, one progresses through a series of five steps: (a) identifying a possible

solution to the problem, (b) restating the felt difficulty into a problem to be solved, (c) proposing hypotheses related to the solution, (d) analyzing the hypotheses against one's past experiences, and (e) implementing the solution overtly or covertly while assessing its results against past experience. A primary component of Dewey's model is the need to connect current and past experience to create meaning. He later argued that such connections are necessary for learning (Dewey, 1938). Freire (1974) similarly noted reflection's role in creating meaningful experiences and avoiding "action for action's sake."

The emphasis on meaning may be the distinguishing feature between reflection and critical thinking. Although Dewey (1933) noted their similarities, he did not clearly distinguish between the two. Warnick and Inch (1994) have suggested that critical thinking involves the ability to "explore a problem, question, or situation; integrate all the available information about it; arrive a solution or hypothesis; and justify one's position" (p. 48). This conceptualization differs from Dewey's reflection conceptualization only in its omission of using past experience to create personal meaning. Instead, observation, experience, analysis, and inference are employed to determine the legitimacy or effectiveness of a belief or action. Reflection, therefore, may incorporate all elements of critical thinking, but critical thinking does not incorporate all elements of reflection.

In his work on professional learning, Schön (1983, 1987) classified two forms of reflection, which he similarly portrayed as problem solving processes. *Reflection-in-action*, he argued, is the process by which professionals examine in the moment their knowing-in-action (i.e., the tacit information underlying skillful performance). As practice situations change and novel conditions arise, professionals utilize reflection-in-

action to assess the potential outcome of an action, the action itself, and the skills and knowledge embedded within the action (Schön, 1983). Using reflection-in-action, a professional may consider the implications of her or his current actions, including how to adapt them to the immediate situation to maximize success. *Reflection-on-action*, on the other hand, is the process by which professionals retrospectively examine their actions or an event in relation to their current experience, skills, and knowledge. In this manner, professionals are able to evaluate how their knowing-in-action contributed to unexpected outcomes (Schön, 1983). Mezirow (1990) described a similar phenomenon, which he termed *Ex post facto* reflection (i.e., the looking back on, and examining, prior experience).

Kolb (1984) conceptualized reflection as two components of a four-stage learning model. In Kolb's view, learning is an individualized process synthesized of four elements: (a) concrete experience, (b) reflective observation, (c) abstract conceptualization, and (d) active experiment. Learners may use different elements depending on the demands of the immediate context; however, the highest level of learning involves a discrete linear progression from concrete experience through active experiment. In this manner, learners proceed through the experiential learning cycle first by directly experiencing the feelings associated with a learning event, then by carefully observing and taking note of the salient details of the event, next by thinking about and drawing conclusions from the experience, and last by acting based on what has been learned. Although he formally termed the second stage *reflective observation*, stages two and three of Kolb's model involve elements of reflection featured in Dewey and Schön's

interpretations (i.e., observation, analysis, reasoning, and hypothesizing). These two phases, Kolb argued, give meaning and purpose to experience and action.

Generalized & Contemporary Conceptualizations of Reflection. Others have proposed less specific conceptualizations that similarly emphasize the problem solving nature of reflection. Van Manen (1991) describes it as a process of deliberation in which one finalizes decisions about alternative courses of action. Masui and De Corte (2005) refer to it as a meta-cognitive activity that involves looking back on one's problem solving processes and learning. Moon (1999) refers to reflection as a cognitive process in which the manipulation of meaning is applied to complex problems lacking obvious solutions.

Still others describe reflection without referencing problem solving. Mezirow (1998) portrays it as a general "turning back" on experience to gain a variety of outcomes, such as awareness of an object, event, or state; consideration of a person, place, or thing; or imagined alternatives. Boud (2001) refers to it as a cognitive process, comprised of intellectual and emotional activities, in which one examines actions or incidents to gain new understandings and appreciations. Burke, Scheuer, and Meredith (2007) describe it as a systematic thought process aiming to simplify experience and to consider contradictions, dilemmas, and possibilities. Boud, Keogh, and Walker (1985) simply refer to it as a "generic" term for such introspective activities.

Although there are wide ranging interpretations of reflection, most describe a cognitive process using various analytic and/or meta-cognitive strategies for problem solving and creating meaning. This general conceptualization aligns well with adult work-related learning contexts that promote content relevancy (a general principle of

adult learning) and require learners to problem solve in novel, often ill defined, applications or settings. Moon's (1999) definition synthesized from the literature fits well with this general conceptualization and, therefore, will serve as an operational definition throughout this study: "reflection is a mental process with purpose and/or outcome in which manipulation of meaning is applied to relatively complicated or unstructured ideas in learning or to problems for which there is no obvious solution" (p. 161).

Reflective Practice. A closely related concept is reflective practice. Both Kolb (1984) and Schön's (1983, 1987) reflection models are often discussed synonymously with this term, the distinction being that reflective practice involves the implementation of their models in professional work. Although conceptualizations of reflective practice vary, a general theme is that reflective practice is the continual application of reflection for the purpose of problem solving and growth in professional practice. What reflection's focus is, however, varies according to two lines of thought. Some authors see reflective practice primarily as a self-examination of professional action. Ruth-Sahd (2003), for example, describes it as a manner of introspection in which professionals assess prior occurrences in practice to improve practice or encourage growth. Clouder (2000) depicts it as the critical analysis of daily practice to improve competence and foster professional development. Florez (2001) portrays reflective practice as a form of self-evaluation occurring in professional practice. It aims to refine practice in a general and ongoing manner. Importantly, these three conceptualizations are not necessarily directed at specific occupational problem solving; rather, their aim is the constant overall improvement of professional practice, which may include generalized improvements in problem solving over time.

Others see reflective practice as also including self-examination of professional thoughts, beliefs, attitudes, and assumptions. In the context of physician education, Mamede and Schmidt (2004) conceptualize reflective practice as the ability of physicians to critically evaluate their reasoning and conclusions. York-Barr, Sommers, Ghore, & Montie (2001) describe reflective practice in K-12 teaching as deliberately pausing to utilize higher-level thinking processes to examine one's beliefs, goals, and practices to change professional actions and improve student learning. Imel (1992) sees it as thinking about and critically analyzing one's actions, including the assumptions and feelings underlying those actions, to improve professional practice and understand how those assumptions and feelings impact practice. Osterman and Kottamp (2004) describe reflective practice for educators as critically examining assumptions, thoughts, and actions to change professional practice and the greater community.

In this study, reflective practice will be framed as the application of Moon's (1999) reflection conceptualization to the context of professional practice. Outcomes may include improved performance or professional growth, as each may result from enhanced immediate or long-term problem solving. Imel's (1992) definition fits well with this general conceptualization as it focuses on overt (visible practice) and covert professional behavior (feelings, beliefs, assumptions). It will, therefore, serve as an operational definition throughout.

Reflective practice . . . is a mode that integrates or links thought and action with reflection. It involves thinking about and critically analyzing one's actions with the goal of improving one's professional practice. Engaging in reflective practice requires individuals to assume the perspective of an external observer in order to

identify the assumptions and feelings underlying their practice and then to speculate about how these assumptions and feelings affect practice. (p. 1)

Critical Reflection. Following a similar vein is the concept of critical reflection. Of the three constructs, it holds most agreement among researchers. It is conventionally defined as a process of identifying, analyzing, and questioning assumptions underlying the way one sees the world (Merriam, Caffarella, & Baumgartner, 2007). In this manner, critical reflection is related to the covert behavior focus of reflective practice. However, it also considers how notions of power and the social environment influence feelings, beliefs, and assumptions (Brookfield, 2000b).

Mezirow (1990) has defined critical reflection as “a critique of the presuppositions on which our beliefs have been built” (p. 1). Three areas of influence are typically assessed and questioned: (a) epistemic distortions (personal beliefs about the nature and use of knowledge), (b) sociocultural distortions (hegemonic belief systems about the nature of power and social relationships), and (c) psychic distortions (personal thoughts and feelings that occasion anxiety and impede action). He adds that an important distinction between critical reflection and reflection is that critical reflection often requires the learner to make an assessment of what is being reflected on (Mezirow, 1998). Silverman and Casazza (2000) extend a similar distinction. Critical reflection, they argue, involves identifying and challenging the reflector and society’s hidden assumptions, whereas reflection simply involves examining actions in light of accepted principles.

In both views, critical reflection is seen as a rational process, whereby learners utilize experience, reason, and information to critically evaluate assumptions. Taylor (2000), however, argues that affective learning occurs simultaneously and may contribute

to critical reflection. Brookfield (2000b), too, contends that emotions are a necessary aspect to critical reflection. According to both theorists, it is vital to acknowledge learners' emotions, feelings, and intuitions when attempting to occasion the process of critical reflection. As a result, Fook and Askeland (2007) suggest that learners be emotionally prepared to engage in this process.

A second disagreement in the literature involves the collaborative nature of critical reflection. While Mezirow (1998) suggests that critical reflection can occur outside *or* within a discursive group, Brookfield (2000b) argues that critical reflection must be collaborative: it is a dialogic process through which individuals examine hegemonic assumptions that influence the context or situation in which learning occurs. In an interpretation of critical reflection termed "really reflective practice," West (2010) suggests that autobiographical analysis and an understanding of the other grounded in emancipatory values occur through questioning assumptions in dialogue. Fook (2010), however, sees critical reflection as assessing the individual's worldview and how that worldview fits within the social context. In her view, critical reflection is not necessarily a dialogic process, but it must situate individual action within a context of social responsibility.

In this study, critical reflection will be defined according to the field's general understanding of the term, but in a way that addresses disagreements without being contradictory. Critical reflection, then, is a dialogic process of identifying, analyzing, and challenging epistemic, sociocultural, and psychic distortions underlying prior learning. Throughout this process, emotional, felt, and intuitive responses may interact with and impact rational analysis.

The Impact of Reflective Activities on Instrumental Learning Outcomes

Given such divergent views, few studies have established a clear relationship between reflection's variants and instrumental learning outcomes (i.e., outcomes measuring learner proficiency in task-performance or the ability to identify or generate skills and knowledge underlying successful task-performance). Several literature reviews from a variety of disciplines illustrate this (see Table 1 for a description of each review's purpose and salient findings). Mamende, Schmidt, and Rikers (2006), for example, found no empirical support in the medical expertise literature for reflective practice's ability to reduce physician's diagnostic errors. Cornsford (2002) found no evidence demonstrating reflective teaching approaches' ability to improve teaching performance or learning for beginning teachers. In the health professional education and practice field, Mann, Gordon, and MacLeod (2009) found no studies demonstrating changes in clinical behavior or improved patient care as a result of, or associated with, reflection. In an early literature review of reflective practice in nursing, Mackintosh (1998) found no evidence that reflective practice benefits nursing practice, adding, "there is also no evidence from the education sector that the use of reflection as a learning tool or strategy equips nurses to be better or more competent practitioners" (p. 556).

These authors' inability to locate empirical support, however, may stem from this research area's reliance on qualitative and theoretical approaches, both of which prevent causal or correlative conclusions. As Burton (2000) notes, "such studies which investigate students' perceptions of personal and professional benefits in relation to using reflection are of interest, but remain merely accounts of how people believe they have benefited" (p. 1014). This trend is exacerbated by some theorists' views that

Table 1

Overview of Literature Reviews Investigating the Impact of Reflective Activities on Instrumental Learning Outcomes

Author/Year	Purpose of the Review	Salient Results
Burton, A. J. (2000)	To examine the theoretical and applied literature on reflection to assess its impact on nurse's knowledge and patient care.	There is a dearth of strong empirical evidence to support the claims made by reflective theorists and reflective proponents that it is beneficial to nursing practice and patient outcomes.
Cornsford, I. A. (2002)	To examine empirical studies that investigate the impact of reflection on teaching practices and teacher learning.	There is no evidence demonstrating the ability of reflective teaching approaches to improve practical teaching performance or learning for beginning teachers.
Mackintosh, C. (1998)	To examine the literature for a conclusive definition of reflective practice, to review its theoretical frameworks, and to examine its applicability to nursing education.	There is no empirical evidence demonstrating reflective practice's benefit to nursing practice. There is also no evidence in the field of education demonstrating that the use of reflective activities leads to increased nursing competence.
Mamede, S., Schmidt, H. G., & Rikers, R. (2006)	To examine the medical expertise literature for potential relationships between reflective practice and physician's diagnostic errors.	There is no empirical evidence demonstrating reflective practice's ability to reduce physician's diagnostic errors
Mann, K., Gordon, J., & MacLeod, A. (2009).	To evaluate existing evidence about reflection and its function in health professional education.	There are no studies demonstrating changes in clinical behavior or improved patient care as a result of, or associated with, reflection. The evidence used to support the inclusion of reflective activities remains largely theoretical.
Ruth-Sahd, L. A. (2003)	To examine data-based studies and provide and overview of the use of reflective practice in nursing education.	Few empirical studies exist demonstrating outcomes associated with reflective practice. The majority of the literature continues to be theoretical.

empirical and quantitative approaches are contradictory to reflection's philosophical bases (Duke & Appleton, 2000) or incapable of assessing reflection's outcomes (Gore, 1987). It is possible, however, that the lack of empirical studies in this area is more

indicative of recent trends in adult education research than in any inability to empirically uncover valuable knowledge regarding reflection. Donavant (2009), for instance, has noted, “Empirical research on adult learning principles and adult educational techniques in professional development is almost nonexistent” (p. 229). Presumably, research trends in other closely associated work-related adult learning areas are no different.

In the four reviews mentioned, only three empirical studies examined reflective activities’ impact on instrumental learning outcomes. Two stem from 1991 or earlier (see Chandler, 1991; Wubbels & Korthagan, 1990) and report no relationship between reflective activities and instrumental learning outcomes. A more recent study (see Lowe & Kerr, 1998) discussed later also failed to find a relationship.

The literature outside these reviews, however, paints a more inconclusive picture (see Table 2 for a description of each study’s purpose, methodology, reflective activity(s), and salient findings). Some studies show mild support for reflective activities. Hayward, Blackmer, and Raelin (2007), for instance, found that physical therapy students who participated in reflective activities (reflective journaling) could better acquire new skills and knowledge in the workplace than students who did not participate in reflective activities. Reflective activities, however, had no impact on students’ abilities to use existing skills and knowledge to make sense of and investigate workplace phenomena.

In a quasi-experimental investigation of the impact of reflective diagnostic activities on the accuracy of beginning physicians’ medical diagnoses, Mamede, Schmidt, and Cesar Penafort (2008) found that reflective activities did not impact the accuracy of diagnoses in simple cases; however, they did improve the accuracy of diagnosing

Table 2

Overview of Empirical Studies Examining Reflective Activities & Instrumental Learning Outcomes

Author/Year	Purpose of the Study	Methodology	Reflective Activity(s)	Salient Results
Antonoff, J. B., et al. (2009)	To examine the impact of a simulation course on surgical interns' readiness to respond to life threatening issues in surgical care.	Quasi-experimental pre-post	Facilitated reflection (not defined)	Participants' test scores, which assessed their knowledge of acute inpatient care skills, increased by an average of 43% following course participation. The impact of facilitated reflection, however, could not be distinguished from other course components, as researchers failed to record skill and knowledge baselines and incorporate a control group to allow for the manipulation of facilitated reflection.
Bannert, M. (2006)	To examine whether prompting for reflection enhances hypermedia learning and transfer.	True experiment	Computer-based reflection prompts	Participants who engaged in reflective verbalizations in a hypermedia (computer-based) learning context were better able to transfer knowledge to practice than those who did not reflect; however, participation in reflective activities had no impact on knowledge recall or knowledge comprehension test performance.
Broyles, T. W., Epler, C. M., & Waknine, J. W. (2011)	To describe the reflective experiences of pre-service teachers and determine how cognitive load impacts reflection and transfer of specific teaching behaviors.	Quasi- experiment	Videotaped self-reflection	Reflective activities with high cognitive load (i.e., having a high demand on working memory) yielded lower behavioral transfer to practice than reflective practice with low cognitive load.
Carter, S. M., & West, M. A. (1998)	To examine the relationship between team reflexivity, team effectiveness, and team mental health.	Correlational design – multiple regression	West (2000) instrument for the self assessment of team reflexivity	Reflexivity predicted team job performance (as determined by supervisor and audience ratings) better than all other examined factors. As team reflexivity increased, performance improved.

D'Amato, L. G., & Krasny, M. E. (2011)	To determine what outdoor adventure education participants found significant about their course.	Qualitative interpretist	Reflective interviews	Critical reflection activities contributed to increased feelings of environmental sensitivity, empowerment, and ownership for nature, which functioned as precursors for instrumental learning of environmental behaviors.
Grez, L. D., Valcke, M., & Roozen, I. (2009)	To examine the impact of goal orientation, self-reflection and personal characteristics on the acquisition of oral presentation skills	True experiment	One-on-one reflective questioning	College students who participated in self-reflection activities (one-on-one reflective questioning) within an oral presentation skills course performed no better on skill assessments than students who did not participate in self-reflective activities.
Hayward, L., Blackmer, B., & Raelin, J. (2007)	To examine the impact of teaching physical therapist students a model of reflective practice.	Quasi-experiment pre-post test	Reflective journaling	Physical therapist students who participated in reflective activities were better able to acquire new skills and knowledge in the workplace than students who did not; however, participation in reflective activities had no impact on students' abilities to use existing skills and knowledge to make sense of and investigate workplace phenomena.
Lockyer, J. M., et al. (2005)	To examine the congruence between reflective activities and course outcomes.	Longitudinal cohort survey	Commitment to change statements, impact on practice statements, and un-met needs statements	75% of physicians who engaged in reflective activities (commitment to change statements) following participation in an Alzheimer's diagnosis and treatment course reported changes in practice attributable to course content.
Lowe, P. B., & Kerr, C. (1998)	To examine the impact of reflective teaching methods on educational outcomes in a nursing biological sciences course.	True experiment	Reflective teaching methods, i.e., approaches to teaching that promote "deep learning" or understanding why something is and what its meaning is	Participants in the reflective teaching methods course performed no better on written assessments of knowledge, comprehension, and application of biological health science material than those in the conventional instruction methods course.

Mamde, S., Schmidt, H. G., & Penafort, J. C. (2008)	To examine the effects of reflective practice on beginning physician's diagnostic accuracy.	Quasi-experiment repeated measures	Reflective diagnostic written prompts	Reflective activities did not impact the accuracy of beginning physician's medical diagnoses in simple cases; they did improve the accuracy of diagnosing complex cases.
Masui, C., & De Corte, E. (2005)	To examine the effect of reflection and attribution on academic performance.	Quasi-experiment non-equivalent groups	Reflective questioning using verbal and written responses	Students who participated in reflective activities in intervention courses obtained higher grades than students taking the same courses without reflective activities. The researchers also found a carry-over effect—that is, students in the experimental (reflective) condition obtained higher grades in four of four subsequent non-reflective courses.
Sims, L., & Sinclair, A. J. (2008)	To examine the learning experiences of Costa Rican farmers in an alternative environmentally sustainable farming practices course.	Qualitative case study	Informal collaborative critical reflection	Instrumental learning, communicative learning, and critical reflection occurred simultaneously. Participants frequently engaged in functional reflection related to new skills and information, which then led to improved outcomes in erosion-minimization.
Van den Boom, G., Paas, F., Van Marrienboer, J. G. (2007)	To examine the impact of reflective activities on self-regulated learning.	True experiment	Electronic reflective question prompts	Students who engaged in reflective activities with feedback scored significantly higher on a multiple-choice assessment than students who engaged in reflective activities without feedback and students who did not engage in reflective activities.
Wetzstein, A., & Hacker, W. (2004)	To examine whether reflective verbalizations improve design problem solving and solution quality.	True experiment	Question-based reflective verbalizations with researcher	Students who participated in reflective activities produced significantly higher quality designs than those given filler (non-reflective) tasks. This effect was significant across three different instructed problem solving strategies. No significant effects were found in non-reflective groups across any of the instructed strategies.

complex cases. Carter and West (1998), in an investigation of the relationship between reflexivity and job effectiveness in television production teams, found that reflexivity (as defined by the Team Reflexivity Scale, see West, 2000), predicted team job performance (as determined by supervisor and audience ratings) better than all other examined factors. As team reflexivity increased, performance improved. The researchers did not, however, investigate the efficacy of reflective activities in occasioning this process.

Antonoff et al. (2009) conducted a quasi-experimental investigation of a skills-based simulation course designed to improve surgical interns' response readiness to life-threatening scenarios in surgical care. The course followed a behavioral skills training model (instruction, modeling, performance, and feedback) and incorporated facilitated reflection (not defined) during the course debriefing phase. Participants' test scores, which assessed their knowledge of acute impatient care skills, increased by an average of 43% following course participation. Facilitated reflection's impact, however, could again not be distinguished from other course components, as researchers neither recorded skill and knowledge baselines nor used a control group. Similarly, Lockyer et al. (2005) found that 75% of physicians who engaged in reflective activities (commitment to change statements) following participation in an Alzheimer's diagnosis and treatment course reported changes in practice attributable to course content. Given the lack of control group or baseline measures, however, the impact of reflective activities could not be distinguished from other course components.

Others, too, failed to control for the impact of reflective activities. In a case study of Costa Rican farmers in a resource management educational program, Sims and Sinclair (2008) described how instrumental learning, communicative learning, and

critical reflection simultaneously created a transformative learning experience. The authors explained how participants frequently engaged in more functional reflective practices related to instrumental domains, such as the process of farming and the course content. These activities then led to improved outcomes in erosion-minimization.

D'Amato and Krasny (2011) found that using transformative learning theory and critical reflection activities to guide an outdoor adventure education program contributed to increased feelings of environmental sensitivity, empowerment, and ownership for nature, which functioned as precursors for "instrumental learning focused on environmental behaviors." As a result, the authors suggest transformative learning theory and critical reflection may help learners attain instrumental learning outcomes in an outdoor adventure education context.

Broyles, Epler, and Waknine (2011), investigating the impact of reflective activities (videotape self-reflection and dialogue) on the transfer of specific teaching behaviors in pre-service teachers, found that reflective practice with high cognitive load (i.e., having a high demand on what they term "working memory") yielded lower behavioral transfer to practice than reflective practice with low cognitive load. Higher cognitive load reflective activities incorporated three additional areas of dialogue than lower cognitive load reflective activities. The authors neither used random assignment, baseline measures, nor a non-reflective condition, so reflective activities' impact could not be determined.

In a quasi-experimental study, Masui and De Corte (2005) investigated the impact of reflective questioning using verbal and written responses on students' academic performance in higher education courses. Students participating in reflective activities

during intervention courses (macroeconomics and management accounting) earned higher grades than students completing the same courses without reflective activities. The researchers also found a carry-over effect: students in the reflective condition earned higher grades in four of four subsequent courses without reflective interventions. Given the study's non-equivalent groups and lack of baseline measures, however, it is unclear whether reflective activities contributed to students' higher grades, or if differences in groups were attributable to some other variable.

Several true experiments (i.e., those incorporating random assignment and a control group) have reported finding no impact or relationship. Lowe and Kerr (1998) found that nursing students participating in a reflective teaching methods course performed no better on written assessments of knowledge, comprehension, and application of biological health science material than those in a conventional instruction methods course. Grez, Valcke, and Roozen (2009) found that college students participating in self-reflection activities (one-on-one reflective questioning) within an oral presentation skills course performed no better on skill assessments than students who did not participate in self-reflective activities. Given the trend in research of not publishing non-significant empirical findings (Cornford, 2002), the body of experimental work demonstrating no relationship may be considerably higher.

Three true experimental studies, however, reported reflective activities improve instrumental learning outcomes. Wetzstein and Hacker (2004) investigated the impact of question-based reflective verbalizations on overall design quality in an engineering design course. Students who participated in reflective activities reportedly produced significantly higher quality designs (as judged by professional engineers) than those

given filler (non-reflective) tasks. This effect was significant across three different instructed problem solving strategies. No significant effects were found for non-reflective groups across any of the instructed strategies. Bannert (2006) found that participants who engaged in reflective verbalizations in a hypermedia (computer-based) learning context were better able to transfer knowledge to practice than those who did not reflect. These results were largely mixed, however, as reflective activities had no impact on knowledge recall or knowledge comprehension test performance.

Van den Boom, Paas, and Van Merriënboer (2007) investigated how reflective dialogue and feedback in an online course impacted students' grades on multiple-choice examinations. The authors found that students who participated in reflective dialogue with reflective feedback scored significantly higher on course examinations than those participating in reflective activities without feedback, or those not participating in reflective activities. Their findings, however, failed to distinguish the impact of feedback from reflection on students' grades, and, therefore, it is unclear whether higher test scores were impacted by reflective activities, feedback, or an interaction between the two.

Contrary to earlier reviews, there initially appears some empirical support for reflective activities' impact on instrumental learning outcomes. The findings suggest that reflective activities may impact learners' performance in educational and occupational contexts. However, only two studies with positive results established methodological controls sufficient to distinguish reflection's impact from other variables. It is possible, then, that reflection's impact was minimal in other studies claiming significant findings. When considering the number of negative findings, mixed-findings, and un-published

non-significant findings, the relationship between reflective activities and instrumental learning outcomes remains unclear.

Theoretical Perspectives on Reflection, Critical Reflection & Instrumental Learning

The ambiguity in the literature may stem from a trend of investigating learning outcomes incongruent with theoretical predictions describing reflection or critical reflection's relationships with instrumental learning. Two prominent theories of adult learning explain and evaluate these relationships. Kang (2007) identified each as representative of what he termed the "how" adjective-plus adult learning theories. Predominate descriptions of adult learning, he argued, are identified according to the preceding adjective that describes some essence of learning. He designated two primary groupings of adult learning theories in terms of *how* the learner processes experience and *where* that experience is processed. Central to *how* adjective-plus learning theories was reflection; central to *where* learning theories was context. The two most representative learning theories of the reflective grouping were Kolb's (1984) experiential learning theory and Mezirow's (1990, 1991, 2000) transformative learning theory. Kolb's (1984) theory considers reflection fundamental to learning, whereas Mezirow's (1990, 1991, 2000) considers critical reflection necessary for transformative learning. An examination of each framework should allow for predictions related to reflection or critical reflection's relationship with instrumental learning.

Kolb's Experiential Learning Theory. Kolb's (1984) experiential learning theory is constructed in the scientific experiential tradition using contributions from Dewey's philosophical pragmatism, Lewin's social psychology, and Piaget's cognitive developmental epistemology. It is based largely on a constructivist model of learning,

which assumes knowledge is actively created by the learner through the meaningful transformation of experience. This “transformation,” as Kolb terms it, involves what he sees as the holistic and purposeful functioning of the organism—i.e., feeling, perceiving, thinking, and behaving.

Reflection has several functions in Kolb’s (1984) theory. First, it is viewed as a necessary intermediary between experience and action for the creation of meaning. Kolb explains,

We learn the meaning of our concrete immediate experiences by internally reflecting on their presymbolic impact on our feelings . . . Learning, the creation of knowledge and meaning, occurs through the active extension and grounding of ideas and experience in the external world and through internal reflection about the attributes of these experiences and ideas. (p. 52)

In Kolb’s view, experience immediately followed by action is an inherently non-critical process, lacking purpose and meaning. Such learning may be rightly conceptualized as rote learning or memorization. To advance to a higher level of learning and thereby transform an experience into purposeful and meaningful behavior, reflection is necessary.

Kolb also sees reflection as vital for adapting and generalizing skills and knowledge to novel contexts and applications. He refers to this as “adaptive flexibility” (p. 213), a quality he considers the primary vehicle for reaching the apex of personal or career growth. According to Kolb, this is how beginning learners, and professionals alike, move beyond mere rote application of skills and knowledge, eventually “transcend[ing] the fixity of their specialized orientation [their career]” (p. 213). Again, he alludes to a linear progression through the experiential learning cycle. In this instance, however, the

result is adaptive flexibility. Kolb explains: “Immediate concrete experience is the basis for observation and reflection. These observations are assimilated into a ‘theory’ from which new implications for action can be deduced. These implications or hypotheses then serve as guides in acting to create new experiences” (p. 21). In other words, as learners reflect on their initial experiences they create rules and techniques that guide new applications of the knowledge gained from their original experience.

An integral component of Kolb’s (1984) theory is learning style. Kolb maintained that individuals have preferred ways of learning that correspond to the quadrants of his learning cycle. Learners with a diverging style combine concrete experience and reflective observation learning phases and are characterized as introverted/feeling. Those with an assimilating learning style combine reflective observation and abstract conceptualization phases and are characterized as introverted/intuitive. Learners with a converging learning style combine abstract conceptualization and active experimentation phases and are characterized as extraverted/ thinking. Those with an accommodating learning style combine active experiment and concrete experience phases and are characterized as extraverted/sensing. Kolb maintains that divergent and assimilative learners use reflection more often in learning than accommodative and convergent learners.

In the context of the current study, Kolb’s (1984) experiential learning theory would predict that adults participating in formal reflective activities (with a reflection focus) would demonstrate increased abilities to adapt instrumentally learned occupational skills to novel applications. It would also predict that learners with a propensity for reflection learning (divergent and assimilating learners) would respond differently to

reflective activities than those with a disinclination for reflective learning. Congruent findings would partially confirm research hypotheses 1a, 2a, 3a, 3b, 4a, and 4b:

1a. Participants in formal reflective activities with a reflection focus will have higher response rates on a novel application task than participants in critical reflection and non-reflection activities.

2a. Participants in formal reflective activities with a reflection focus will have lower error rates on a novel application task than participants in critical reflection and non-reflection activities.

3a. Reflective activities with a reflection focus will impact the response rates of participants with a propensity for reflective learning differently than those with a disinclination for reflective learning.

3b. Reflective activities with a critical reflection focus will impact the response rates of participants with a propensity for reflective learning differently than those with a disinclination for reflective learning.

4a. Reflective activities with a reflection focus will impact the error rates of participants with a propensity for reflective learning differently than those with a disinclination for reflective learning.

4b. Reflective activities with a critical reflection focus will impact the error rates of participants with a propensity for reflective learning differently than those with a disinclination for reflective learning.

Mezirow's Transformational Learning Theory. Mezirow's (1990, 1991, 2000) transformative learning theory shares similar conceptual foundations with Kolb's (1984) theory. It, too, is based largely on a constructivist model of adult learning from which

learning is viewed as “the process of using a prior interpretation to construe a new or revised interpretation of the meaning of one’s experience as a guide to future action” (Mezirow, 2000, p. 5). Mezirow’s theory also borrows from an information-processing model of learning, employing computer storage/retrieval metaphors such as meaning schemas (or meaning structures) and frames of reference to illustrate how learners’ prior experiences are stored within the brain and later retrieved to understand and influence current thoughts and actions.

At the heart of Mezirow’s theory is the idea that learners create meaning by constructing their own interpretations of knowledge and truth. These interpretations are influenced by various “meaning structures,” including what Mezirow refers to as “frames of reference,” which are comprised of “habits of mind” (broad, generalized assumptions) and “points of view” (expectations, beliefs, feelings, attitudes, and judgments). According to Mezirow, one of the ways learning occurs is by the transformation of frames of reference through the process of critical reflection. Mezirow (1990) describes critical reflection as occurring when learners reflect on their own, and others’, assumptions. This is done by elaborating on existing frames of reference, learning new frames of reference, transforming existing points of view, and transforming existing habits of mind. This process assumes the learner is able to assess meaning structures rationally—that is, with objectivity, absent tradition, authority, or force. Mezirow (1991) also acknowledges that some forms of action (what he refers to as habitual and thoughtful action) do not require reflection. Like Kolb, though, Mezirow sees reflection as a necessary component of higher-level learning.

Critical reflection has a variety of functions in Mezirow's (1990, 1991, 2000) theory. First—consistent with Kolb's (1984) view of reflection—critical reflection is seen as a means for creating meaning. According to Mezirow (2000), adults make meaning through critical reflection's chief products—awareness and understanding. During this process, they may assess the validity of an expressed idea, including its biographical, historical, and cultural influences. Mezirow (1998) explains,

If we are to fully comprehend when the meaning of what is being communicated to us includes feelings, values, ideals, moral decisions, and intentions, we must of necessity become critically reflective. . . . We cannot learn the meaning of what is being communicated without becoming critically reflective of sub-textual assumptions of truthfulness, truth, authenticity, and coherence. (p. 188)

Although the creation of meaning is a consistent function of critical reflection across various critical reflection foci, Mezirow (1998) postulates other functions specific to an assortment of approaches to critical reflection. Relevant to this study are those he claims involve “objective reframing,” that is, “critical reflection on the assumptions of others in . . . task-oriented problem solving” (Mezirow, 2000, p. 23). These learning contexts, he argues, involve instrumental learning, and frequently center on problems pertaining to improving performance (Mezirow, 1998). During objective reframing, learners may use *narrative critical reflection* to assess the validity of the skills and knowledge being communicated, and/or *action critical reflection* to examine the assumptions underlying the definition of the problem. In the latter, learners may reflect on the content of the problem, the process of the problem, or the premise underlying the problem. For example, the learner may ask herself, “What are the important pieces of

information I must know to solve this problem, and what information is missing?” (content reflection), “What strategies can I use to be more effective in solving the current problem?” (process reflection), and “Why is this problem important to solve?” (premise reflection).

This process, Mezirow argues, when used in instrumental learning contexts, can lead to improved performance (Mezirow, 2000). He indicates that when learners reflect on the assumptions supporting the *content* and *process* of learning material they are better able to adapt or modify what they have learned to the demands of the immediate context. Although Mezirow does not specifically mention adaptability or generalization, the examples he extends to demonstrate critical reflection’s impact on instrumental learning allude to these phenomena. For example, when discussing beginning teachers’ use of critical reflection while learning how to assign students’ grades, Mezirow (2000) suggests teachers may reflect on how to select and determine value for different learning artifacts encountered in their practice (content reflection). They may also reflect on whether the number and diversity of artifacts received in a given context is representative of a particular student’s abilities (process reflection). In both cases, the implication is that a teacher who critically reflects on the content and process of how to assign students’ grades will be able to successfully adapt and generalize this skill to the particular demands of a given context. Recchia, Beck, Esposito, and Tarrant (2009) have explicitly formalized this ability as an outcome of Mezirow’s critical reflection in teacher training.

Mezirow’s theory, then, would make a similar prediction to Kolb’s (1984) theory—that is, adult participants in formal reflective activities (with a critical reflection focus) will demonstrate improved abilities to adapt instrumentally learned occupational

skills to novel applications. Congruent findings would partially confirm research hypotheses 1b and 2b:

1b. Participants in formal reflective activities with a critical reflection focus will have higher response rates on a novel application task than those in non-reflective activities but lower than those in activities with a reflection focus.

2b. Participants in formal reflective activities with a critical reflection focus will have lower error rates on a novel application task than those in non-reflective activities but higher than participants in activities with a reflection focus.

Empirical Research Examining the Relationship Between Reflective Activities and Skill Adaptation

Although no studies in this review openly acknowledged the theoretical link between skill adaptation and reflection/critical reflection, a small number investigated their relationship (see Table 3 for a description of each study's purpose, methodology, reflective activity(s), and salient findings). Several highlighted reflection/critical reflection's positive impact on skill adaptation, although in nearly all studies methodological controls were lacking to establish causality or correlation. Reilly (2006), for instance, conducted a qualitative investigation of the impact of public reflection activities (e.g., group dialogue, one-on-one dialogue, and reflective diaries) on novices' abilities to facilitate groups. She found that reflective activities led to the collective formation of flexible and adaptive expert thinking patterns. Data collection, however, consisted of individual interviews, group interviews, observation, and reflective diaries. Reflective activities' impact on skill adaptation, then, could not be differentiated from other variables in the study.

Table 3

Overview of Empirical Studies Examining Reflective Activities & Skill Adaptation

Author/Year	Purpose of the Study	Methodology	Reflective Activity(s)	Salient Results
Hetzner, S., Gartmeier, M., Heid, H., & Gruber, H. (2009)	To analyze employees' perceptions of an organizational change effort and learning in the context of this change.	Qualitative semi-structured interview design	Dialogue with colleagues related to workplace errors	Experienced retail bank managers facing an organizational change effort used informal reflective activities to adapt their existing knowledge and skills to new applications.
Hetzner, S., Heid, H., & Gruber, H. (2012)	To examine how readiness to change, self-determination and personal initiative impact learning through reflection in a changing workplace.	Correlational design – multiple regression	Kauffeld et al. (2007) instrument for the self-assessment of reflection at work.	Participants' perceived social integration and competence were significant predictors of their willingness to engage in reflective activities while modifying work routines and adapting new tasks to novel situations.
Niessen, C., & Volmer, J. (2010)	To examine how individuals adapt to increased work autonomy and the moderating role of task reflection in the process.	True experiment	Prompted reflective verbalizations	Task reflection was negatively related to skill adaptation and increased autonomy—as reflection increased, performance decreased. Participants who engaged in more intense reflective activities demonstrated greater decreases in performance when moving from a low autonomy environment to a high autonomy environment than those who engaged in moderate reflective activities.
Parsons, S. A., et al. (2011)	To describe teachers' reflective thinking and adaptive teaching as they complete graduate coursework.	Qualitative case study	Videotaped reflection, reflective journaling, developing and articulating instructional visions, reflective dialogue	Graduate education students who engaged in classroom reflective activities showed evidence of reflective thinking and instructional adaptability.
Reilly, R. C. (2006)	To examine the impact of public reflection on novice learners in a group facilitation course.	Qualitative case study	Group dialogue, individual dialogue, and reflective diaries	Participation in public reflective activities led to the formation of flexible and adaptive expert thinking patterns in novice learners.
Wiedow, A., & Konradt, U. (2011)	To demonstrate a proposed two-dimensional construct model of	Confirmatory factor analysis	Edmondson's (1999) team learning instrument – team	Team reflection and team adaptation are distinct abilities. Therefore, the two-dimensional model is a better fit than a

team process improvement, which includes team reflection and team adaptation as distinct abilities.	Correlational design – multiple regression	reflection subscale	unidimensional model.
To examine the relationship between team reflection, team adaptation, and team performance.			Team reflection had no impact on team performance, as evaluated by team members. It was also found to negatively impact team performance, as evaluated by supervisors. Team adaptation, however, positively impacted team performance as evaluated by both team members and supervisors.

In a similar qualitative investigation, Parsons et al. (2011) found that graduate education students who engaged in classroom reflective activities (e.g., developing and articulating instructional visions; videotaping, viewing, and discussing instruction; and creating personalized case studies with online dialogue) showed evidence of reflective thinking and instructional adaptability, the latter of which the authors argued, “may be an essential component of adaptive teaching” (p. 95). Given the absence of baselines for participants’ reflective thinking and skill-adaptation, however, the impact of reflective activities could not be distinguished from other components of the course.

Hetzner, Gartmeier, Heid, and Gruber (2009) interviewed ten experienced retail bank managers who, as a result of an organizational change effort, were required to adapt traditional approaches to client service to include new standardized procedures (structured advisory and question sheets). The researchers found that workers used a variety of informal learning activities throughout this process. These included: communications with colleagues, trial-and-error strategies, and dialogue related to workplace errors. As a result, the researchers suggested using structured group reflective activities to stabilize new work routines and reduce error reoccurrences during periods of necessary skill-adaptation. This study, however, raises similar methodological concerns as those discussed earlier. Its suggestions, then, remain questionable.

In a later regression analysis, Hetzner, Heid, and Gruber (2012) investigated the use of reflection by banking advisors forced to modify work routines and adapt new tasks to novel situations. They found that participants' perceived social integration and competence were significant predictors of their willingness to engage in reflective activities at work. In addition, the authors found that perceived hypothetical constructs such as "self-determination" and "readiness to change" were positively correlated with participants' perceived reflective abilities. Although the authors implied that, given such relationships, participation in reflective activities would improve performance on changing work tasks, they did not investigate whether this did indeed occur. Despite its sample size ($N = 84$) and methodological controls, then, this study's focus on constructs rather than behaviors provided few answers regarding reflection's impact on skill-adaptation.

Wiedow and Konradt (2011) proposed a two-dimensional structure of team process improvement, which identified team reflection and team adaptation as individual units of analysis. Using confirmatory factor analysis, the authors found the two abilities distinct, thereby confirming the two-dimensional structure's superior fit over the traditional unidimensional model, which incorporates both abilities into the team process improvement construct. The authors suggested that a causal relation may exist between team reflection and team adaptation, but failed to indicate or demonstrate one. Although these findings may serve as catalysts for future causal investigations, they, too, provide few answers to the question of reflection's impact on skill-adaptation in the workplace.

In a follow up multiple regression analysis, Wiedow and Konradt (2011) found that team reflection (as measured by Edmondson's team learning scale) had no

relationship with team performance when evaluated by team members, but a negative relationship with team performance when evaluated by supervisors. When both groups were merged, reflection was found to significantly negatively affect performance. Team adaptation, however, positively correlated with team performance as evaluated by both team members and supervisors. The authors explained these findings by suggesting that management may perceive reflection as a nonessential use of resources and time, whereas team adaptation is associated with visible behaviors contributing directly to improved performance.

Fitting with previously discussed research trends, a single experimental study was conducted. Niessen and Volmer (2010) found that task reflection (prompted reflective verbalizations) was negatively related to skill adaptation and increased autonomy—as reflection increased, performance (schedule building for other students) decreased. In addition, participants who engaged in more intense reflective activities (higher number of reflective verbalizations) demonstrated greater decreases in performance when moving from a low autonomy environment to a high autonomy environment than those who engaged in moderate reflective activities. As mentioned earlier, given the trend of not publishing non-significant empirical findings (Cornford, 2002), the body of work demonstrating no impact or relationship may be considerably higher.

Although the bulk of literature in this area remains inconclusive, most studies suggest that reflective activities enhance skill-adaptation in professional and educational learning contexts. However, the evidence is derived entirely from qualitative research designs, investigations of hypothetical constructs, and retrospective reporting of perceived effects on performance. In addition, several studies' conclusions remain little

more than researchers' inferences. Apart from Niessen and Volmer's (2010) study, which found no relationship between reflection/critical reflection and skill-adaptation, no studies utilized random assignment, control of extraneous variables, behavioral observations, or control groups. It is unclear, then, whether learner's actual ability to adapt an instrumentally learned skill is impacted by reflective activities.

Summary, Implications, & Discussions

This literature review has attempted to comprehensively identify and classify the current literature examining the effects of reflective activities on instrumental learning outcomes. Consistent with earlier reviews (see Burton, 2000; Cornsford, 2002; Mackintosh, 1998; Mamede, Schmidt, & Rikers, 2006; Mann, Gordon, MacLeod, 2009; Ruth-Sahd, 2003), it reveals a lack of empirical studies demonstrating a clear link in educational or professional contexts. Only two studies incorporating a control group, measurable performance outcomes, control of extraneous variables, or random assignment found a positive relationship (see Bannert, 2006; Wetzstein & Hacker, 2004). No other study claiming such a relationship met these or similar standards.

Fewer studies attempted to examine this relationship among this review's target population and context—that is, with adult learners in work-related learning environments. Of the 15 studies investigating general relationships between reflective activities and instrumental learning outcomes, only nine fit within a loosely defined area of work-related learning (i.e., having subject matter pertaining to a chosen occupational track). Missing were any investigations in construction or career and technical education contexts, or any investigation featuring motor learning tasks, a critical component of construction and career and technical education (see Roessger, 2012). Also, just one of

the 15 reviewed studies (Lockyer et al., 2005) apparently examined participants who met this review's definition of an adult learner—24 or older (Kazis et al., 2007). In all other instances it was necessary to infer participants' legal adulthood (18 or older) based on occupational learning contexts or participation in college undergraduate/graduate courses. It was further necessary, then, to assume that the potential inclusion of participants aged 18-23 would not detract from these studies' relevancy. Both assumptions add to the difficulty of drawing substantive conclusions.

Research examining skill-adaptation as a potential benefit/outcome of reflective activities in instrumental learning contexts was similarly lacking. Although all six studies took place in work-related learning contexts, only one (Hetzner, Gartmeier, Heid, & Gruber, 2009) appeared to examine participants fitting this study's definition of an adult learner. Further complicating any understanding of this relationship were the negative findings of the lone experiment (Niessen & Volmer, 2010) and the positive findings of other studies utilizing self-report and hypothetical construct data. Perhaps this may be because peoples' perceptions of reflective activities' impact on skill-adaption differ from these activities' actual impact. Predictions derived from Mezirow (1990, 1991, 2000) and Kolb's (1984) theories, then, appear to have minimal, contradictory, and/or inconclusive evidentiary support. At this point, stakeholders remain dependent on the contradictory conceptual positions suggesting that reflection and critical reflection may either improve performance related to instrumental learning (see Burke, Schuer, & Meredith, 2007; Mezirow, 2000; Van Woerkom, 2004) or minimally impact such learning (see Boud, 2010; Boud and Walker, 1998).

Lack of evidentiary support, however, should not be interpreted as demonstrating no relationship between reflective activities and instrumental learning outcomes. In all, only five studies were found that met methodological criteria rigorous enough to draw causal or sound correlative conclusions (see Bannert, 2006; Grez, Valcke, & Roozen, 2009; Lowe & Kerr, 1998; Niessen & Volmer's, 2010; Wetzstein & Hacker, 2004). It is impossible, therefore, to infer if/how reflective activities impact specific aspects of practice related to instrumental learning (e.g., reduced/increased task duration, lower/higher error rate) because insufficient data exists demonstrating if/how reflective activities generally impact practice.

Currently, then, there exist no substantive answers to this study's four research questions: a) How do formal reflective activities affect a participant's response rate during a novel application of an instrumentally learned skill? b) How do formal reflective activities affect a participant's error rate during a novel application of an instrumentally learned skill? c) Is there an interaction effect between formal reflective activities and reflective propensity on response rate? d) Is there an interaction effect between formal reflective activities and reflective propensity on error rate? Any conclusion based on current data remains suspect. Although qualitative and regression studies hint at a potential positive relationship, these findings remain entirely based on self-report and hypothetical construct data. What the literature clearly reveals is the need for systematic, empirical investigation into how reflective activities actually impact an adult's ability to do something.

Despite inconclusive empirical findings, this review extends several theoretical discoveries, which, when taken together, serve to expedite the systematic examination of

reflective activities' impact on instrumental skill-adaptation. First, based largely on Habermas and Mezirow's conceptualizations, instrumental learning can be understood as a distinct process of adult learning characterized by task-oriented problem solving, hypothetical-deductive reasoning, and environmental manipulation for increased performance and prediction (Mezirow, 2009). Second, although there are wide ranging interpretations of reflection, a large number describe it as a cognitive process using various analytic and/or meta-cognitive strategies for problem solving and the creation of meaning. Moon's (1999) definition fits well with this general conceptualization. Third, a general theme throughout the literature is that reflective practice is the continual application of reflection for the purpose of problem solving and growth in professional practice. It is easily framed as the application of Moon's (1999) reflection conceptualization to the context of professional practice. Outcomes may include improved performance or professional growth. Fifth, critical reflection is generally referred to in the literature as a process of identifying, analyzing, and questioning assumptions underlying the way one sees the world (Merriam, Caffarella, & Baumgartner, 2007). Without contradicting opposing theoretical positions, it can be conceptualized as a dialogic process of identifying, analyzing, and challenging epistemic, sociocultural, and psychic distortions underlying prior learning; throughout this process, emotional, felt, and intuitive responses may interact with and impact rational analysis. Last, the ambiguity in the literature may stem from a trend of investigating learning outcomes incongruent with theoretical predictions describing reflection or critical reflection's relationships with instrumental learning. Two prominent theories of adult learning can be used to explain and evaluate these relationships. Kolb's (1984)

experiential learning theory would predict that adults participating in formal reflective activities (with a reflection focus) would demonstrate increased abilities to adapt instrumentally learned occupational skills to novel applications. It would also predict that learners with a propensity for reflection learning (divergent and assimilating learners) would respond differently to reflective activities than those with a disinclination for reflective learning. Mezirow's (2000) theory would make a similar prediction: adult participants in formal reflective activities (with a critical reflection focus) would demonstrate improved abilities to adapt instrumentally learned occupational skills to novel applications.

In summary, the literature investigating the impact of reflective activities on instrumental learning outcomes (including skill-adaptation) is inconclusive. Contrary to the opinions of those who argue against quantitative investigations of reflection (Duke & Appleton, 2000; Gore, 1987), however, the theoretical findings presented here indicate the utility of a systematic, empirical approach—the first step toward drawing substantive conclusions. Such an approach is necessary to address the paradox encountered by many stakeholders in work-related adult education contexts—that is, how to establish learning evidences (i.e., competencies) while simultaneously incorporating educational activities that have minimal evidentiary support. At this point, the field of adult work-related learning offers little guidance to stakeholders whose role it is to help adults learn specific, demonstrable occupational skills.

CHAPTER 3

Methodology

Philosophical Framework

This study is situated within a post-positivist research paradigm that acknowledges the influence of a researcher's beliefs, assumptions, and values on knowledge and discovery, but assumes the existence of a mind-independent reality, which can only be known imperfectly and probabilistically (Robson, 2002). A primary goal of post-positivist research is to discover close approximations of the singular reality inherent in our social and natural world (Sokal, 2008). Fitting incompletely within this paradigm is this study's guiding philosophical framework, radical behaviorism. Roessger (2012b), in his call for adult education to re-conceptualize its monolithic behaviorist interpretation, has outlined the chief guiding assumptions and principles of radical behaviorism: (a) behavior is solely determined by heredity and environment, (b) empiricism (the belief that knowledge is derived from sensory experience) guides inductive inquiry, (c) mentalism (the belief that subjective mental events cause behavior) is rejected, and (d) private events (private stimuli and covert behavior adhering to the same lawfulness as overt behavior) are acknowledged. Although this study will not focus on contingencies of reinforcement—a traditional emphasis in behavior analytic research—it will adhere to the assumptions and principles outlined above. That is, the proposed study will seek to empirically examine how the learning environment in-and-of-itself impacts behavior. It is important to note that references to hypothetical constructs (e.g., beliefs, assumptions, and intuitions) do not imply their physical existence nor, for that matter, their ability to cause behavior. In short, this study is situated within the field

of adult education, not behavior-analysis. Therefore, a decision was made in some instances to utilize mentalistic language when a more precise description was thought to detract from the primary audience's understanding. In addition, explanations for this study's findings situated outside a radical behaviorist perspective will be considered if they have pragmatic value and are amenable to empirical examination.

An experimental design was chosen because it aligns with this paradigm and philosophy and because it addresses this study's research purpose and questions. In attempting to identify the benefits and outcomes of reflective activities in work-related instrumental learning contexts, it is essential to control extraneous variables so that causality can be determined. Both requirements are exclusive advantages of experimental designs (see Creswell, 2005; Muijs, 2004). Without experimental control, this study's research questions could not be credibly answered, as causality could not be established between participation in reflective activities and a learner's ability to adapt instrumentally learned skills. That is, the impact of reflective activities on performance could not be separated from the impact of other variables (e.g., gender, age, aptitude, and reflective propensity). Both the practical and theoretical needs addressed earlier call for a research methodology able to clearly attribute the benefits and outcomes associated with reflective activities to the activities themselves.

There are, however, limitations of experimental designs in educational research that warrant discussion. First, generalization may be difficult in educational contexts, as applications often require modifications to account for a variety of context-specific variables. This, in turn, may invalidate the design. Second, given the large number of additional variables encountered in real-world settings, participants may respond

differently, thereby altering predictive relationships between independent and dependent variables established in the laboratory setting (Muijs, 2004). Last, a relatively lengthy amount of time and large number of resources are required to carry out experimental designs, particularly when interventions are delivered to participants individually.

Research Questions

As previously discussed, four research questions guide this investigation. First, how do formal reflective activities affect a participant's response rate (number of responses/unit of time) during a novel application of an instrumentally learned skill? Second, how do formal reflective activities affect a participant's error rate (number of errors/response) during a novel application of an instrumentally learned skill? Third, is there an interaction effect between formal reflective activities and reflective propensity on response rate? Last, is there an interaction effect between formal reflective activities and reflective propensity on error rate?

Design Considerations

An experimental design was used to vary reflective activities according to condition. All other study phases remained constant. There were three conditions, each consisting of 14 learners participating independently. References to "groups" or "conditions" refer only to a participant's reflective activity assignment, not cooperative learning arrangement. The control condition featured no reflective activity (interference task), the reflection condition a formal reflective activity with a reflection focus, and the critical reflection condition a formal reflective activity with a critical reflection focus. A visual model of the complete procedural sequence for each condition is presented in Figure 1 on the following page. All aspects of the study occurred in a classroom at the

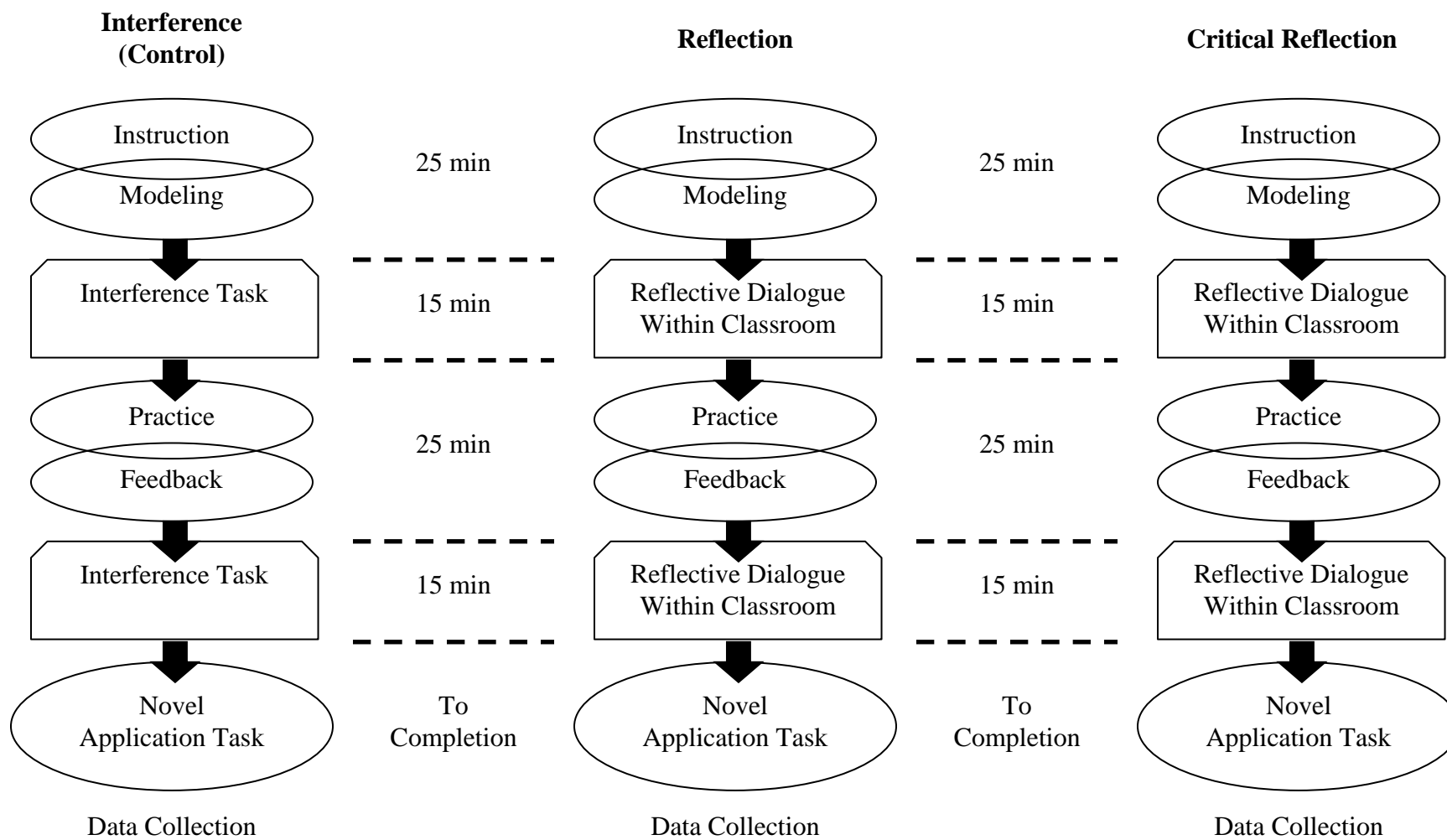


Figure 1. Visual model of procedural sequence for each condition (experimental design)

technical college. Permission was secured at the time of the Institutional Review Board (IRB) submission.

Each condition featured a fifty-minute hands-on course (divided into two blocks) based on a behavioral skills training model (BST) (Miltenberger, 2008). The BST model consists of four phases: (a) instruction, (b) modeling, (c) practice, and (d) feedback.

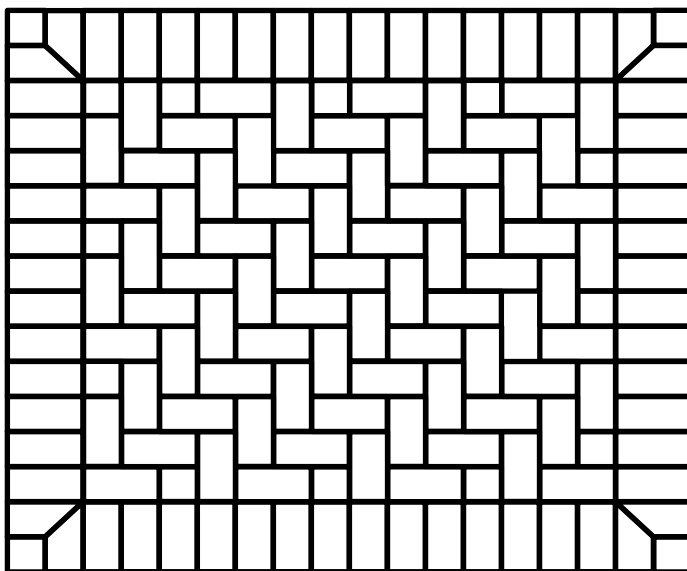


Figure 2. 90-degree herringbone pattern.

Instruction and modeling phases were combined into one 25-minute block, practice and feedback phases into another. The course focused on how to install a 90-degree herringbone patterned paver walkway (see Figure 2). The instruction and modeling phases were pre-

recorded and presented on a 13" laptop computer screen to ensure consistent delivery across conditions. These phases lasted 25 minutes. Immediately following, participants in each condition took part in a 15-minute reflective activity, which varied across conditions.

At the conclusion of the first reflective activity, participants took part in the practice and feedback block of the course. This block lasted 25 minutes. Participants were asked to install a 25 square foot 90-degree herringbone patterned paver walkway, adhering to the methods discussed and demonstrated in the presentation. This occurred within a prepared area in the classroom (see Figure 3 on the following page). The area

contained a 66" x 66" platform constructed from tongue and groove oriented strand board subfloor panels with honeycombed plastic backing. A 58" x 58" frame constructed from PVC paver edge restraints was fastened to the platform using $\frac{3}{4}$ " bolts. Within the frame, 1" of screeded, washed concrete sand was distributed. One pallet of 4" x 8" Holland



Figure 3. Prepared area in classroom.

pavers laid adjacent to the frame. Pre-cut pavers were stacked alongside these pavers.

The researcher, who was unaware of the participant's assigned condition, provided verbal feedback. Participants were instructed that their performance would not be formally assessed and that the purpose of the activity was to practice with feedback to improve performance.

Feedback consisted of praise and correction. When a participant performed according to the methods outlined in instruction, the researcher verbally identified the behavior and stated either “good job,” “that’s how it’s done,” or “excellent work.” When a participant committed an error, the researcher verbally identified the error and then re-stated the applicable best practice. If, following correction, the participant expressed confusion, the researcher then modeled the behavior. At the conclusion of this activity, participants again took part in a 15-minute reflective activity, which varied across conditions.

Interference. During the reflective activity interval, participants in the interference condition performed an interference task to prevent reflection from occurring. A reading aloud procedure (Mulatti, Peressotti, Job, Saunders, & Coltheart, 2012; Reynolds & Besner, 2006; Roelofs, 2008) was used. This procedure is thought to require learner attention and interfere with the acquisition of further explicit knowledge. At the start of each reflective activity interval, participants in this condition were asked to read aloud for 15 minutes from the *Writing Composition Handbook* (Hairston & Ruszkiewicz, 1996), which was selected for its unrelated subject matter. Participants were asked to read from a chapter on forming logical arguments and detecting fallacies. The research assistant stated “continue” if participants paused from reading aloud for longer than two seconds. During this time, the research assistant recorded inconsequential notes to prevent demand characteristics (interpretations of a study’s purpose and alteration of behavior to align with those interpretations).

Reflection. During the reflective activity interval, those in the reflection condition engaged in reflective dialogue (with a reflection focus) with the research assistant.

Cranton (1994, 2006) has claimed that educators can stimulate content and process reflection in instrumental learning contexts by asking suitable reflective questions. A series of questions, then, was designed to incorporate the problem-solving and meaning-making nature of reflection. These questions were divided equally between two foci: (a) the content related to the problem and (b) the process of problem solving. In keeping with Mezirow (1998) and Silverman and Casazza's (2000) reflection/critical reflection distinction, these questions did not attempt to identify and/or challenge hidden assumptions; rather, they simply asked participants to examine actions and potential actions in light of accepted principles. In addition, questions were included that specifically addressed Kolb (1984) and Dewey's (1933) suggestions that connections be made between new and prior experiences for the creation of meaning.

The series of questions consisted of 12 content and 12 process reflection questions (see Figure 4 on the following page). Questions were divided into two blocks. Block 1 was delivered during the first reflective activity interval and focused on content and potential problem solving related to instruction and modeling phases. Block 2 was delivered during the second reflective activity interval and focused on content and problem solving related to practice and feedback phases. Questions were delivered sequentially in paired sequences; that is, a content reflection question always preceded a specific process reflection question. Participants were told there were no right or wrong answers. The research assistant followed short responses (one sentence or less) with one of three follow up questions to occasion additional reflection: (a) "Can you explain that further?" (b) "What do you mean by that?" and (c) "Can you give me an example?" The

CONTENT REFLECTION QUESTIONS		PROCESS REFLECTION QUESTIONS	
Block 1			
1a	What steps do you feel are most important when laying pavers?	1b	How did you come to this conclusion?
2a	What is the relationship between these steps?	2b	How did you make sure that this relationship was effective and useful?
3a	What similarities do you see between laying pavers and other activities you have experienced in life?	3b	How did your experience in this class so far lead you to identify these similarities?
4a	What potential difficulties do you see yourself having when laying pavers?	4b	How did you come to identify these difficulties?
5a	What might be a potential solution to this problem?	5b	How did you come to identify this solution?
6a	What do you think would happen, based on your experiences, if you carried out your solution?	6a	How do you know this would happen?
Block 2			
7a	What difficulties did you experience when laying pavers?	7b	How can you restate these difficulties into a problem?
8a	What are the important details of this problem?	8b	How did you come to identify them?
9a	What would be a possible solution to that problem?	9b	How did you come to identify this solution?
10a	What do you think would potentially happen if you carried out this solution?	10b	How do you know this would happen?
11a	What past experiences have you had that have led you to believe your solution might work?	11b	How did you gain these experiences?
12a	What alternative solution could you identify if your primary solution was ineffective?	12b	How did you come to identify this solution?

Figure 4. Questions & sequence for formal reflective activity with reflection focus.

second reflective activity interval began with Block 2 questions regardless of whether Block 1 was completed. When a participant completed either block early, the research assistant asked for further elaboration on previously answered questions. Dialogue was recorded for future analysis.

Critical Reflection. During the reflective activity interval, those in the critical reflection condition engaged in reflective dialogue (with a critical reflection focus) with the research assistant. A series of questions was adapted from Cranton's (1994, 2006) critical reflection questioning examples, which she extends as a way to facilitate content and process critical reflection (see Figure 5 on the following page). Cranton cautions that her examples not be used to oversimplify these processes; instead, she suggests they be used to develop further strategies to encourage specific types of critical reflection. This study, then, employed Cranton's examples as models from which critical reflective questions were developed specific to its focus.

The series of questions consisted of 12 content and 12 process reflection questions. Questions were divided into three reflective foci: (a) psychological meaning schemes, (b) sociological meaning schemes, and (c) epistemic meaning schemes. Each was consistent with Mezirow's (1990) three original critical reflection foci: (a) psychic distortions, (b) sociocultural distortions, and (c) epistemic distortions. Questions were delivered sequentially in paired sequences; that is, a content reflection question always preceded a specific process reflection question. Participants were told there were no right or wrong answers. The research assistant followed short responses (one sentence or less)

CONTENT REFLECTION QUESTIONS		PROCESS REFLECTION QUESTIONS	
Psychological Meaning Schemes			
1a	What do you see as your greatest skills in laying pavers or doing manual construction work?	1b	How did you come to this view of yourself?
2a	What would you like to improve in this area?	2b	How did you come to this conclusion?
3a	What aspects of your nature are suitable to laying pavers?	3b	How did you decide that these aspects of your nature were suitable to laying pavers?
4a	What do you not like about laying pavers?	4b	How did you decide that you don't like this part of laying pavers?
Sociolinguistic Meaning Schemes			
5a	What are the social norms related to laying pavers?	5b	How have these social norms been influential in your life?
6a	What was the perception of laying pavers in your home community?	6b	How did the community's feelings toward this type of work affect your opinion of those who do it?
7a	What views do the media present related to laying pavers?	7b	How did the media's description of this type of work influence your view?
8a	What does the way people talk about laying pavers or similar skills tell you?	8b	How have people's language related to this type of work influenced you?
Epistemic Meaning Schemes			
9a	What have you read or heard about laying pavers?	9b	How did you obtain this knowledge?
10a	What enabled you to learn this skill, or what enabled you to learn this skill more effectively?	10b	How did you decide that this really helped you?
11a	What is your favorite way of learning a manual skill?	11b	How did you come to the conclusion that this was your favorite approach?
12a	What did you already know about laying pavers?	12b	How did you obtain this knowledge?

Figure 5. Questions & sequence for formal reflective activity with critical reflection focus.

with follow up questions previously discussed. The second reflective activity interval began with the content reflection question immediately following the last two-question sequence discussed. When a participant completed all 24 questions before the conclusion of the second reflective interval, the research assistant asked for further elaboration on previously answered questions. Dialogue was recorded for future analysis.

Novel Application Task. Following BST blocks and reflective activity intervals,

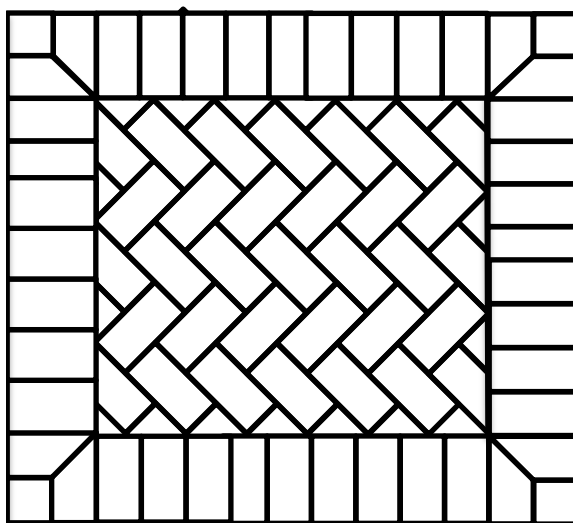


Figure 6. 45-degree herringbone pattern.

participants in all conditions completed an identical novel application task. Each was asked to install a 58" x 58" 45-degree herringbone paver walkway (see Figure 6). This task took place in the same prepared classroom area, which was cleared and readied following the practice and feedback phase. Set up was

identical to the first prepared area. One 14" x 14" photographic model featuring a 45° herringbone patterned walkway constructed in this area was displayed on an adjacent easel. Participants were told it was a good example of the new pattern. The researcher then asked each participant to complete the task in as little time as possible with as few errors as possible using the methods and techniques discussed earlier. No further guidance, instructions, or feedback were given. At that point the researcher began timing the task. At the conclusion of the 25-minute phase, participants were fully debriefed, thanked, and dismissed from the study.

Research Permission and Ethical Considerations. A request for permission to conduct this research was filed with the Institutional Review Board (IRB) at both the principle research university and technical college. Prior to filing with the technical college, institutional permission was obtained from the principle research university. An IRB manager protocol form, informed consent form, and recruiting flyers were submitted in each application (see Appendix A for complete applications and approval letters). Information included the principle investigator's (PI) name and contact information, the type of review requested, the project title and summary, the study's duration, the number and description of participants, and the presumed risks and benefits to participants. Participants were not asked to provide identifiable information (e.g., names, student ID numbers, social security numbers), thereby assuring participant anonymity. Participants' data was coded using numerical identifiers. All study records were housed in a locked metal file cabinet in the primary researcher's office.

Because the study did not involve vulnerable populations, and because it took place in a commonly accepted educational setting and evaluated the comparison of commonly accepted instructional techniques, it qualified for category one exemption status. Although incomplete disclosure was involved (i.e., participants were told the study was investigating the impact of instructional techniques on learning, not investigating the impact of reflective activities on skill adaptation), a full IRB board review was not required. The decision to limit participants' knowledge of the study's specific aims was made to limit or reduce threats to internal validity. These risks included (a) demand characteristics (Weber & Cook, 1972), (b) compensatory rivalry (Creswell, 2005), and (c) resentful demoralization (Creswell, 2005).

An informed consent form was developed that provided the following information to participants prior to their involvement: (a) the study's title, (b) the PI's information, (c) the study's description and purpose with incomplete disclosure, (d) the study's procedures, (e) the study's risks and benefits, (f) and the study's compensation and confidentiality.

Several potential ethical issues may have arisen. First, participants assigned to the interference condition did not take part in reflection or critical reflection activities. This may have prevented them from gaining new and meaningful understandings about the instructed skill and/or themselves. Second, incomplete disclosure may have created an inequitable power relationship between the researcher and participant. Curran (2006) has argued that incomplete disclosure may be ethically possible, however, if the threat to the study's validity prevents accomplishing the goals of the research, if there are no undisclosed risks to participants that are more than minimal, and if there are plans to fully debrief participants and share results following the study. This study adhered to each of these stipulations.

Sampling and Sampling Rationale

Participants and Placement. Adult students from an urban Midwestern two-year technical college participated in the study. Approximately 30 percent of the school's student body is classified as low income. The ethnic breakdown is as follows: 53 percent white, 28 percent African American, 14 percent Hispanic, 4 percent Asian American, and 1 percent Native American/Alaska Native. A convenience sample, later equated using matched random assignment, was comprised of students responding to campus-wide requests for research participants. Selection criteria were: (a) participants must be age 24

or older, (b) participants must hold a valid student ID from the technical college, (c) participants must have a high school diploma or general equivalence degree (GED), and (d) participants must have no prior experience installing concrete or clay pavers. Those failing to meet these criteria were not included in the study. Participants received \$40 for taking part in the two-hour study. A sample size of 42 yielded statistical power of > 0.80 . A 0.5 effect size and 0.05 alpha level, both customary settings for educational research (see Creswell, 2005; Murphy & Myers, 1998), were used.

Matched random assignment was used to ensure extraneous variables (participant characteristics) did not confound results (Creswell, 2005). Participants were identified according to three blocking variables: (a) gender, (b) age, and (b) reflective propensity. Gender was categorized as male or female. Age was categorized according to three intervals: (a) 24-29, (b) 30-39, and (c) 40+. To categorize reflective propensity, participants completed the Kolb Learning Styles Inventory version three (KLSI 3.0). The KLSI 3.0 evaluated a learner's propensity toward one of four learning styles: (a) diverging (introverted/feeling), (b) assimilating (introverted/intuition), (c) converging (extraverted/thinking), and (d) accommodating (extraverted/sensation). Divergent and assimilative learners are thought to use reflection more often in learning than accommodative and convergent learners (Kolb, 1984). Divergent and assimilative learners, then, were grouped together and classified as reflective learners, while convergent and accommodative learners were classified as non-reflective learners. The internal validity and reliability of the KLSI 3.0 have been repeatedly demonstrated (Kayes, 2005).

Each participant was identified and matched according to three blocking variable sub-categories. For example, a participant may have been identified as male, 24-29, reflective, and matched with two other male, 24-29, reflective participants. Each of the three matched participants was randomly assigned to one of three conditions. A six-sided fair die was used to assign the first participant of this block. A die showing one or two dots indicated the interference group, three or four dots the reflection group, and five or six dots the critical reflection group. A coin (each side representing the remaining two conditions) was used to assign the second participant. The third participant was assigned to the remaining condition. Matched random assignment has been repeatedly used in experimental designs to equate groups while adhering to principles of random assignment (see Kroeger, Schultz, & Newsom, 2007; Matson, 2007). It is important to note that random assignment, a necessary condition for experimental research, is not analogous with random selection (randomly choosing participants from a population), a process that is rarely employed in experimental research (Creswell, 2005).

Data Collection

Final novel application task projects were quantitatively assessed using two behavioral observation data categories: (a) number of pavers installed per 25-minute time interval (response rate), and (b) number of errors produced per paver installed (error rate). Errors were defined as: (a) number of paver joints exceeding 1/8", (b) number of upside down pavers, (c) number of chipped or cracked pavers, and (c) number of pavers deviating from the 45 degree herringbone pattern. A participant's error rate was his or her cumulative error total divided by the total number of pavers he or she installed. Number of pavers installed per 25-minute interval was counted by visual inspection. All errors,

too, were counted in this manner. Paver joints exceeding industry standard tolerance were verified using an electronic caliper with accuracy to ± 0.001 inch. A photograph was taken of each participant's novel application task project to document performance. All data was entered immediately in an electronic spreadsheet.

Data Analysis

Inferential statistics were used to determine differences between conditions. Two separate one-way analysis of variance (ANOVA) tests were conducted to determine if statistically significant differences existed between groups' response rates and error rates. Three assumptions underlie this test (Howell, 2010). First, it is assumed that participants in each condition are drawn from populations with equal variance; second, that error is normally distributed within each condition; and third, that observations are independent of one another. Because group sizes were equal, the test is particularly robust against violations of these assumptions (Howell, 2010). Using the computer statistics program SPSS v.11, two *F*-scores were generated, one for response rate, the other for error rate. A score exceeding the critical value $F_{.05}(2,39) = 3.24$ indicated a statistically significant difference between condition means.

Multiple comparisons among treatment means were measured using Dunnett's test. Dunnett's test is commonly used in experimental designs when comparing all treatments with a single control group (Howell, 2010). This post hoc test helps identify which condition means differ significantly from the control. It also allows the researcher to compare the magnitudes by which performance means differ from the control.

Two separate two-way ANOVA tests were then conducted to determine if significant interaction effects exist between reflective propensity and reflective activity

condition on response rate and error rate. The assumptions underlying this test are identical to those underlying one-way ANOVA. Using the computer statistics program SPSS v.11, two F -scores were generated, one for the interaction term as it relates to response rate, the other for the interaction term as it relates to error rate. A score exceeding the critical value $F_{.05}(2,36) = 3.26$ indicated a statistically significant interaction. The main effects for reflective activity condition duplicate earlier one-way ANOVA analyses. Main effects for reflective propensity, however, were not duplicative and will be discussed.

Tests for simple main effects were used to determine where significant mean differences exist in each formal reflective activity of the two-factor data matrix. That is, the simple main effect of learning style was tested at each level of reflective activity. Three F -scores were generated. A score exceeding the critical value $F_{.05}(1,36) = 4.11$ indicated a statistically significant simple main effect. Line graphs were used to further communicate these findings.

Reliability and Validity

Reliability refers to the consistency or dependability of a measuring process (Leary, 2011). A common threat to reliability in behavioral observation studies are discrepancies between true scores and those recorded by the observer (Kaplan & Saccuzzo, 2009). Because this study's behavioral observations left lasting evidences (e.g., the number of pavers installed upside down), this threat was averted. Observers, for example, were not at risk of missing one or two behavioral observations bound in a singular temporal instance due to distraction. Therefore, there was no need to employ traditional reliability controls such as inter-rater reliability estimates. Photographic

evidences of novel application task projects, however, were made available for data confirmation.

Validity refers to the ability of researchers to draw meaningful and correct inferences from scores obtained in a study (Creswell, 2005). There are a variety of potential threats to validity in an experimental study. Several are immediately applicable to the current study, and procedures to address these threats will be discussed.

Threats to internal validity represents confounds that limit the ability to draw correct cause and effect inferences. There were four threats to internal validity in this study. Demand characteristics (a participant's interpretation of the study's purpose and alteration of their behavior to align with that interpretation), compensatory rivalry (positive change in the control group's behavior due to their knowledge of being in the control group), and resentful demoralization (negative change in the control group's behavior due to their knowledge of being in the control group) were controlled for by limiting participants' knowledge of the study's purpose. Ethical issues related to this control procedure were discussed in the research permission and ethical considerations section of this paper. Selection threats (participant characteristics that may unequally impact the dependent variable across conditions) were controlled for using a matched random assignment procedure, which was discussed at length in the participants and placement section.

Threats to external validity represent problems that may prevent generalizability. Three potential threats to external validity were discussed in the limitation section. First, because participants were drawn from a specific urban Midwestern two-year technical college, they may have possessed behavioral repertoires predisposing them to unique

outcomes. Therefore, it may be difficult to generalize these findings to disparate populations. Second, because this study's instrumentally learned skill was unique to a specific occupation, it may be difficult to generalize these findings to disparate fields. In instances where tools, materials, visual stimuli, and behaviors are shared, findings may prove generalizable. In contexts with few shared elements, however, they may not. Last, because a convenience sample was used, the sample may not be representative of the population from which it was derived (Creswell, 2005). Such threats may be difficult to completely eliminate. However, systematic replications in other contexts at later times may be one solution.

CHAPTER 4

Findings

The purpose of this study was to examine the impact of formal reflective activities on skill adaptation in adult work-related learning settings. With this in mind, findings will be discussed for each of the study's eight hypotheses. Before presenting these findings, the following information will be reviewed: data demographics, test and data collection methods, variable measurement, and pilot study results. After presenting the findings, data outliers and study reliability and validity will be discussed. The section will conclude with a brief summary of salient results.

Data Demographics

Participants were drawn from an urban Midwestern two-year technical college student population. Approximately 30 percent of its student body is classified as low income. The ethnic breakdown is as follows: 53 percent white, 28 percent African American, 14 percent Hispanic, 4 percent Asian American, and 1 percent Native American/Alaska Native. The gender distribution is 51% female and 49% male. The average student age is 27, and 65% of the student population is 25 or older. A convenience sample ($n = 42$) drawn from this population was composed of student volunteers responding to campus advertisements. The sample was 85.7% male and 14.3% female. Age was distributed across three pre-defined categories: (a) 24-29: 14.3%, (b) 30-39: 28.6%, and (c) 40 and above: 57.1%. A frequency chart showing sample data demographics is presented in figure 7.

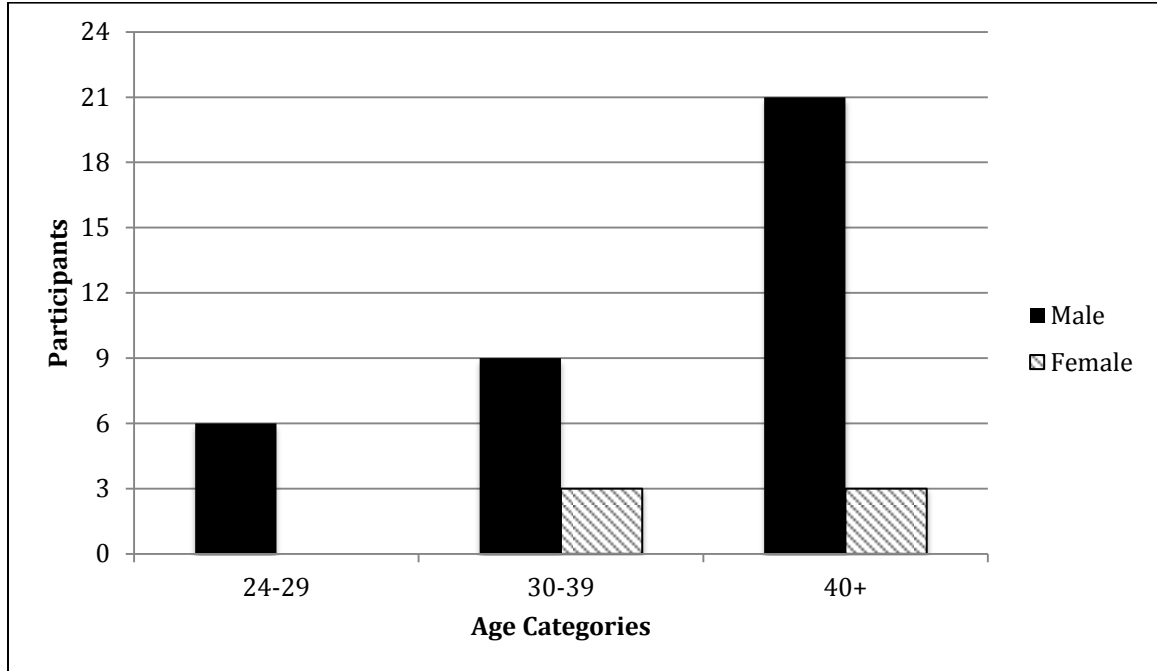


Figure 7. Sample data demographics.

Tests and Data Collection Methods

One-way ANOVA tests were used to evaluate mean differences between groups' response rates and error rates. Hypotheses 1a, 1b, 2a, and 2b were tested using this procedure. Gravetter and Wallnau (2009) have argued that one-way ANOVA is the appropriate hypothesis-testing procedure when evaluating mean differences (attributable to a single factor) between three or more groups. A separate test was performed to evaluate each dependent variable (i.e., response rate and error rate). Using the computer statistics program SPSS v.11, two F -scores were generated. A score exceeding the critical value $F_{.05}(2,39) = 3.24$ indicated a statistically significant difference between condition means.

Two-way ANOVA tests were used to determine if significant interaction effects existed between reflective activity condition and reflective propensity on response rate

and error rate. Hypotheses 3a, 3b, 4a, and 4b were tested using this procedure. Two-way ANOVA allows the researcher to evaluate interaction effects in addition to main effects, which can also be evaluated using a one-way ANOVA. A separate test was performed to evaluate the interaction in relation to each dependent variable. Using the computer statistics program SPSS v.11, two F -scores were generated. A score exceeding the critical value $F_{.05}(2,36) = 3.26$ indicated a statistically significant interaction. For significant interaction terms, additional tests for simple main effects were used to determine where significant mean differences existed in each formal reflective activity of the two-factor data matrix. Three additional F -scores were generated for each significant interaction term. A score exceeding the critical value $F_{.05}(1,36) = 4.11$ indicated a statistically significant simple main effect.

Behavioral observation data was collected. The number of pavers installed was counted by visual inspection. Errors were also counted by visual inspection. The following were classified as errors: (a) a paver joint exceeding 1/8", (b) a paver installed upside down, (c) a paver installed with a crack or chip, and (d) a paver installed deviating from the correct pattern. Paver joints exceeding 1/8" were verified using an electronic caliper with accuracy to +/- 0.001inch. Photographs were taken of participants' novel application task projects to document performance. All data was entered immediately in an electronic spreadsheet.

Variable Measurement

The two dependent variables were measured as follows. Response rate was measured by counting the number of pavers installed during the 25-minute novel application task. All pavers lying flat on the bedding sand—regardless of correct

placement—were classified as installed and, therefore, were included in a participant's response rate. Pavers lying outside the bedding sand or on top of other pavers were not considered installed and were removed from the project prior to data collection. A participant's response rate could range from 0 to 140. Error rate was measured by dividing a participant's cumulative error total during the 25-minute novel application task by her or his response rate. This yielded a number ranging from 0 to 4.13. A participant's error rate could potentially reach 4.13 because there were 578 possible errors and 140 possible pavers to install. An error rate of 0 represented perfect performance.

A participant's reflective propensity was measured using the Kolb Learning Style Inventory (KLSI) 3.0. The internal validity and reliability of the KLSI 3.0 have been repeatedly demonstrated, establishing Cronbach alpha coefficients of reliability from .77 to .84 (Kayes, 2005; Wierstra & DeJong, 2002). The KLSI 3.0 evaluates a learner's propensity toward one of four learning styles: (a) diverging (introverted/feeling), (b) assimilating (introverted/intuition), (c) converging (extraverted/thinking), and (d) accommodating (extraverted/sensation). Divergent and assimilative learners are thought to use reflection more often in learning than accommodative and convergent learners (Kolb, 1984). Divergent and assimilative learners were grouped together and classified as reflective learners. Convergent and accommodative learners were grouped together and classified as non-reflective learners. The two groups were distributed evenly across conditions.

Pilot Study

A pilot study was conducted prior to data collection. Two participants, whose data were not included in the final analysis, completed the study on consecutive days. Several

modifications were made following their participation. First, because these participants had difficulty maintaining meaningful dialogue for 20 minutes during the reflective activity interval, the activity was shortened to 15 minutes. Second, because both participants experienced great difficulty starting the novel application task with only a photograph of a *similar* project as a model, a photograph of the *actual* completed novel application task was used for subsequent participants. Third, because of these difficulties, the first dependent variable was changed from *time to completion* to response rate. This change provided a meaningful dependent variable for all participants, including those who did not finish the task. Retrospectively, this proved to be an important change as only four of the 42 participants completed the task, all four using the entire 25-minute interval. Third, to accommodate the change to response rate as a new dependent variable, the second dependent variable was changed from *error total* to error rate. This change allowed for meaningful comparisons of performance between participants with different response rates. For example, prior to this change a meaningful comparison was impossible between a participant who installed 25 pavers with 10 errors and a participant who installed 140 pavers with 10 errors. Although their error totals were equal (10), the latter participant clearly performed more effectively. Using error rates as a dependent variable, a meaningful comparison can be made. It now becomes clear that the former participant (error rate = 0.4) performed less effectively than the latter (error rate = 0.07).

Hypothesis 1a & 1b Findings

Hypothesis 1a stated that participants in formal reflective activities with a reflection focus would have higher response rates on a novel application task than participants in critical reflection and non-reflection activities. To test this hypothesis a

one-way ANOVA was conducted that examined response rate differences between the three reflective activity conditions. Levene's test indicated equal variances ($F=.050$, $p=.952$). Therefore, the assumption of equal variance was met. Shapiro-Wilk's test for normality indicated that reflective activity conditions were normally distributed: interference ($p=.740$), reflection ($p=.500$), and critical reflection ($p=.182$). Therefore, the assumption of normality was met. The mean, standard deviations, and 95% confidence intervals are presented in table 4. Response rates did not differ significantly between groups, $F(2, 39)=.603$, $p=.552$, $\eta^2=.031$. Findings, therefore, failed to support hypothesis 1a. This study did not find strong evidence that participants in formal reflective activities with a reflection focus have higher response rates on novel application tasks than participants in other groups. In fact, participants in the reflection condition had lower response rates than those in the interference and critical reflection conditions.

TABLE 4

Number of paver installed per 25 minutes (response rate)

	Interference	Reflection	Critical Reflection
M	86.214	73.214	77.571
SD	31.911	31.259	32.458
95% CI	[67.8, 104.6]	[55.2, 91.3]	[58.8, 96.3]

Given these findings, hypothesis 1b was also not supported. Hypothesis 1b stated that participants in formal reflective activities with a critical reflection focus will have higher response rates on a novel application task than those in non-reflective activities

but lower than those is activities with a reflection focus. Response rates did not differ significantly between groups, $F(2, 39)=.603, p=.552, \eta^2=.031$. This study, therefore, did not find that participants in formal reflective activities with a critical reflection focus have higher response rates on novel application tasks than participants not given an opportunity to reflect. In fact, participants in the critical reflection condition had lower response rates than those in the interference condition.

Hypothesis 2a & 2b Findings

Hypothesis 2a stated that participants in formal reflective activities with a reflection focus would have lower error rates on a novel application task than participants in critical reflection and non-reflection activities. To test this hypothesis a one-way ANOVA was conducted that examined error rate differences between the three reflective activity conditions. Levene's test indicated equal variances ($F=1.472, p=.242$). Therefore, the assumption of equal variance was met. Shapiro-Wilk's test for normality indicated that reflective activity conditions were normally distributed: interference ($p=.881$), reflection ($p=.132$), and critical reflection ($p=.229$). Therefore, the assumption of normality was met. The mean, standard deviations, and 95% confidence intervals are presented in table 5. Error rates did not differ significantly between groups, $F(2, 39) = .715, p = .495, \eta^2=.036$. Findings, therefore, failed to support hypothesis 2a. Although error rate was lowest in the reflection condition, this study did not find strong evidence that participants in formal reflective activities with a reflection focus have lower error rates on novel application tasks than participants in other groups.

TABLE 5

Number of errors committed per paver installed (error rate)

	Interference	Reflection	Critical Reflection
M	0.439	0.362	0.363
SD	0.134	0.239	0.200
95% CI	[.36, .52]	[.22, .50]	[.25, .48]

Given these findings, hypothesis 2b was also not supported. Hypothesis 2b stated that participants in formal reflective activities with a critical reflection focus would have lower error rates on a novel application task than those in non-reflective activities but higher than participants in activities with a reflection focus. Error rates did not differ significantly between groups, $F(2, 39) = .715, p = .495$. Therefore, although error rate was lower in the critical reflection condition than in the interference condition, this study did not find strong evidence that participants in formal reflective activities with a critical reflection focus have lower error rates than participants who are not given an opportunity to reflect.

Hypothesis 3a & 3b Findings

Hypothesis 3a stated that reflective activities with a reflection focus would impact the response rates of reflective participants differently than non-reflective participants. To test this hypothesis a two-way ANOVA was conducted that examined the effect of reflective activity condition and reflective propensity on response rate. The mean, standard deviations, and 95% confidence intervals are presented in table 6. Levene's test indicated equal variances ($F=.947, p=.463$). Therefore, the assumption of equal variances was met. There was no significant main effect of reflective propensity ($F(2, 39)=2.243$,

$p=.143$, $\eta^2=.059$) or interaction effect ($F(2, 39)=1.353$, $p=.271$, $\eta^2=.070$). Although a significant interaction was not found, Figure 8 is offered to further illustrate response rate differences between reflective and non-reflective learners within the interference condition. Findings failed to support hypothesis 3a. This study did not find strong evidence that reflective activities with a reflection focus impact the response rates of learners with different learning styles differently.

TABLE 6

Response rates by reflective propensity and reflective activity condition.

Condition	Reflective propensity					
	Reflective			Non-reflective		
	<i>n</i>	<i>M (SD)</i>	95% CI	<i>n</i>	<i>M (SD)</i>	95% CI
Interference	7	67.9 (26.7)	[44.0, 91.7]	7	104.6 (26.6)	[80.7, 128.4]
Reflection	7	71.7 (24.3)	[47.9, 95.6]	7	74.7 (39.0)	[50.9, 98.6]
Critical Reflection	7	75.9 (27.5)	[52.0, 99.7]	7	79.3 (27.5)	[55.4, 103.1]
Total	21	71.8 (29.3)	[58.0, 85.6]	21	86.2 (32.8)	[72.4, 100.0]

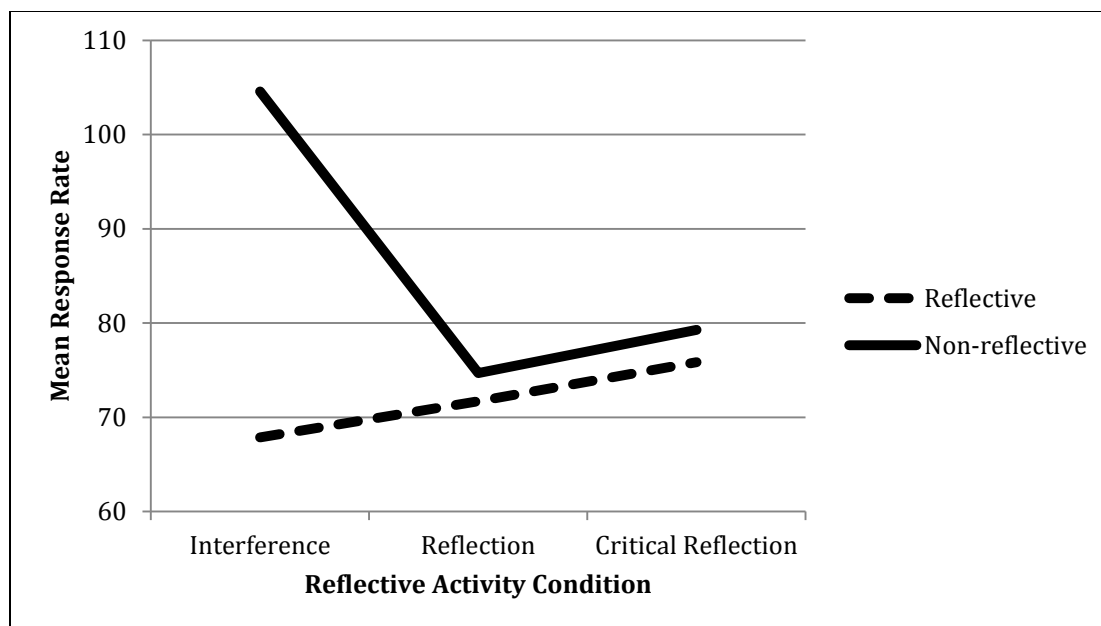


Figure 8. Interaction of reflective activity condition and learning style on response rate.

Given these findings, hypothesis 3b was also not supported. Hypothesis 3b stated that reflective activities with a critical reflection focus would impact reflective participants differently than non-reflective participants. This study did not find strong evidence that reflective activities with a critical reflection focus impact the response rates of learners with different learning styles differently.

Hypothesis 4a & 4b Findings

Hypothesis 4a stated that reflective activities with a reflection focus would impact the error rates of reflective participants differently than non-reflective participants. To test this hypothesis a two-way ANOVA was conducted that examined the effect of reflective activity condition and reflective propensity on error rate. The mean, standard deviations, and 95% confidence intervals are presented in table 7. Levene's test indicated equal variances ($F=1.561$, $p=.196$). Therefore, the assumption of equal variances was met. There was no main effect of reflective propensity, $F(2,39)=.733$, $p=.398$, $\eta^2=.017$. There was a significant interaction between the effects of condition and reflective

propensity on error rate, $F(2, 39) = 3.251$, $p = .050$, $\eta^2 = .153$. Figure 9 demonstrates this interaction. Simple main effects post hoc analysis, however, showed no differences in error rate between reflective propensity groups engaged in formal reflective activities with a reflection focus, $F(1,36)=0.061$, $p=.806$, $\eta^2=.002$. Findings, therefore, failed to support hypothesis 4a. This study did not find strong evidence that reflective activities with a reflection focus impact the error rates of participants with dissimilar learning styles differently.

TABLE 7

Error rates by reflective propensity and reflective activity condition.

Condition	Reflective Propensity					
	Reflective			Non-Reflective		
	<i>n</i>	<i>M (SD)</i>	95% CI	<i>n</i>	<i>M (SD)</i>	95% CI
Interference	7	.480 (.13)	[.34, .62]	7	.398 (.13)	[.26, .54]
Reflection	7	.375 (.12)	[.23, .52]	7	.350 (.33)	[.21, .49]
Critical Reflection	7	.236 (.14)	[.09, .38]	7	.490 (.18)	[.35, .63]
Total	21	.364 (.16)	[.28, .45]	21	.413 (.23)	[.33, .50]

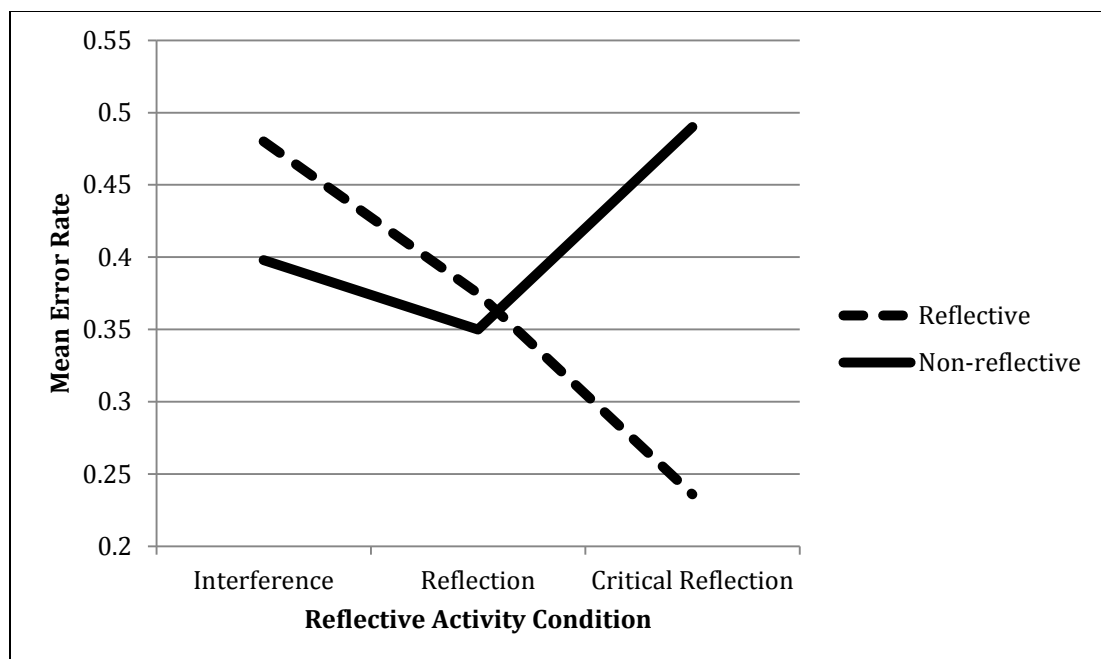


Figure 9. Interaction of reflective activity condition and learning style on error rate.

Hypothesis 4b stated that reflective activities with a critical reflection focus would impact the error rates of reflective participants differently than non-reflective participants. Simple main effects analysis showed that participants with reflective learning styles had significantly different error rates than those with non-reflective learning styles when engaged in critical reflection activities ($F(1,36)=6.501$, $p = .015$, $\eta^2=.153$). Participants with a propensity for reflective learning had error rates 0.254 points lower than participants with a disinclination for reflective learning. Figure 9 demonstrates this interaction. These findings, therefore, support hypothesis 4b. Reflective activities with a critical reflection focus do impact the error rates of participants with dissimilar learning styles differently: participants with reflective learning styles have lower error rates, while those with non-reflective learning styles have higher error rates.

Outliers

A box-and-whisker plot was created for each dependent variable (i.e., response

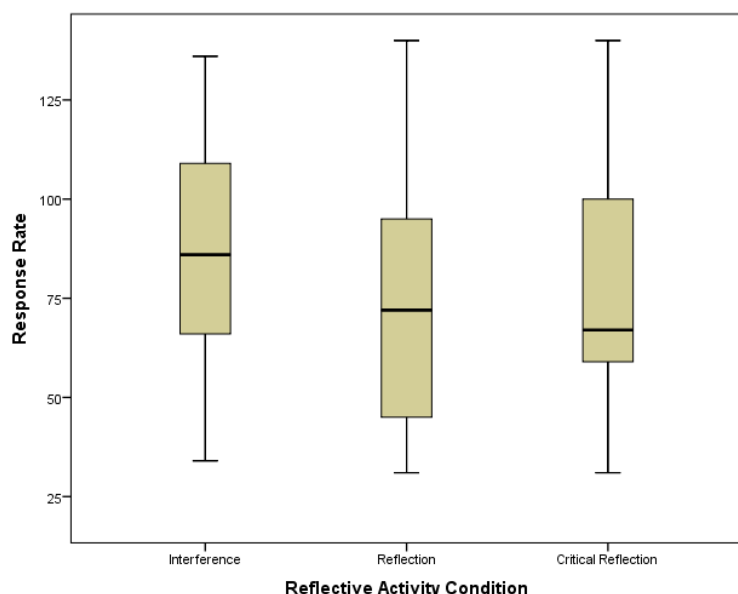


Figure 10. Response rate distribution.

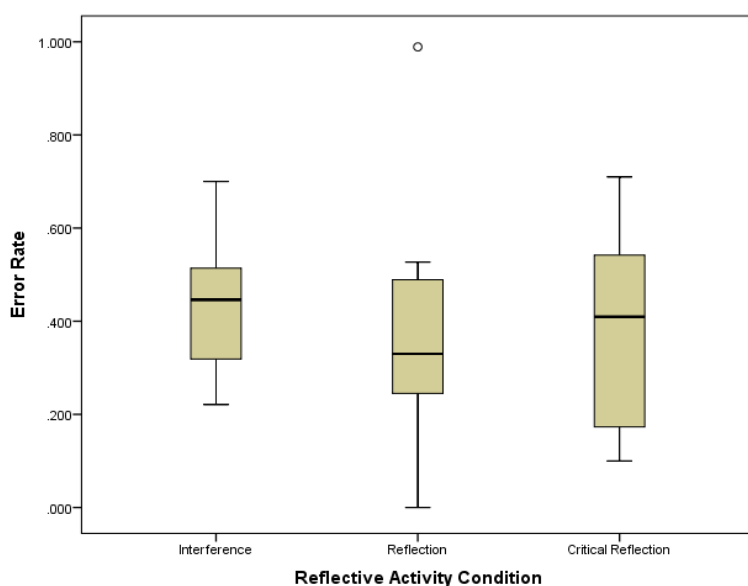


Figure 11. Error rate distribution.

rate and error rate) to help identify outliers. Figure 10 shows the distribution of response rate for each reflective activity condition. No outliers were found with values 1.5 times greater than the upper quartiles or 1.5 times lesser than the lower

quartiles of each condition. Figure 11 shows the distribution of error rate for each reflective activity condition. One outlier was found in the reflection group. Participant 25, a 40+, non-reflective male, recorded an error rate of

0.989, which was 1.88 times the value of the upper quartile (0.53) in the reflection condition. This score was also 39% greater than the next highest recorded error rate (0.710) in the sample ($n=42$). It is likely this outlier inflated overall variance and

decreased the *F* statistic, potentially eliminating significant differences between conditions.

Validity and Reliability

Because this study's behavioral observations left lasting evidences (e.g., the number of pavers installed upside down), threats to reliability were averted. The researcher, for example, was not at risk of missing a behavioral observation bound in a singular temporal instance due to distraction. Therefore, it was decided that traditional reliability controls, such as inter-rater reliability estimates, were unwarranted. Photographs of novel application task projects, however, were taken for data confirmation (see Appendix B).

There were four threats to internal validity in this study. Demand characteristics (a participant's interpretation of the study's purpose and alteration of their behavior to align with that interpretation), compensatory rivalry (positive change in the control group's behavior due to their knowledge of being in the control group), and resentful demoralization (negative change in the control group's behavior due to their knowledge of being in the control group) were controlled for by limiting participants' knowledge of the study's purpose. Selection threats (participant characteristics that may unequally impact the dependent variable across conditions) were controlled for using a matched random assignment procedure, which was discussed at length in the participants and placement section of the proposal.

There were three potential threats to external validity in this study. First, because participants were drawn from a specific urban Midwestern two-year technical college, they may have had behavioral repertoires predisposing them to unique outcomes.

Therefore, it may be difficult to generalize these findings to disparate populations. Second, because this study's instrumentally learned skill was unique to a specific occupation, it may be difficult to generalize these findings to disparate fields. In instances where tools, materials, visual stimuli, and behaviors are shared, findings may prove generalizable. In contexts with few shared elements, however, they may not. Last, because a convenience sample was used, the sample may not have been representative of the population from which it was derived (Creswell, 2005). Such threats may be difficult to completely eliminate. However, systematic replications in other contexts at later times may be one solution.

Summary and Conclusion

This study did not find evidence to support seven of its eight hypotheses. There were no significant differences in response rate or error rate between reflective activity conditions. There were also no significant differences in response rate or error rate between reflective and non-reflective learners within the reflection condition. Only hypothesis 4b was supported. Reflective activities with a critical reflection focus do appear to significantly impact the error rates of participants with dissimilar learning styles differently. Reflective participants have lower error rates when participating in critical reflective activities, whereas non-reflective participants have higher error rates when participating in these activities. The following chapter will discuss and interpret these findings while providing recommendations and suggestions for practice and further research.

CHAPTER 5

Summary, Conclusions, Limitations, Discussion, & Recommendations

This chapter is divided into five sections. The summary section provides a brief overview of this study's purpose and problem, literature review, methodology, and findings. The conclusions section details this study's four conclusions related to their overriding research questions and supporting findings. The limitations section discusses this study's five primary limitations. The discussion section connects this study's conclusions to supporting theory and literature, and explores relevant ideas and possibilities drawn from these conclusions. The recommendations section is divided into two subsections discussing recommendations for teaching and practice and further study. The chapter closes with a brief conclusion.

Summary

Purpose & Problem. The purpose of this study was to examine the impact of formal reflective activities on skill adaptation in adult work-related instrumental learning settings. This study was undertaken to provide stakeholders in competency-based work-related learning contexts empirical research to inform their decisions to use formal reflective activities. Given the paucity of empirical research demonstrating the benefits and outcomes of reflective activities in such contexts, stakeholders remain largely dependent on inconsistent conceptual positions.

Research Questions. Two prominent adult learning theories were employed to explain and evaluate the relationship between instrumental learning and formal reflective activities. The ability to adapt was suggested as a benefit or outcome of reflection/critical reflection in skills-based learning in Kolb's (1984) experiential learning theory and

Mezirow's (2001) transformative learning theory. Four research questions, then, were created to evaluate these claims in light of the study's purpose and research problem. How do formal reflective activities affect a participant's response rate during a novel application of an instrumentally learned skill? How do formal reflective activities affect a participant's error rate during a novel application of an instrumentally learned skill? Is there an interaction effect between formal reflective activities and reflective propensity on response rate? Is there an interaction effect between formal reflective activities and reflective propensity on error rate?

Literature Review. A review of the literature revealed a lack of empirical studies demonstrating a clear link between formal reflective activities and instrumental learning outcomes. Although there initially appears some empirical support for reflective activities' impact on instrumental learning outcomes, only two studies using controlled, experimental designs found a positive relationship (see Bannert, 2006; Wetzstein & Hacker, 2004). No other study claiming such a relationship met these or similar standards. These findings were consistent with earlier reviews (see Burton, 2000; Cornsford, 2002; Mackintosh, 1998; Mamede, Schmidt, & Rikers, 2006; Mann, Gordon, MacLeod, 2009; Ruth-Sahd, 2003).

Similarly, literature investigating the relationship between reflective activities and skill-adaptation was inconclusive. Although some studies suggested that reflective activities enhance skill-adaptation in profession and educational learning contexts, the evidence was derived from qualitative research designs, investigations of hypothetical constructs, and retrospective reporting of perceived effects on performance. Apart from Niessen and Volmer's (2010) study, which found no relationship between

reflection/critical reflection and skill-adaptation, no studies used controlled, experimental designs. Predictions derived from Mezirow (1990, 1991, 2000) and Kolb's (1984) theories, then, appear to have minimal, contradictory, and/or inconclusive evidentiary support. As a result, the literature provides no substantive answers to this study's four research questions.

Methodology. An experimental design was used to answer these questions. Participants were randomly assigned to one of three conditions: interference, reflection, and critical reflection. Each condition featured an identical fifty-minute hands-on course based on a behavioral skills training (BST) model: (a) instruction, (b) modeling, (c) practice, and (d) feedback. The course focused on how to install a 90-degree herringbone patterned paver walkway. The instruction and modeling phases were pre-recorded and presented on a 13" laptop computer screen to ensure consistent delivery across conditions. During practice and feedback phases, participants were asked to install a 25 square foot 90-degree herringbone patterned paver walkway, adhering to the methods discussed and demonstrated in the presentation. Feedback consisted of praise and correction. Two fifteen-minute reflective activity intervals, which varied by condition, were interspaced between BST phases. Those in the interference condition were not given an opportunity to reflect, those in the reflection condition took part in formal reflective activities with a reflection focus, and those in the critical reflection condition took part in formal reflective activities with a critical reflection focus. Following BST blocks and reflective activity intervals, all participants completed a novel application task. Each was asked to install a 58" x 58" 45-degree herringbone paver walkway with no feedback or guidance. A photograph model was supplied.

Final novel application task projects were quantitatively assessed using two behavioral observation data categories: (a) number of pavers installed per 25-minute time interval (response rate), and (b) number of errors produced per paver installed (error rate). Errors were defined as: (a) number of paver joints exceeding 1/8", (b) number of upside down pavers, (c) number of chipped or cracked pavers, and (c) number of pavers deviating from the 45 degree herringbone pattern. A participant's error rate was his or her cumulative error total divided by the total number of pavers he or she installed.

Findings. This study did not find evidence to support seven of its eight hypotheses. There were no significant differences in response rate or error rate between reflective activity conditions. There were also no significant differences in response rate or error rate between reflective and non-reflective learners within the reflection condition. Only hypothesis 4b was supported. Reflective activities with a critical reflection focus do appear to significantly impact the error rates of participants with dissimilar learning styles differently. Reflective participants have lower error rates when participating in critical reflective activities, whereas non-reflective participants have higher error rates.

Conclusions

Four conclusions were drawn from this study. Each is presented with the research question it addresses and supportive findings.

Conclusion 1. Research question 1 asked the following: How do formal reflective activities affect a participant's response rate during a novel application of an instrumentally learned skill? This study did not find strong evidence that participants in formal reflective activities with a reflection or critical reflection focus have different response rates on novel application tasks than participants in other groups.

From these findings the following conclusion was drawn: Formal reflective activities may not significantly impact how efficiently participants adapt instrumentally learned skills to novel applications. These activities, therefore, may not be effective pedagogical tools for increasing efficient adaptations in skills-based learning. If formal reflective activities have any impact, our results would tentatively suggest that they impede the pace learners adapt skills. Although not statistically significant, response rates of those in reflection ($M=73.2$, $SD=31.3$) and critical reflection ($M=77.6$, $SD=32.5$) conditions, when aggregated ($M=75.4$), were 10.8 points less than those in the interference condition ($M=86.2$, $SD=31.9$). This equates to a difference of over 10.5 pavers installed per 25-minute interval, or 14% of the average reflection/critical reflection participant's final project. The large variance in response rates may have prevented these differences from reaching statistical significance. This suggests that variables other than reflective activity participation may be more important when considering how to influence learners' response rates when adapting skills to novel applications.

Conclusion 2. Research question 2 asked the following: How do formal reflective activities affect a participant's error rate during a novel application of an instrumentally learned skill? This study did not find strong evidence that participants in formal reflective activities with a reflection or critical reflection focus have overall different error rates on novel application tasks than participants in other groups.

From these findings, the following conclusion was drawn: Formal reflective activities may not overall significantly impact how effectively participants adapt instrumentally learned skills to novel applications. These activities, therefore, may not be effective pedagogical tools for increasing effective adaptations for the majority of

learners in skills-based learning. This conclusion, however, should be interpreted in light of the significant interaction effect found between reflective propensity and participation in reflective activities. Although significant differences in error rate were found between reflective and non-reflective learners in the critical reflection condition, their polarized mean error rates neutralized critical reflection's overall impact. For educators, then, the overall impact of using this activity with all learners may be minimal. If formal reflective activities have any overall impact, our results would tentatively suggest that they increase the accuracy and quality of skill adaptations. Although not statistically significant, error rates of those in reflection ($M=0.362$, $SD=0.239$) and critical reflection ($M=0.363$, $SD=0.200$) conditions, when aggregated ($M=0.363$), were 0.077 points less than those in the interference condition ($M=0.439$, $SD=0.134$). This equates to a difference of almost 11 errors on a 140-paver (25 square foot) project – a difference in quality noticeable to most skilled professionals. Again, however, the large variance in error rates may have prevented these differences from reaching statistical significance, which suggests that variables other than reflective activity participation may be more important when considering how to influence learners' error rates when adapting skills to novel applications.

Conclusion 3. Research question 3 asked the following: Is there an interaction effect between formal reflective activities and reflective propensity on response rate? This study did not find strong evidence that formal reflective activities with a reflection or critical reflection focus impact the response rates of participants with different learning styles differently.

From these findings, the following conclusion was drawn: Formal reflective activities may not significantly impact the response rates of reflective and non-reflective learners differently. It may be unnecessary, therefore, to consider a learner's reflective propensity when using formal reflective activities to increase efficient adaptations in skills-based learning. If reflective propensity interacts at all with formal reflective activities on response rate, the results would tentatively suggest that the absence of reflective activities (in this case, interference) might contribute to higher response rates in non-reflective learners. Although not statistically significant, mean response rates of non-reflective learners ($M=104.6$, $SD=26.6$) in the interference condition were far greater than reflective learners ($M=67.9$, $SD=26.7$). This equates to a difference of over 36.5 pavers installed per 25-minute interval, or 54% of the average reflective participant's final project. A noticeable drop-off, too, occurred in non-reflective learners' response rates between interference and reflective conditions, tentatively suggesting that formal reflective activities may hinder response rate in non-reflective learners. Again, however, the large variance in response rates may have prevented these differences from reaching statistical significance. This suggests that variables other than reflective activity participation may be more important when considering the difference in response rates between reflective and non-reflective learners when adapting skills to novel applications.

Conclusion 4. Research question 4 asked the following: Is there an interaction effect between formal reflective activities and reflective propensity on error rate? This study did not find strong evidence that formal reflective activities with a reflection focus impact the error rates of participants with different learning styles differently. It did, however, find strong evidence that formal reflective activities with a critical reflection

focus impact the error rates of participants with different learning styles differently. Reflective learners have lower error rates following critical reflective activities, while non-reflective learners have higher error rates following critical reflective activities.

From these findings, the following conclusion was drawn: Formal reflective activities with a reflection focus may not significantly impact the error rates of reflective and non-reflective learners differently. It may be unnecessary, then, to consider a learner's reflective propensity when using formal reflective activities with a reflection focus to increase effective adaptations in skills-based learning. Formal reflective activities with a critical reflection focus, however, do appear to significantly impact the error rates of reflective and non-reflective learners differently. Educators, therefore, may find it useful to consider a learner's reflective propensity when using these activities to increase effective adaptations in skills-based learning. Critical reflective activities appear to have a polarizing impact on learners, leading to very different outcomes. The highest and lowest error rates in the study were by non-reflective learners ($M=.490$, $SD=.18$) and reflective learners ($M=.236$, $SD=.14$) in the critical reflection condition. This equates to a difference of almost 31 errors on a 140-paver (25 square foot) project – a difference in quality noticeable to most laypeople. Comparable differences were not found in the reflection or interference conditions.

Limitations

This study's conclusions should be interpreted in light of its methodological limitations. There are five to consider. First, this study's sample was drawn from a specific urban Midwestern two-year technical college. Its students may have behavioral repertoires unique to this community and, therefore, researchers should consider whether

it is appropriate to generalize these findings to other populations. Second, this study examined a particular instrumentally learned skill unique to the hardscaping profession. Careful consideration, therefore, is needed when generalizing these findings to other fields with substantially different contextual elements. Third, this study utilized a convenience sample comprised of students who voluntarily responded to campus-wide advertisements seeking research participants. Such samples may not be representative of the populations from which they are derived (Creswell, 2005). Fourth, outcomes associated with formal reflective activities in the experimental context may not transfer to the workplace. Some have suggested a questionable link between various types of work-related learning and workplace performance (Cervero, 1988; Eraut, 1994; Singer & Edmondson, 2008). Last, others may interpret this study's quantitative approach as contradictory or inapplicable to the philosophical foundation of reflection or critical reflection (Cranton, 2000; Duke & Appleton, 2000). Still others may question whether reflection and critical reflection actually occurred in this study. The former limitation is not universally accepted, as evidenced in the "Significance of the Study" section of the research proposal, which details repeated calls for empirical evidence demonstrating reflective activities' impact on learning outcomes and performance. The latter limitation is inapplicable to the current study and its research questions, as no investigation was made into the impact of reflection or critical reflection, only the formal activities thought to occasion these processes.

Discussion

This study's findings and first two conclusions align with the small number of empirical studies that have also found no overall impact of reflective activities on

instrumental learning outcomes. Although each was discussed earlier, a brief summary is provided to clarify their relevance. Lowe and Kerr (1998) found that nursing students participating in a reflective teaching methods course performed no better on written assessments of knowledge, comprehension, and application of biological health science material than those in a conventional instruction methods course. Grez, Valcke, and Roozen (2009) found that college students participating in self-reflection activities (one-on-one reflective questioning) within an oral presentation skills course performed no better on skill assessments than students who did not participate in self-reflective activities. Bannert (2006) found that participants engaged in reflective verbalizations in a computer-based learning context performed no better on knowledge recall or knowledge comprehension tests than those not given an opportunity to reflect.

An important difference between this study's findings and those outlined above is that they did not specifically examine response rate and error rate outcomes. Scores derived from written assessments such as those used in these studies can easily be transformed to error rate and are likely representing the same thing – effective performance. Response rate, however, is not traditionally measured in written assessments unless specifically called for. This study's findings on response rate, then, should be considered new additions to the literature showing no overall impact of reflective activities on instrumental learning outcomes. As new research becomes available, it may be useful to consider the relationship between reflective activities and specific performance indicators (e.g., response and error rate) rather than the broader concept of instrumental learning outcomes. In addition, this study's examination of motor skills is a significant departure from earlier findings. Roessger (2012a) has called for

adult education to directly examine the relationship between adult motor learning and reflective activities. The findings presented here begin to illuminate this area of inquiry.

One previous study appears initially at odds with this study's findings and first two conclusions. Wetzstein and Hacker (2004) found that students participating in reflective activities sketched significantly higher quality engineering designs (as judged by professional engineers) than those given filler (non-reflective) tasks. This effect was significant across three different instructed problem solving strategies. No significant effects were found in non-reflective groups across any of the instructed strategies. The assessment procedure used in this study, however, was markedly different than those in the current and previously discussed studies. Wetzstein and Hacker's outcomes were measured using subjective quality assessments rather than testing instruments or quantifiable performance indicators. Inter-rater reliability measures were not used. It is possible, then, that judges in this study were assessing different things or performance qualities (e.g., aesthetic appeal) deviating from the instrumental domain. Their results are difficult to interpret and, therefore, do not strongly contradict the first two conclusions of the current study.

Conclusions 1 and 2 of this study should also help inform repeated calls for increased use of reflective activities in construction education courses (see Boyd, 2012; Hayles & Holdsworth, 2008; Kozolanka, 1995; Lee, 2010; Mills, Wingrove, & McLaughlin, 2010; Monson & Hauck, 2012; Selman & Westcott, 2005). Educators searching for pedagogical activities that overall improve construction skill learning outcomes may find more effective alternatives elsewhere. Error and response rates are essential adaptive competencies in this field, and both reflection and critical reflection

activities were not found to have an overall impact on these outcomes for all learners. Even when considering the interaction between reflective propensity and participation in reflective activities, which manifested in significant differences between learners' performance within the critical reflection condition, it is difficult to responsibly advocate for their use in construction education settings. If some learners' performances are markedly improved and others markedly worsened, are these activities truly an effective strategy for improving overall instrumental learning outcomes?

Conclusions 3 and 4 of this study directly addressed how the interaction between reflective activity and reflective propensity impacted skill adaptation. It was first shown that formal reflective activities (both reflection and critical reflection) do not significantly impact the response rates of reflective and non-reflective learners differently. This conclusion, when considered with this study's first two conclusions, depicts reflective activities as fairly innocuous events. Conclusion 4, however, established that critical reflection activities do significantly impact the error rates of reflective and non-reflective learners differently. Specifically, reflective learners within this condition had the lowest error rates of any group, whereas non-reflective learners in the same condition had the highest.

Several theories support this finding. Kolb's (1984) experiential learning theory claims that assimilative and divergent learners have preferences for reflective learning and, therefore, should excel when placed in settings that accommodate those preferences. Mezirow's (2000) transformative learning theory does not directly address reflective propensity, but it does claim that critical reflection in skills-based learning settings can improve performance on adaptive tasks. This study did not find strong support for this

claim across *all* learners, but its findings with reflective learners are entirely consistent with Mezirow's assertion. When considered in light of Kiely's (2005) claim that learning style has a significant impact on learners' transformative learning experiences, these findings appear to support Mezirow's theory. Further, these findings empirically demonstrate the direction in which learning style impacts transforming learning.

One potential explanation for reflective learners' improved performance following critical reflection activities can be derived from relational frame theory (RFT). Although a comprehensive treatment of RFT is beyond the scope of this discussion, a brief summary of its principles and their application to this study's findings is offered. This will require a short digression. Admittedly, RFT is a dense theory, and readers may be unfamiliar with its terminology, so I will aim for brevity and simplicity. Readers are encouraged to consult Torneke's (2010) *Learning RFT* and Hayes, Barnes-Holmes, and Roche's (2001) *Relational Frame Theory: A Post-Skinnerian Account of Human Language and Cognition* for more comprehensive treatments.

Through a series of experiments spanning several decades, Sidman (1994) uncovered a learning phenomenon he termed an *equivalence relation*—that is, a grouping of functionally equivalent stimuli that share membership in a “class.” The simplest example of this is, if one learns that $A=B$ and $A=C$ through direct experience, then he or she will know that $B=A$, $C=A$, $B=C$, and $C=B$ without ever having been taught these relationships directly. Understanding that $B=A$ after learning $A=B$ is referred to as *combinatorial entailment*. Understanding that $B=C$ after learning $A=B$ and $A=C$ is termed *mutual combinatorial entailment*. This set of relationships is termed an equivalence class (see Figure 12).

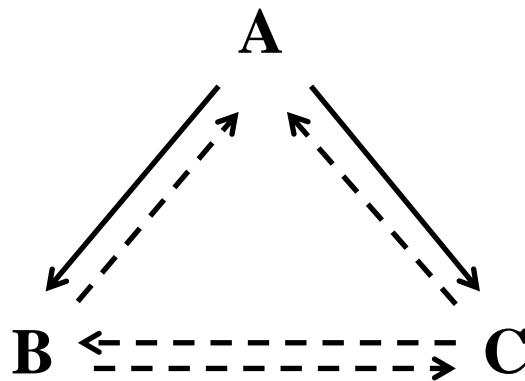


Figure 12. Equivalence class (Sidman, 1994).

Hayes, Barnes-Holmes, and Roche (2001) suggested that equivalence relations are only one way we relate stimuli (A is *equivalent to* B, A is *equivalent to* C, and so on). “Equivalencing” (or coordinate relating) is the first rule-

governed behavior we learn as children (Torneke, 2010). Later, we learn additional rules, e.g., temporal relations (A comes before B, B comes before C, and so on); comparative relations (A is larger than B, B is larger than C, and so on); and others such as causal relations, hierarchical relations, perspective relations, and difference relations. Hayes, Barnes-Holmes, and Roche (2001) refer to these relations as *relational frames*, and argue that the ability to relate stimuli in this manner is a learned behavior, the result of direct experiences with one’s verbal community.

Relational framing is not always dependent on non-arbitrary physical, temporal, or spatial characteristics of stimuli. We also frame through arbitrary socially reinforced relations. For example, the social community can teach an individual that A is greater than B regardless of the non-arbitrary relation between A and B. The individual, then, may act in accordance with this learned relation, and, through combinatorial entailment and mutual combinatorial entailment, learn an infinite number of derived arbitrary relations that affect, and are affected by, shared stimuli within the frame.

Through relational framing, stimuli develop functions shared by other stimuli within the frame. Therefore, variables affecting a particular stimuli have the potential to affect *all other stimuli* within the relation frame. Hayes, Barnes-Holmes, and Roche (2001) express the profound impact of this phenomenon: “hundreds of thousands of existing stimulus relations in one domain can be brought suddenly to bear on another and generate myriad derived relations as a result” (p. 85). For example, reading that a “chair” was used to bludgeon a store clerk during a robbery may affect an individual’s response to the Spanish equivalent “silla” the next time it is encountered. The stimulus “silla” was never directly related to the described event, but its stimulus function is now changed as a result of its inclusion in a relational frame of coordination with “chair.” It is now also related in a causal frame with physical pain. Hayes, Barnes-Holmes, and Roche refer to this phenomenon as the transformation of stimulus functions. It is important to note that context plays a critical role in this process. If the stimulus function of “silla” were transformed without regard to context, then an individual would relate it to pain in inappropriate situations. Instead, the newly developed causal frame depends upon the context of a violent criminal in the act of stealing. Because of contextual control, relational framing allows humans to infer consequences in novel situations. For example, if one was a bystander at a robbery in a Spanish speaking community and heard the word “silla” spoken in a long string of words by the criminal, one might seek shelter or guard oneself from the possibility of being struck.

Returning to our current study, because relational framing is learned behavior, there are undoubtedly those with more advanced repertoires than others. These learners may benefit more from critical reflective activities, which ask learners to relate novel

stimuli (paver installation) to familiar stimuli. Consider several questions in this study's critical reflection activity that do just that: (6a) What was the perception of laying pavers in your home community?, (9a) What have you read or heard about laying pavers?, (11a) What is your favorite way of learning a manual skill? As learners relate, stimuli are brought together into a single relational frame and their function transformed. Hayes, Barnes-Holmes, and Roche (2001) explain: "Learning to relate sets of stimulus relations allows the efficient development of entirely new ways of thinking, while providing the guidance of a model drawn from a more known domain" (p. 86). Again, consider question 11a. In forming a response, one may frame the act of installing pavers in a relation of equivalence with manual skills, which are already in a relation of coordination with one's father (who was a carpenter), who is already in a relation of equivalence with meticulous, thoughtful behavior. As a result, the stimulus function of installing pavers transforms because of its inclusion within a relational frame of coordination with manual skills. In other words, paver setting comes to occasion meticulous and thoughtful behavior. Such an illustration is entirely speculative but situated within a theoretical tradition supported by extensive empirical research.

Formal reflective activities with a reflection focus may not similarly impact reflective learners because much of reflection's focus is on problem solving and therefore limited to the immediate methods, applications, and problems present in the novel task. Drawing comparisons to previous experience was only a tangential focus of the reflection activity in this study (two of twelve content related questions asked learners to relate to familiar stimuli), whereas it was a defining characteristic of the critical reflection activity (nine of twelve asked for similar relations). Reflective learners in the reflection condition,

therefore, were given fewer opportunities to relate novel stimuli (paver setting) to familiar stimuli. As a result, opportunities for drawing on models and methods from other domains were reduced.

There are several potential explanations for why non-reflective learners did not display the reduced error rates of reflective learners in the critical reflection condition. One is that non-reflective learners were simply not critically reflecting and thereby not relating novel and experienced stimuli. Examining the data, however, this explanation, on its own, appears unlikely. The error rates of non-reflective learners in the critical reflection condition were 40% higher than those of non-reflective learners in the reflection condition and 22.5% higher than those in the interference condition. Further, the similar error rate data trends of reflective and non-reflective learners were dramatically reversed in the critical reflection condition. If non-reflective learners were simply not critically reflecting, their error rates should have been similar to their error rates in other conditions and not diametrically contrasting those of reflective learners. Critical reflection activities, then, appear more than simple inert events for members of this group.

A potential explanation can be found in cognitive psychology. Processing efficiency theory (Eysenck & Calvo, 1992) suggests that storage capacity of the working memory system is finite and that performance is affected by additional cognitive demands placed on this system during learning. Anxiety behaviors are specifically thought to reduce the storage and processing capacity of working memory available for concurrent tasks. Some have described critical reflective activities, particularly their subject matter (e.g., cultural norms, societal assumptions, personal biases), as a source of

anxiety behaviors (see Fook & Askeland, 2007; Nicolini, Sher, Childerstone, & Gorli, 2004). It is worth considering that these behaviors, for some learners, arise in response to the activity itself. That is, non-reflective learners may still choose not to reflect on these subjects, or lack the repertoires to do so, but by simply asking them to, educators occasion anxiety behavior. Moon (2004a), a renowned proponent of reflective learning, has noted that learners who approach short courses or workshops with anxiety toward learning tend to use non-reflective approaches. Although this explanation acknowledges the impact of anxiety behaviors, it ignores preferred learning style and may very well have mischaracterized the relationship between non-reflective approaches to learning and anxiety behaviors. An equally likely account is that learners who prefer non-reflective approaches feel anxious when asked to engage in critical reflection activities. These anxious feelings then interfere with performance related behavior. If, as Jarvis (2004) has argued, some adults are simply non-reflective learners and some forms of education are simply non-reflective learning (e.g., skills training), the latter account, prior to settling the debate empirically, is far more harmonized with the equitable foundations of adult education and contrary to the idea of “fixing” adults who don’t learn the way educators want them to.

This study’s findings, then, can potentially inform research showing that some reflective activities negatively impact performance. Several experimental and quasi-experimental studies (see Broyles, Epler, & Waknine, 2011; Niesen & Volmer, 2010) have found that as the level of reflection increases (potentially increasing the number of relations a learner is asked to make), performance suffers. In each of these studies, researchers did not control for, nor for that matter, consider a learner’s reflective

propensity. The negative impact of reflective activities deemed “more intense” or having a “higher cognitive load” may have stemmed from performance declines in non-reflective learners, which may have negatively influenced aggregate sample data. Further, a combination of reflective propensity, reflective activity, and task may be at work. This study examined a largely non-verbal, motor learning task. Wetzstein and Hacker (2004) have concluded that cognitive psychology literature examining how reflective verbalizations impact problem solving abilities shows that dialogue-specific reflective verbalizations (e.g., those used in this study) improve performance when solving complex problems but worsen it for simple and predominantly non-verbal tasks.

The real world impact of reflective and non-reflective learners’ responses to critical reflection activities is especially critical in work-related learning contexts. This can be evaluated using Gilbert’s (2007) worthy performance model. Gilbert suggested that human competence is a function of what he termed worthy performance (W). He defined this as the ratio of valuable accomplishment (A) to costly behavior (B) using the following theorem: $W = A / B$. Worthy performance is achieved when one maximizes valuable accomplishments and minimizing costly behavior. A worth index (W) greater than one indicates that accomplishments outweigh the costs involved in achieving them. In such cases, performance is considered effective and sustainable. A worth index less than one indicates that costs outweigh accomplishments and performance is largely ineffective and unsustainable. To calculate participants’ valuable accomplishment and behavioral cost related to paver setting, three sets of data were used: (a) participants’ response and error rates, (b) error constants from the novel application project, and (c) current market labor rates for paver installation. This study’s novel application project

allowed for 578 possible errors and 140 possible installed pavers. The current labor rate for a paver setter is \$1.56 per paver installed. This is based on a \$7 per square foot installation charge and 4.5 pavers per square foot. A paver setter's cost is \$0.62 per paver. This includes a \$0.40 per paver material cost and \$0.22 per paver labor cost. The labor cost is based on a competent installer installing 10 square feet per hour at \$10 per hour. Using these values, a worthy performance formula was created for paver setting (see Figure 13). The denominator describes a participant's total cost, that is, the dollar amount she or he will pay for all pavers installed. The numerator describes the net income generated for all *correct* pavers installed, that is, the number of pavers installed without error. Clients, of course, will not normally pay for defective installations. The left factor of the numerator considers a participant's number of errors committed with regard to the number of errors encountered. When subtracted from one, this provides a success rate that can be multiplied by the number of pavers installed to closely approximate a participant's valuable accomplishment.

$$W = \frac{A}{B} = \frac{\left(1 - \left(\frac{\text{\# of errors}}{\left(\frac{\text{\# of pavers installed}}{\text{\# of possible pavers installed}}\right)(\text{\# of possible errors})}\right)\right)(\text{\# of pavers installed})\left(\frac{\$ \text{ received}}{\text{paver installed}}\right)}{(\text{\# of pavers installed})\left(\frac{\$ \text{ paid}}{\text{paver installed}}\right)}$$

Figure 13. Worthy performance for novel application task.

Using mean response and error rates, a worth index was generated for reflective ($W = 2.37$) and non-reflective learners ($W = 2.22$) in the critical reflection condition, indicating that for every dollar invested in performance, non-reflective learners receive \$2.22 and reflective learners receive \$2.37. Using the novel application task as an example, the real world consequences become clear. On a 25 square foot project (140 pavers) at a \$0.62

per paver cost, the total project cost is \$86.80. Using each group's worthy performance score, we can calculate their gross return. Reflective learners participating in critical reflection activities generate \$205.72 (\$8.23/square foot), non-reflective learners \$192.70 (\$7.71/square foot)—a difference of \$13.02 gross and \$0.52 per square foot! Given that typical projects often reach several thousand square feet, these differences equate to considerable consequences for learners and/or sponsoring organizations. Even granting the possibility that non-reflective learners' will eventually catch up, these initial differences have large implications for teaching and practice.

Recommendations

Recommendations for Teaching & Practice. This study's findings demonstrate that formal reflective activities may not be effective overall strategies for increasing the efficiency and effectiveness of instrumental skill adaptations. The significant performance differences between reflective and non-reflective participants in critical reflection activities, however, may lead some to conclude that educators should teach non-reflective learners how to critically reflect. It is important to note that the learning style assessment tool used in this study (KLSI v3.0) does not assess a learner's *ability* to reflect, rather her or his *preference* or *propensity* for reflective learning. This is an important distinction, because this means that non-reflective learners may be as capable of, or as skilled at, critically reflecting as reflective learners, but for a variety of reasons do not feel it necessary or useful to do so. Moon (2004b) provides a similar, albeit more general, explanation:

There is often a belief that *some people cannot reflect*. . . . Since reflection is suggested to be an element in good quality forms of learning, we clearly take the

position that everyone can reflect, though this may not always be a conscious activity and may not be done willingly when required. . . . Assuming that everyone *can* reflect does not assume that everyone uses reflection effectively to improve performance. (p. 89)

Moon's assessment, however, is blatantly value-laden. Notice its assumption: reflection effectively improves performance for all learners. Without acknowledging it, one may find difficulty questioning her last sentence's implication—that is, educators can and should teach learners who do not use reflection effectively to do so. To be fair, Moon distances herself from what she refers to as “learning of physical skills,” which she suggests involve processes not amenable to her thoughts on reflection (a point similarly made by Wetzstein and Hacker, 2004). Skills-based (instrumental) learning, however, does not necessitate physical skills. Instrumental learning is simply a logical approach (hypothetical-deductive) to skill and knowledge acquisition. There are numerous instrumental learning subject areas lacking physical skill components (e.g., physician and mechanic diagnostic procedures). Based on this study's findings, and the literature reviewed, there is simply no strong empirical support for Moon's assumption that reflection and/or critical reflection effectively improves performance for all learners. If we are to base recommendations for teaching and practice on evidence, we should resist the conclusion that reflection would work if we simply taught learners how to do it properly.

Educators in work-related instrumental learning settings would be best served offering learners the choice between critical reflection and other empirically supported activities. In this way, those with reflective learning preferences could learn in their

chosen manner and benefit from the gains in adaptive competencies demonstrated here. Non-reflective learners, in turn, could participate in non-reflective activities, avoiding performance declines associated with required participation in critical reflection activities. Although it may be difficult for some practitioners to advocate non-reflective learning approaches for certain learners—Mezirow (1991) has argued that reflection is the defining quality of adult learning—a number of studies empirically demonstrate these approaches' effectiveness in select contexts. Karpicke and Blunt (2011), for example, found that retrieval practice (recalling salient information following study) produced significantly better performance on short-answer tests than elaborative concept mapping—an activity advocated by a growing number of adult educators (see Daley, 2002; Daley et al., 2010; Hay, Kinchin, Lygo-baker, 2008). A follow up experiment replicated these findings despite learners consistently predicting that concept mapping would yield better results than retrieval practice. Bucklin, Dickinson, and Brethower (2000) found that fluency training (practice for both speed and accuracy) produced significantly higher response rates, better accuracy, and less deterioration of accuracy in skilled performance than accuracy training (practice for accuracy alone). A comprehensive review of such approaches is beyond the scope of this paper, but the current examples serve to demonstrate the availability of effective alternatives to critical reflection. Allowing non-reflective learners who seek demonstrable, occupational skills the ability to choose such approaches may be the most effective way to help them attain their goals.

Recommendations for Further Study. Potential explanations and implications presented here are amenable to empirical inquiry. Six recommendations for further study

are advanced. First, if relational frame theory has pragmatic value in offering a functional explanation for reflective learners' gains following critical reflection activities, then the ensuing prediction should be confirmed: reflective learners who form more relations between novel and previously learned stimuli will perform better on tests of novel stimuli than reflective learners who form less relations. This prediction could be tested by assembling a sample of reflective learners and, prior to learning, asking them to complete detailed questionnaires assessing their reported experiences related to the select instrumental learning task. At a later date, participants would complete a course similar to that used in the current study with one alteration—*all* learners would participate in critical reflective activities. The response and error rates of reflective learners making a high number of relations (measured using their pre-study questionnaire and in-study critical reflection responses) should be superior to those of reflective learners making a low number of relations. Alternative designs may also confirm or refute this claim.

Similarly, if processing efficiency theory has pragmatic value in offering a functional explanation for non-reflective learners' poor performance following critical reflection activities, then the ensuing prediction should be confirmed: non-reflective learners participating in critical reflection activities should have higher physiological measures of anxiety behavior (e.g., heart rate, respiration rate, galvanic skin response) than reflective learners participating in critical reflection activities. This prediction could be tested by replicating the current study with one alteration—*all* learners would participate in critical reflection activities. Physiological measures of anxiety behavior during critical reflection activities can then be compared between groups. Higher

measures in the non-reflective group would support the theory's claim that anxiety behaviors prevent concomitant learning.

Researchers may also wish to examine how other learning methodologies compare with critical reflection activities. Do alternative approaches effect overall change in learner performance in instrumental learning settings? Do other approaches avoid the negative impact on non-reflective learners? To evaluate such questions, the current study could be replicated using different learning activities in place of the interference and reflection conditions. Researchers could then examine the main effects of activity on response and error rates, as well as interaction effects between activity and reflective propensity.

In light of the high variance within conditions in this study, researchers may also want to examine if increasing sample size yields different results. Although not statistically significant, aggregate error rates in the reflection and critical reflection conditions were visibly lower than those in the interference condition. Presumably, large variance, manifest in each group's relatively large standard deviation, reduced the magnitude of *F*-scores. A larger sample size will decrease variance and, therefore, provide a clearer picture of overall differences (if any) between conditions. However, this may also eliminate differences through the regression toward the mean phenomena.

A unique aspect of this study was its investigation of response rate and formal reflective activities. Earlier it was noted that its findings on response rate should be considered new additions to the literature showing no overall impact of reflective activities on instrumental learning outcomes. To collect stronger support for this claim, researchers may wish to replicate this study or design new studies investigating formal

reflective activities' impact on response rate. When doing so, researchers may also consider the visibly large, yet statistically insignificant, response rate differences between reflective and non-reflective learners in the interference condition. Why were mean response rates of reflective learners 35% lower than those of non-reflective learners in this condition? Could larger sample sizes elucidate these differences?

Last, researchers may wish to investigate how experienced learners respond to formal reflective activities in instrumental learning contexts. The current study investigated novice learners' adaptive competencies. Daley (1999) has noted that novices and experts use different learning strategies in work-related learning contexts. It remains unclear, then, how formal reflective activities impact experts' skill adaptations in instrumental learning contexts. Do non-reflective experts experience similar performance declines following critical reflection activities? Do reflective experts show similar improvements? Might some professions select for reflective learners and, thereby, eliminate practical concerns over the polarizing effects of critical reflection?

An effective means of developing a coherent literature is to replicate and extend earlier research (Dermer, 1993). This study's findings are the result of the first controlled, experimental investigation of formal reflective activities' impact on instrumental learning outcomes within the field of adult education. The recommendations presented here offer adult education researchers theoretically grounded suggestions for replicating and extending this study's findings. Central to this effort is the researcher's concern for discovering what best helps learners accomplish their chosen goals. This pragmatic view guides each recommendation.

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Appendix A: IRB Application

IRBManager Protocol Form

Instructions: Each Section must be completed unless directed otherwise. Incomplete forms will delay the IRB review process and may be returned to you. Enter your information in the **colored boxes** or place an **“X”** in front of the appropriate response(s). If the question does not apply, write **“N/A.”**

SECTION A: Title

A1. Full Study Title:

Investigating the Impact of Formal Reflective Activities on Skill Adaptation in a Work-Related Instrumental Learning Setting

SECTION B: Study Duration

B1. What is the expected start date? *Data collection, screening, recruitment, enrollment, or consenting activities may not begin until IRB approval has been granted. Format: 07/05/2011*

02/11/2013

B2. What is the expected end date? *Expected end date should take into account data analysis, queries, and paper write-up. Format: 07/05/2014*

05/24/2013

SECTION C: Summary

C1. Write a brief descriptive summary of this study in Layman Terms (non-technical language):

This study is being conducted as partial fulfillment of the requirements for the degree of Doctor of Philosophy in Urban Education by Kevin M. Roessger (Research Coordinator) under the guidance of Dr. Barbara J. Daley (Principle Investigator).

This study will examine the impact of formal reflective activities on skill adaptation in adult work-related instrumental learning settings. Reflective activities will vary across three conditions: (a) no reflection (control), (b) reflection (experimental 1), and (c) critical reflection (experimental 2). All other study phases will remain constant across conditions. There will be 14 participants in each condition. The control condition will feature no reflective activity (reading out loud), the experimental 1 condition will feature formal reflective dialogue with a reflection focus, and the experimental 2 condition will feature formal reflective dialogue with a critical reflection focus.

Each condition will feature an identical fifty-minute hands-on course (divided into two blocks) based on a behavioral skills training model (BST). The BST model consists of four phases: (a) instruction, (b) modeling, (c) practice, and (d) feedback. Instruction and modeling phases will be combined into one 25-minute block, practice and feedback phases into another. The course will focus on how to install a 90-degree herringbone patterned concrete paver walkway. The instruction and modeling phases will be pre-recorded and presented on an overhead to ensure consistent delivery across conditions. These phases together will last 25 minutes. Immediately following, participants in each condition will take part in a 20-minute reflective activity, which will vary across conditions.

At the conclusion of this reflective activity, participants will take part in the practice and feedback block of the course. This block will last 25 minutes. Participants will be asked to install a 25 square foot 90-degree herringbone patterned paver walkway, adhering to the methods discussed and demonstrated in the presentation. This will occur within a prepared area in the classroom. A trained research assistant with no knowledge of the study's purpose, hypotheses, or participants' reflective activity condition will provide verbal feedback. Participants will be instructed that their performance will not be formally assessed and that the purpose of the activity is to practice with feedback to improve performance. At the conclusion of this activity, participants will again take part in a 20-minute reflective activity, which will vary across conditions.

Following BST blocks and reflective activity intervals, participants in all conditions will complete an identical novel application task. Each will be asked to install a 20 square foot 45-degree herringbone paver walkway. The research assistant will ask each participant to complete the task in as little time as possible with as few errors as possible using the methods discussed earlier. No further guidance, instructions, or feedback will be given. At this point, the research assistant will begin timing the task. Upon completion, participants will be fully debriefed, thanked, and dismissed from the study.

Final novel application task projects will be quantitatively assessed using the following behavioral observation data: (a) time to completion, (b) number of paver joints exceeding industry standard tolerance ($> 3/16''$ or $< 1/16''$), (c) number of bond lines deviating $1/4''$ or greater from true, (c) number of pavers installed upside down, and (d) number of chipped or cracked pavers installed.

C2. Describe the purpose/objective and the significance of the research:

The purpose of this experimental study is to examine the impact of formal reflective activities on skill adaptation in adult work-related instrumental learning settings. The study's overall objective is to answer two research questions: (a) How do formal reflective activities affect the time required to complete a novel application of an instrumentally learned skill? and (b) How do formal reflective activities affect the number of errors committed during a novel application of the instrumentally learned skill?

The information gathered in this study will be particularly useful to stakeholders within the field of construction education, which is experiencing a growing advocacy for reflective activities in its learning settings. These appeals are frequently made, however, with no empirical support – a glaring omission at odds with the field's traditional focus on evidence-based learning outcomes. Learners participating in these courses are required to master specific skills and knowledge to gain access to professional communities of practice. Well-defined competencies are used to assess a learner's ability to perform these skills and to identify the procedural and technical knowledge underlying these skills. The role of reflective activities in this process remains unclear. Further, how these activities impact a learner's ability to meet these competencies is largely unknown. This study will make a significant contribution by generating empirically based evidence that can begin to address these uncertainties.

C3. Cite any relevant literature pertaining to the proposed research:

This study fulfills a growing need repeatedly cited within the literature for greater empirical support for reflective activities' impact on learning outcomes and practice. Some notable requests can be heard from researchers in the areas of physician education (Mamede, Schmidt, & Cesar Penaforte, 2008; Mamende, Schmidt, & Rikers, 2006), K-12 teacher education (Borko, Michalec, Timmons, & Siddle, 1997; Cornford, 2002), adult and post-secondary professional education (Malkki & Lindblom-Ylanne, 2012; McAlpine & Weston, 2002; Warhurst, 2008), nursing education (Burton, 2000; Carroll et al., 2002; Hannigan, 2001; Mann, Gordon, & MacLeod, 2009; Mackintosh, 1998; Ruth-Sahd, 2003), and career and technical adult education with a motor learning focus (Roessger, 2012).

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- Ruth-Sahd, L. A., (2003). Reflective practice: A Critical analysis of data-based studies and implications for nursing education. *Journal of Nursing Education*, 42, 488-497.
- Warhurst, R. (2008). Reflections on reflective learning in professional formation. *Studies in the Education of Adults*, 40(2), 176-191.

SECTION D: Subject Population

Section Notes...

- D1. If this study involves analysis of de-identified data only (i.e., no human subject interaction), IRB submission/review may not be necessary. Visit the Pre-Submission section in the [IRB website](#) for more information.

D1. Identify any population(s) that you will be specifically targeting for the study. Check **all that apply: (Place an "X" in the column next to the name of the special population.)**

	Not Applicable (e.g., de-identified datasets)	Institutionalized/ Nursing home residents recruited in the nursing home
	UWM Students of PI or study staff	Diagnosable Psychological Disorder/Psychiatrically impaired
X	Non-UWM students to be recruited in their educational setting, i.e. in class or at school	Decisionally/Cognitively Impaired

	UWM Staff or Faculty		Economically/Educationally Disadvantaged
	Pregnant Women/Neonates		Prisoners
	Minors under 18 and ARE NOT wards of the State		Non-English Speaking
	Minors under 18 and ARE wards of the State		Terminally ill
	Other (Please identify):		

D2. Describe the subject group and enter the total number to be enrolled for each group. For example: teachers-50, students-200, parents-25, parent's children-25, student control-30, student experimental-30, medical charts-500, dataset of 1500, etc. Enter the total number of subjects below.

Describe subject group:	Number:
Current MATC adult students (24 and older)	42
TOTAL # OF SUBJECTS:	42
TOTAL # OF SUBJECTS (If UWM is a collaborating site):	

D3. List any major inclusion and exclusion criteria (e.g., age, gender, health status/condition, ethnicity, location, English speaking, etc.) and state the justification for the inclusion and exclusion:

Selection criteria are (a) participants must be age 24 or older, (b) participants must hold a valid student ID from the technical college, and (c) participants must have no prior experience installing concrete or clay pavers. Those failing to meet these criteria will not be included in the study.

Participants must be 24 or older to align with this study’s focus on adult learners, which is defined as those 24 and older (Kazis et al., 2007). Participants must be enrolled at MATC to align with this study’s focus on career and technical education settings. Participants must have no prior experience installing pavers to prevent confounding.

Kazis, R., Callahan, A., Davidson, C., McLeod, A., Bosworth, B., Choltz, V., & Hoops, J. (2007). *Adult learners in higher education: Barriers to success and strategies to improve results*. (Employment and Training Administration Occasional Paper 2007-03). Washington, DC: Department of Labor. (ERIC Document Reproduction Service No. ED497801)

SECTION E: Informed Consent
Section Notes... <ul style="list-style-type: none">E1. Make sure to attach any recruitment materials for IRB approval.E3. The privacy of the participants must be maintained throughout the consent process.

E1. Describe how the subjects will be recruited. (E.g., through flyers, beginning announcement for X class, referrals, random telephone sampling, etc.). If this study involves secondary analysis of data/charts/specimens only, provide information on the source of the data, whether the data is publicly available and whether the data contains direct or indirect identifiers.

Participants will be recruited using flyers placed at all four Milwaukee Area Technical College campuses: (a) downtown Milwaukee, (b) Mequon, (c) Oak Creek, and (d) West Allis.

Announcements will also be made in select trades courses, upon instructor approval.

E2. Describe the forms that will be used for each subject group (e.g., short version, combined parent/child consent form, child assent form, verbal script, information sheet): If data from failed eligibility screenings will be used as part of your “research data”, then these individuals are considered research subjects and consent will need to be obtained. Copies of all forms should be attached for approval. If requesting to waive documentation (not collecting subject’s signature) or to waive consent all together, state so and complete the “Waiver to Obtain-Document-Alter Consent” and attach:

Because all participants are 24 and older, one typed informed consent form will be used. The form is attached.

E3. Describe who will obtain consent and where and when consent will be obtained. When appropriate (for higher risk and complex study activities), a process should be mentioned to assure that participants understand the information. For example, in addition to the signed consent form, describing the study procedures verbally or visually:

Consent will be obtained by the research coordinator at a reserved classroom at the downtown Milwaukee Area Technical College campus on the day of the study. Prior to beginning, participants will be asked to sign an informed consent form, which includes the following information: (a) the study's title, (b) the PI's information, (c) the study's description and purpose with incomplete disclosure, (d) the study's procedures, (e) the study's risks and benefits, (f) and the study's compensation and confidentiality. The research coordinator will read through and discuss all elements of the form with the participant. He will also describe the study's procedure using a graphic representation.

SECTION F: Data Collection and Design

Section Notes...

- F1. Reminder, all data collection instruments should be attached for IRB review.
- F1. The IRB welcomes the use of flowcharts and tables in the consent form for complex/ multiple study activities.

F1. In the table below, chronologically describe all study activities where human subjects are involved.

- In **column A**, give the activity a short name. E.g., Obtaining Dataset, Records Review, Recruiting, Consenting, Screening, Interview, Online Survey, Lab Visit 1, 4 Week Follow-Up, Debriefing, etc.
- In **column B**, describe in greater detail the activities (surveys, audiotaped interviews, tasks, etc.) research participants will be engaged in. Address where, how long, and when each activity takes place.
- In **column C**, describe any possible risks (e.g., physical, psychological, social, economic, legal, etc.) the subject may *reasonably* encounter. Describe the **safeguards** that will be put into place to minimize possible risks (e.g., interviews are in a private location, data is anonymous, assigning pseudonyms, where data is stored, coded data, etc.) and what happens if the participant gets hurt or upset (e.g., referred to Norris Health Center, PI will stop the interview and assess, given referral, etc.).

A. Activity Name:	B. Activity Description:	C. Activity Risks and Safeguards:
Recruiting	Participants will be recruited using flyers and course announcements at MATC campuses. Participants can inquire via phone or email.	There are no perceived risks associated with this activity.
Screening	Selection criteria are: (a) participants must be age 24 or older, (b) participants must hold a valid student ID from the technical college, and (c) participants must have no prior experience installing concrete or clay pavers. Those failing to meet these criteria will not be included in the study.	This activity may pose privacy risks. To safeguard against such risks, screening interviews will be conducted over the phone and a participant's information will be assigned a numerical identifier; names or student identification numbers will not be recorded.

Consenting	<p>The study will be described in its entirety to participants. Participants will be told that the purpose of the study is to investigate the impact of instructional techniques on learning how to install concrete pavers, not that it is to investigate the impact of reflective activities on skill adaptation. This incomplete disclosure poses no additional risk to participants and was decided on to limit or reduce threats to internal validity, e.g., demand characteristics, compensatory rivalry, and resentful demoralization.</p> <p>Participants will be asked to sign an informed consent form, which includes the following information: (a) the study's title, (b) the PI's information, (c) the study's description and purpose with incomplete disclosure, (d) the study's procedures, (e) the study's risks and benefits, (f) and the study's compensation and confidentiality.</p>	There are no perceived risks associated with this activity.
Assessing	To assess reflective propensity in order to equate conditions, participants will complete the Kolb Learning Styles Inventory version three (KLSI 3.0). The KLSI 3.0 evaluates a learner's propensity toward one of four learning styles: (a) diverging (introverted/feeling), (b) assimilating (introverted/intuition), (c) converging (extraverted/thinking), and (d) accommodating (extraverted/sensation). Divergent and assimilative learners are thought to use reflection more often in learning than accommodative and convergent learners.	This activity may pose privacy risks. To safeguard against such risks, KLSI 3.0 assessments will be conducted in a private room and participants' scores will be attached only to their numerical identifier.
Matched Random Assignment	Participants will be identified according to three blocking variables: (a) gender, (b) age, and (b) reflective propensity. They will then be matched with others along these variables and randomly assigned to one of three conditions.	There are no perceived risks associated with this activity.
Instruction / Modeling	Participants will watch a 25 minute video describing and demonstrating how to install a 90-degree herringbone patterned concrete paver walkway.	There are no perceived risks associated with this activity.

Reflective Activity 1	<p>Participants will take part in one of three reflective activities, depending on condition.</p> <p>The non-reflective activity will feature a reading aloud procedure, which is thought to load abstract working memory and prevent the acquisition of further explicit knowledge. At the start of each reflective activity interval, participants will be asked to read aloud for 15 minutes from a writing composition handbook. The researcher assistant will take notes inconsequential to data analysis. The research assistant will state “continue” if participants pause from reading aloud for longer than 2 seconds.</p> <p>Those in the experimental 1 condition will engage in reflective dialogue (with a reflection focus) with the primary researcher. A series of 12 questions will be asked that focus on course content and the process of problem-solving.</p> <p>Those in the experimental 2 condition will engage in reflective dialogue (with a critical reflection focus) with the primary researcher. A series of 12 questions will be asked that focus on identifying and/or challenging hidden assumptions inherent in the course content.</p>	<p>Audio recording of this activity may pose privacy risks. To safeguard against such risks, only participants’ numerical identifiers will be stated during recording. Participants will be told that this activity is being recorded.</p> <p>This activity may pose psychological risks to the participant. When engaged in critical reflection, participants may uncover assumptions underlying their understanding of course content that occasion psychological stress. To safeguard against such risks, the researcher will stop the activity if he notices the participant exhibiting psychological stress beyond what would be reasonably expected in a higher education course. In such instances, participants will be instructed to visit the Counseling Office in Room S209 at the Downtown Milwaukee Campus.</p>
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Practice / Feedback	<p>Participants will be asked to install a 25 square foot 90-degree herringbone patterned paver walkway, adhering to the methods discussed and demonstrated in the presentation. This will occur within a prepared area in the classroom. A trained research assistant will provide verbal feedback and model techniques if needed.</p>	<p>This activity may pose physical risks to the participant. Participants will be required to bend repeatedly at the waist and knees. Participants will also be required to lift up to 12.4 pounds repeatedly. Such risks, however, are no greater than those experienced in other MATC hands-on courses (e.g., bricklaying and masonry, preparatory plumbing, carpentry, medical assistance, and nursing).</p> <p>To safeguard against physical risks, the physical requirements of the study will be accurately described in recruitment materials and in the informed consent procedure. Instruction phases of the study will provide directions on safe material handling and correct installation postures. Participants will be provided with gloves and eye protection. The research assistant will immediately stop the activity if participants attempt to lift more than 2 pavers (12.4 pounds) in a single instance.</p> <p>In the unlikely event that a participant injures him/herself, the MATC public safety office will be contacted in room M274. MATC public safety officers are trained as medical emergency first responders. If more advanced care is needed, the dispatcher will contact 911.</p>
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<p>Reflective Activity 2</p>	<p>Participants will take part in one of three reflective activities, depending on condition.</p> <p>The non-reflective activity will feature a reading aloud procedure, which is thought to load abstract working memory and prevent the acquisition of further explicit knowledge. At the start of each reflective activity interval, participants will be asked to read aloud for 15 minutes from a writing composition handbook. The researcher assistant will take notes inconsequential to data analysis. The research assistant will state “continue” if participants pause from reading aloud for longer than 2 seconds.</p> <p>Those in the experimental 1 condition will engage in reflective dialogue (with a reflection focus) with the primary researcher. A series of 12 questions will be asked that focus on course content and the process of problem-solving.</p> <p>Those in the experimental 2 condition will engage in reflective dialogue (with a critical reflection focus) with the primary researcher. A series of 12 questions will be asked that focus on identifying and/or challenging hidden assumptions inherent in the course content.</p>	<p>Audio recording of this activity may pose privacy risks. To safeguard against such risks, only participants’ numerical identifiers will be stated during recording. Participants will be told that this activity is being recorded.</p> <p>This activity may pose psychological risks to the participant. When engaged in critical reflection, participants may uncover assumptions underlying their understanding of course content that occasion psychological stress. To safeguard against such risks, the researcher will stop the activity if he notices the participant exhibiting psychological stress beyond what would be reasonably expected in a higher education course. In such instances, participants will be instructed to visit the Counseling Office in Room S209 at the Downtown Milwaukee Campus.</p>
<p>Novel Application Task</p>	<p>Participants will be asked to install a 20 square foot 45-degree herringbone paver walkway. A photograph model will be provided. No further guidance, instructions, or feedback will be given. This task will take place in a second prepared area within the classroom.</p>	<p>This activity may pose physical risks to the participant. Participants will be required to bend repeatedly at the waist and knees. Participants will also be required to lift up to 12.4 pounds repeatedly. Such risks, however, are no greater than those experienced in other MATC hands-on courses (e.g., bricklaying and masonry, preparatory plumbing, carpentry, medical assistance, and nursing).</p> <p>To safeguard against physical risks, the physical requirements of the study will be accurately described in recruitment materials and in the informed consent procedure. Instruction phases of the study will provide directions on safe material handling and correct installation postures. Participants will be</p>

		<p>provided with gloves and eye protection. The research assistant will immediately stop the activity if participants attempt to lift more than 2 pavers (12.4 pounds) in a single instance.</p> <p>In the unlikely event that a participant injures him/herself, the MATC public safety office will be contacted in room M274. MATC public safety officers are trained as medical emergency first responders. If more advanced care is needed, the dispatcher will contact 911.</p>
Debriefing	After completion of the novel application task, participants will be fully debriefed, thanked, paid \$40 for study participation, and dismissed from the study.	<p>This activity may pose privacy risks. In keeping with level 3 payment confidentiality requirements, participants' names will be recorded and linked to their numerical identifier. To safeguard against such risks, participants' names will be kept separate from behavioral observation data and assessment data. Payment receipts with name and numerical identifiers will be kept in a locked file cabinet in the research coordinator's office. All salient study data will be linked only with a participant's numerical identifier and kept in a separate location.</p>

F2. Explain how the privacy and confidentiality of the participants' data will be maintained after study closure:

No personally identifiable information will be recorded that links behavioral observation data and assessment to the participant. Participants will be assigned a numeric identifier that will accompany all behavioral observation and assessment data.

Participants names will, however, be recorded and linked only to their numerical identifier (apart from all other data) in order to adhere to level 3 payment confidentiality requirements. These records will be kept separately in a locked file cabinet in the research coordinator's office.

F3. Explain how the data will be analyzed or studied (i.e. quantitatively or qualitatively) and how the data will be reported (i.e. aggregated, anonymously, pseudonyms for participants, etc.):

Final novel application task projects will be quantitatively assessed using the following behavioral observation data: (a) time to completion, (b) number of paver joints exceeding industry standard tolerance ($> 3/16''$ or $< 1/16''$), (c) number of bond lines deviating $1/4''$ or greater from true, (c) number of pavers installed upside down, and (d) number of chipped or cracked pavers installed. Time to completion will be recorded using a standard stopwatch 0.001inch. Number of bond lines deviating $1/4''$ or greater from true will be recorded using a mason's string line and standard tape measure. The number of pavers installed upside down, as well as the number of chipped or cracked pavers, will be recorded by visual inspection. All data will be entered immediately in an electronic spreadsheet at the study's location. No personally identifiable information will be recorded.

Data will be reported in aggregate form using inferential statistics to determine differences between conditions. No personally identifiable information will be reported.

SECTION G: Benefits and Risk/Benefit Analysis

Section Notes...

- Do not include Incentives/ Compensations in this section.

G1. Describe any benefits to the individual participants. If there are no anticipated benefits to the subject directly, state so. Describe potential benefits to society (i.e., further knowledge to the area of study) or a specific group of individuals (i.e., teachers, foster children). Describe the ratio of risks to benefits.

Study participants will benefit by learning how to install concrete pavers.

The information gathered in this study will also be particularly beneficial to stakeholders in the field of construction education, which is experiencing a growing advocacy for reflective activities in its learning settings. Educators, instructional designers, and program planners will be able to making better informed decisions regarding the use of these activities in learning settings. A greater understanding may also help decision-makers identify the immediate and long-term benefits of using reflective activities in their courses. In turn, this may lead to more effective courses and workshops for adult learners seeking specific, demonstrable occupational skills.

A greater understanding of this issue may be most beneficial to the learners themselves. Although learners are not this study's primary audience, the inclusion of effective learning activities, or the removal of ineffective ones, will yield courses that better serve those seeking specific, demonstrable occupational skills. This is particularly critical when learners' abilities to perform such skills have considerable consequences for themselves, their organizations, and their clients and/or customers. Nowhere is this more apparent than in occupations that rely heavily on both the systematic and adaptable performance of complex occupational tasks (e.g., plumbers, surgeons, bricklayers, computer programmers, or airline pilots). In addition, findings may be useful to adults seeking to gain work-related skills and knowledge through informal educational avenues.

Such benefits have the potential to positively affect a large number of adult learners and their clients by precipitating changes in pedagogical approaches to adult work-related learning, which result in more effective work practices. The minimal risks outlined in section F1 are outweighed by these potential benefits.

G2. Risks to research participants should be justified by the anticipated benefits to the participants or society. Provide your assessment of how the anticipated risks to participants and steps taken to minimize these risks, balance against anticipated benefits to the individual or to society.

The minimal physical risks outlined in section F1 are no more than would be encountered by any individual attempting a do-it-yourself home project using concrete pavers. Concrete pavers are sold regularly for such projects at home improvement stores (e.g., Lowes and Home Depot). In fact, the minimal physical risks outlined here would be less than those experienced in such a project because of the presence of an expert to ensure safe material handling and proper installation techniques. Also the scope of the study's project is small compared to most home projects. Moreover, home projects would almost certainly involve the use of a concrete saw, which has been omitted from this study. The safeguards discussed above provide immediate medical assistance should an unlikely injury occur.

The potential psychological risks of critical reflection involve no more risk than that experienced in any adult learning course utilizing critical reflection dialogue as a pedagogical strategy. The safeguards discussed above provide immediate assistance to any participant who may experience psychological stress.

Potential privacy risks have been minimized by conducting all sensitive discussions and assessments by phone or in a private room. In addition, all study data will be attached only to a participant's numerical identifier, not his or her name. No private information will be recorded or reported.

These minimal risks are largely outweighed by this study's potential benefits for all stakeholders of adult work-related education. Effective classroom practices depend on strong educational research. Currently, there is very little known about how reflective activities impact adult skill-based learning. Stakeholders, then, are often unsure of this activity's benefit to learners, and, as a result, it is frequently not utilized in skill-based courses. Some educators, however, have endorsed it as an effective practice in such courses with little to no empirical support. The findings of this study would greatly benefit all involved.

SECTION H: Subject Incentives/ Compensations

Section Notes...

- H2 & H3. The IRB recognizes the potential for undue influence and coercion when extra credit is offered. The UWM IRB, as also recommended by OHRP and APA Code of Ethics, agrees when extra credit is offered or required, prospective subjects should be given the choice of an equitable alternative. In instances where the researcher does not know whether extra credit will be accepted and its worth, such information should be conveyed to the subject in the recruitment materials and the consent form. For example, "The awarding of extra credit and its amount is dependent upon your instructor. Please contact your instructor before participating if you have any questions. If extra credit is awarded and you choose to not participate, the instructor will offer an equitable alternative."
- H4. If you intend to submit to the Travel Management Office for reimbursement purposes make sure you understand what each level of payment confidentiality means ([click here for additional information](#)).

H1. Does this study involve incentives or compensation to the subjects? For example cash, class extra credit, gift cards, or items.

☒ Yes

☐ No [SKIP THIS SECTION]

H2. Explain what (a) the item is, (b) the amount or approximate value of the item, and (c) when it will be given. For extra credit, state the number of credit hours and/or points. (e.g., \$5 after completing each survey, subject will receive [item] even if they do not complete the procedure, extra credit will be award at the end of the semester):

Participants will be given a \$40 Visa gift card after completing the 2.5 hour study. Participants must complete the study in its entirety to receive this incentive.

H3. If extra credit is offered as compensation/incentive, an alternative activity (which can be another research study or class assignment) should be offered. The alternative activity (either class assignment or another research study) should be similar in the amount of time involved to complete and worth the same extra credit.

NA

H4. If cash or gift cards, select the appropriate confidentiality level for payments (see section notes):

- ☐ **Level 1** indicates that confidentiality of the subjects is not a serious issue, e.g., providing a social security number or other identifying information for payment would not pose a serious risk to subjects.
- Choosing a Level 1 requires the researcher to maintain a record of the following: The payee's name, address, and social security number and the amount paid.
 - When Level 1 is selected, a formal notice is not issued by the IRB and the Travel Management Office assumes Level 1.
 - Level 1 payment information will be retained in the extramural account folder at UWM/Research Services and attached to the voucher in Accounts Payable. These are public documents, potentially open to public review.
- ☐ **Level 2** indicates that confidentiality is an issue, but is not paramount to the study, e.g., the participant will be involved in a study researching sensitive, yet not illegal issues.
- Choosing a Level 2 requires the researcher to maintain a record of the following: A list of names, social security numbers, home addresses and amounts paid

- When Level 2 is selected, a formal notice will be issued by the IRB.
- Level 2 payment information, including the names, are attached to the PIR and become part of the voucher in Accounts Payable. The records retained by Accounts Payable are not considered public record.

[x] Level 3 indicates that confidentiality of the subjects must be guaranteed. In this category, identifying information such as a social security number would put a subject at increased risk.

- Choosing a Level 3 requires the researcher to maintain a record of the following: research subject's name and corresponding coded identification. This will be the only record of payee names, and it will stay in the control of the PI.
- Payments are made to the research subjects by either personal check or cash.
- Gift cards are considered cash.
- If a cash payment is made, the PI must obtain signed receipts.

SECTION I: Deception/ Incomplete Disclosure (INSERT “NA” IF NOT APPLICABLE)

Section Notes...

- If you cannot adequately state the true purpose of the study to the subject in the informed consent, deception/ incomplete disclosure is involved.

I1. Describe (a) what information will be withheld from the subject (b) why such deception/ incomplete disclosure is necessary, and (c) when the subjects will be debriefed about the deception/ incomplete disclosure.

Participants will be told that the purpose of the study is “to investigate the impact of instructional techniques on learning how to install concrete pavers,” not that it is to investigate the impact of reflective activities on skill adaptation. This incomplete disclosure poses no additional risk to participants and was decided on to limit or reduce threats to internal validity, e.g., demand characteristics (a participant’s interpretation of the study’s purpose and alteration of their behavior to align with that interpretation), compensatory rivalry (positive change in the control group’s behavior due to their knowledge of being in the control group), and resentful demoralization (negative change in the control group’s behavior due to their knowledge of being in the control group).

Participants will be fully debriefed immediately following study completion.

IMPORTANT – Make sure all sections are complete and attach this document to your IRBManager web submission in the Attachment Page (Y1).

UNIVERSITY OF WISCONSIN – MILWAUKEE CONSENT TO PARTICIPATE IN RESEARCH

THIS CONSENT FORM HAS BEEN APPROVED BY THE IRB FOR A ONE YEAR PERIOD

1. General Information

Study title:

- Investigating the impact of instructional techniques on learning how to install concrete pavers.

Person in Charge of Study (Principal Investigator):

- Barbara J. Daley, PhD
- Professor, Administrative Leadership

2. Study Description

You are being asked to participate in a research study. Your participation is completely voluntary. You do not have to participate if you do not want to.

Study description:

The purpose of this study is to

- Investigate the impact of instructional techniques on your ability to install concrete pavers.
- This study is being conducted to help educators, instructional designers, and administrators design more effective career and technical education courses.
- The goals of this study are to identify how certain instructional techniques impact how efficiently and effectively you complete a concrete paver project.
- The study will be conducted in a classroom at Milwaukee Area Technical College's Downtown Milwaukee campus.
- There will be 42 participants in this study.
- You will need to commit approximately 2.5 hours on one day to complete this study. The actual length of the study may be slightly more or less than 2.5 hours.

3. Study Procedures

What will I be asked to do if I participate in the study?

If you agree to participate you will be asked to

- Arrive at the designated classroom on the designated time assigned to you during your initial phone screening. If you are more than 10 minutes late, you may be asked to reschedule your session.
- When you arrive you will be asked to complete six tasks:
 1. You will take a paper and pencil test that identifies your learning style (approximately 15 minutes).
 2. You will watch a video on how to install a concrete paver walkway (approximately 25 minutes).
 3. You will participate in an instructional activity that requires you to engage in dialogue with the researcher (approximately 15 minutes).
 4. You will construct a 25 square foot walkway in a classroom using concrete pavers, sand, and the tools and techniques featured in the video (approximately 25 minutes).
 5. You will again participate in an instructional activity that requires you to engage in dialogue with the researcher (approximately 15 minutes).
 6. You will construct a 20 square foot walkway in a classroom using concrete pavers, sand, and the tools and techniques featured in the video (approximately 25 minutes).
- You will NOT be audio or video recorded at any point in this study.

4. Risks and Minimizing Risks

What risks will I face by participating in this study?

- Privacy Risks (unlikely to occur):
 1. During the initial screening phase you may divulge information you may not want others to hear. To safeguard against this risk, screening interviews will be conducted over the phone and your information will be assigned a numerical identifier; your name or student identification number will not be recorded.
 2. After taking the written assessment, you may not want others to see your results. To safeguard against this risk, the assessments will be conducted in a private room and your score will be attached only to your numerical identifier, not your name.
 3. When receiving your \$40 gift card at the completion of the study you will be asked to sign a receipt of payment, which will include your name. This receipt of payment will be attached to your numeric identifier. To safeguard against privacy risk, your name will be kept separate from all study data. Payment receipts with name and numerical identifiers will be kept in a locked file cabinet in the research coordinator's office. All study data will be linked only with a participant's numerical identifier and kept in a separate location.
- Psychological Risks (unlikely to occur):
 1. When participating in the instructional activity, you may be asked to discuss your views, society's views, and your community's views regarding paver installation and the construction trades. In the process you may experience psychological stress. To safeguard against this risk, the researcher will stop the activity if he notices you

exhibiting psychological stress beyond what would be reasonably expected in a course where similar topics were discussed.

- **Physical Risks (unlikely to occur):**
 1. This activity may pose physical risks. You will be required to bend repeatedly at the waist and knees. You will also be required to lift up to 12.4 pounds repeatedly. You will be asked to perform such tasks during two 25-minute segments (a total of 50 minutes). If you think you cannot perform such tasks safely, you should not participate in this study. Such risks are no greater than those experienced in other MATC hands-on courses (e.g., bricklaying and masonry, preparatory plumbing, carpentry, medical assistance, and nursing). To safeguard against such risks, you will be provided with directions on safe material handling and correct installation postures. You will also be provided with gloves and eye protection. The research assistant will immediately stop the activity if you attempt to lift more than 2 pavers (12.4 pounds) in a single instance.

5. Benefits

Will I receive any benefit from my participation in this study?

- You may benefit by learning how to install concrete pavers.

6. Study Costs and Compensation

Will I be charged anything for participating in this study?

- You will not be responsible for any of the costs associated with taking part in this research study.

Are subjects paid or given anything for being in the study?

- You will receive a \$40 Visa gift card for completing all elements of this study in their entirety at the conclusion of the study.

7. Confidentiality

What happens to the information collected?

All information collected about you during the course of this study will be kept confidential to the extent permitted by law. We may decide to present what we find to others, or publish our results in scientific journals or at scientific conferences. Information that identifies you personally will not be released without your written permission. Only the PI and study coordinator, Kevin Roessger, will have access to the information. However, the Institutional Review Board at UW-Milwaukee or appropriate federal agencies like the Office for Human Research Protections may review this study's records.

- You study data will be recorded using a numerical identifier assigned to you at the beginning of the study. Your name will not be attached to study data. This data will be kept on a password protected computer. When the study is complete, this data will be stored on a password protected computer for 5 years for future use.
- Your study payment receipt with your name and numerical identifier will be kept separately from your study data in a locked file cabinet in the study coordinator's office. When the study is complete, this information will be scanned onto a PDF file and stored on a password protected computer for 2 years.

8. Alternatives

Are there alternatives to participating in the study?

- There are no known alternatives available to you other than not taking part in this study.

9. Voluntary Participation and Withdrawal

What happens if I decide not to be in this study?

Your participation in this study is entirely voluntary. You may choose not to take part in this study. If you decide to take part, you can change your mind later and withdraw from the study. You are free to not answer any questions or withdraw at any time. Your decision will not change any present or future relationships with the University of Wisconsin Milwaukee.

- If you withdraw from the study before completion, we will destroy all information we collect about you.
- Your refusal to take part in the study will not affect your grade for any class or your class standing.
- You will not receive study reimbursement if you withdraw from the study prior to completion.

10. Questions

Who do I contact for questions about this study?

For more information about the study or the study procedures or treatments, or to withdraw from the study, contact:

Barbara J. Daley, PhD. (Principle Investigator)

University of Wisconsin-Milwaukee, Department of
Administrative Leadership
PO Box 413
Milwaukee, WI 53201
(414) 229-4311

Kevin M. Roessger, M.S. (Research Coordinator)
University of Wisconsin-Milwaukee
Panther Academic Support Services
PO Box 413
Milwaukee, WI 53201
(414) 229-3726

Who do I contact for questions about my rights or complaints towards my treatment as a research subject?

The Institutional Review Board may ask your name, but all complaints are kept in confidence.

Institutional Review Board
Human Research Protection Program
Department of University Safety and Assurances
University of Wisconsin – Milwaukee
P.O. Box 413
Milwaukee, WI 53201
(414) 229-3173

11. Signatures

Research Subject's Consent to Participate in Research:

To voluntarily agree to take part in this study, you must sign on the line below. If you choose to take part in this study, you may withdraw at any time. You are not giving up any of your legal rights by signing this form. Your signature below indicates that you have read or had read to you this entire consent form, including the risks and benefits, and have had all of your questions answered, and that you are 18 years of age or older.

Printed Name of Subject/ Legally Authorized Representative

Signature of Subject/Legally Authorized Representative

Date

Principal Investigator (or Designee)

I have given this research subject information on the study that is accurate and sufficient for the subject to fully understand the nature, risks and benefits of the study.

Printed Name of Person Obtaining Consent

Study Role

Signature of Person Obtaining Consent

Date

Adult Research Volunteers Needed

We are looking for current MATC students who are 24 or older with no prior experience working with concrete block, clay pavers, concrete pavers, or tile and stone to participate in a study examining the impact of instructional techniques on learning how to install concrete pavers.

Participants must be able to repeatedly bend at the waste and knees for up to two 25-minute intervals and lift up to 13 pounds.

Participants will be paid \$40 for completion of one 2.5-hour study visit.

WHAT: Participate in a 2.5 hour hands-on course on segmental paver installation.

WHERE: Milwaukee Area Technical College –
Downtown

CONTACT: Kevin Roessger, Research Study Coordinator
(414) 759-1224 or roessge2@uwm.edu

Barbara J. Daley, PhD. – Principle Investigator
University of Wisconsin-Milwaukee
Department of Administrative Leadership
Protocol No.



Department of University Safety & Assurances

Melissa Spadanuda
 IRB Manager
 Institutional Review Board
 Engelmann 270
 P. O. Box 413
 Milwaukee, WI 53201-0413
 (414) 229-3173 phone
 (414) 229-6729 fax

<http://www.urb.uwm.edu>
spadanud@uwm.edu

New Study - Notice of IRB Expedited Approval

Date: January 24, 2013

To: Barbara Daley, PhD

Dept: Administrative Leadership

Cc: Kevin Roessger

IRB#: 13.240

Title: Investigating the Impact of Formal Reflective Activities on Skill Adaptation in a Work-Related Instrumental Learning Setting

After review of your research protocol by the University of Wisconsin – Milwaukee Institutional Review Board, your protocol has been approved as minimal risk Expedited under **Category 6 and 7** as governed by 45 CFR 46.110.

This protocol has been approved on **January 24, 2013** for one year. IRB approval will expire on **January 23, 2014**. If you plan to continue any research related activities (e.g., enrollment of subjects, study interventions, data analysis, etc.) past the date of IRB expiration, a continuation for IRB approval must be filed by the submission deadline. If the study is closed or completed before the IRB expiration date, please notify the IRB by completing and submitting the Continuing Review form found on the IRB website.

Unless specifically where the change is necessary to eliminate apparent immediate hazards to the subjects, any proposed changes to the protocol must be reviewed by the IRB before implementation. It is the principal investigator's responsibility to adhere to the policies and guidelines set forth by the UWM IRB and maintain proper documentation of its records and promptly report to the IRB any adverse events which require reporting.

It is the principal investigator's responsibility to adhere to UWM and UW System Policies, and any applicable state and federal laws governing activities the principal investigator may seek to employ (e.g., [FERPA](#), [Radiation Safety](#), [UWM Data Security](#), [UW System policy on Prizes, Awards and Gifts](#), state gambling laws, etc.) which are independent of IRB review/approval.

Contact the IRB office if you have any further questions. Thank you for your cooperation and best wishes for a successful project

Respectfully,

Melissa C. Spadanuda

Melissa C. Spadanuda
 IRB Manager

Milwaukee Area Technical College
REQUEST FOR INSTITUTIONAL REVIEW BOARD ACTION
Shaded areas of this form are for IRB use only

1. PROJECT INFORMATION:

Investigator name: Kevin Roessger Date: 1/16/13

Email: roessge2@uwm.edu Phone Number: (414) 759-1224

Project Title: Investigating the Impact of Formal Reflective Activities on Skill Adaptation in a Work-Related Instrumental Learning Setting

Action Requested: Initial Review ☒ Closure ☐

2. PROJECT SUPPORT:

a) Project Funding: Not Funded/self-supported ☒ Grant proposal ☐

External Funding (indicate source): _____

b) Are other institutions involved with this project: No ☐ Yes ☒ (list names below)

University of Wisconsin-Milwaukee

c) If you answered Yes to (b), check one:

- IRB approved at other institutions (attach approval) ☐

- Approval pending, contingent on MATC approval ☒

- Cooperating institution does not require human subjects approval ☐

3. RESEACHER STATUS: (check one)

MATC Faculty ☐ MATC Student ☐ MATC Staff ☐ Other ☒ UWM PhD Student

4. SUPERVISING FACULTY APPROVAL:

My signature verifies that 1) I will supervise this research project, 2) if appropriate, it has been approved by our IRB, and 3) that it meets current standard of the disciplines

Signature _____ Date 1/16/13

Printed Name Barbara J. Daley, PhD College/University University of Wisconsin-Milwaukee

5. MATC SUPERVISOR APPROVAL (if applicable):

I have reviewed the proposal and determined that its use of Milwaukee Area Technical College resources is reasonable and that it does not conflict with any existing labor agreement.

Signature _____ Date _____

Printed Name _____ Division/Department _____

--

Signature of IRB Chair _____ Date _____
Printed Name _____

**Milwaukee Area Technical College
Institutional Review Board**

Human Subjects Review Protocol

(Please type out or word process this form.)

Please answer all of the following questions (attached additional pages as needed).

1. PURPOSE AND OBJECTIVES OF THE RESEARCH

This study is being proposed by Kevin Roessger under the guidance of Dr. Barbara Daley in partial fulfillment of the requirements of Doctor of Philosophy in Urban Education at the University of Wisconsin-Milwaukee.

The purpose of this experimental study is to examine the impact of formal reflective activities on skill adaptation in adult work-related instrumental learning settings. The study's overall objective is to answer two research questions: (a) How do formal reflective activities affect the time required to complete a novel application of an instrumentally learned skill? and (b) How do formal reflective activities affect the number of errors committed during a novel application of the instrumentally learned skill?

The information gathered in this study will be particularly useful to stakeholders within the field of construction education, which is experiencing a growing advocacy for reflective activities in its learning settings. These appeals are frequently made, however, with no empirical support, a glaring omission at odds with the field's traditional focus on evidence-based learning outcomes. Learners participating in these courses are required to master specific skills and knowledge to gain access to professional communities of practice. Well-defined competencies are used to assess a learner's ability to perform these skills and to identify the procedural and technical knowledge underlying these skills. The role of reflective activities in this process remains unclear. Further, how these activities impact a learner's ability to meet these competencies is largely unknown. This study will make a significant contribution by generating empirically based evidence that can begin to address these uncertainties.

2. DESCRIPTION OF PARTICIPANT POPULATION(S)

a) Who are the subject groups and how are they being recruited?

Participants are current MATC students age 24 or older with a high school diploma or GED equivalent and no prior experience installing concrete or clay pavers.

Participants will be recruited using flyers placed at all four Milwaukee Area Technical College campuses: (a) downtown Milwaukee, (b) Mequon, (c) Oak Creek, and (d) West Allis.

Announcements will also be made in select trades courses, upon instructor approval.

b) Approximate number of participants in each group to be used: 14

c) If advertising for participants, include a copy of the proposed advertisement.

Recruitment flyer is attached.

d) What are the criteria for selection and/or exclusion of participants?

Selection criteria are: (a) participants must be age 24 or older, (b) participants must hold a valid student ID from the technical college, (c) participants must hold a high school diploma or GED equivalent, and (d) participants must have no prior experience installing concrete or clay pavers. Those failing to meet these criteria will not be included in the study.

Participants must be 24 or older to align with this study's focus on adult learners, which is defined as those 24 and older (Kazis et al., 2007). Participants must be enrolled at MATC to align with this study's focus on career and technical education settings. Participants must have a high school degree or GED equivalent to ensure similar learning aptitudes. Participants must have no prior experience installing pavers to ensure experience levels are equivalent across groups.

Kazis, R., Callahan, A., Davidson, C., McLeod, A., Bosworth, B., Choltz, V., & Hoops, J. (2007). *Adult learners in higher education: Barriers to success and strategies to improve results*. (Employment and Training Administration Occasional Paper 2007-03). Washington, DC: Department of Labor. (ERIC Document Reproduction Service No. ED497801)

3. ACTIVITIES INVOLVING HUMAN SUBJECTS

a) Describe the activities involving each participant group. Include the expected amount of time participants will be involved in each activity and where the activities will be conducted.

This study will examine the impact of formal reflective activities on skill adaptation in adult work-related instrumental learning settings. Participants will be told that the purpose of the study is “to investigate the impact of instructional techniques on learning how to install concrete pavers,” not that it is to investigate the impact of reflective activities on skill adaptation. This incomplete disclosure poses no additional risk to participants and was decided on to limit or reduce threats to internal validity, e.g., demand characteristics (a participant’s interpretation of the study’s purpose and alteration of their behavior to align with that interpretation), compensatory rivalry (positive change in the control group’s behavior due to their knowledge of being in the control group), and resentful demoralization (negative change in the control group’s behavior due to their knowledge of being in the control group). Participants will be fully debriefed immediately following study completion.

Reflective activities will vary across three conditions: (a) no reflection (reading aloud), (b) reflection (experimental 1), and (c) critical reflection (experimental 2). All other study phases will remain constant across conditions. There will be 14 participants in each condition. The control condition will feature no reflective activity (random letter generation), the experimental 1 condition will feature formal reflective dialogue with a reflection focus, and the experimental 2 condition will feature formal reflective dialogue with a critical reflection focus.

Each condition will feature an identical fifty-minute hands-on course (divided into two blocks) based on a behavioral skills training model (BST). The BST model consists of four phases: (a) instruction, (b) modeling, (c) practice, and (d) feedback. Instruction and modeling phases will be combined into one 25-minute block, practice and feedback phases into another. The course will focus on how to install a 90-degree herringbone patterned concrete paver walkway. The instruction and modeling phases will be pre-recorded and presented on an overhead to ensure consistent delivery across conditions. These phases together will last 25 minutes. Immediately following, participants in each condition will take part in a 20-minute reflective activity, which will vary across conditions.

At the conclusion of this reflective activity, participants will take part in the practice and feedback block of the course. This block will last 25 minutes. Participants will be asked to install a 25 square foot 90-degree herringbone patterned paver walkway, adhering to the methods discussed and demonstrated in the presentation. This will occur within a prepared area in the classroom. The researcher will provide verbal feedback. Participants will be instructed that their performance will not be formally assessed and that the purpose of the activity is to practice with feedback to improve performance. At the conclusion of this activity, participants will again take part in a 20-minute reflective activity, which will vary across conditions.

Following BST blocks and reflective activity intervals, participants in all conditions will complete an identical novel application task. Each will be asked to install a 20 square foot 45-degree herringbone paver walkway. The researcher will ask each participant to complete the task in as little time as possible with as few errors as possible using the methods discussed earlier. No further guidance, instructions, or feedback will be given. At this point, the research assistant will begin timing the task. Upon completion, participants will be fully debriefed, thanked, and dismissed from the study.

A more detailed description of each activity is listed below:

ACTIVITY	DESCRIPTION
Recruiting	Participants will be recruited using flyers and course announcements at MATC campuses. Participants can inquire via phone or email.
Screening	Selection criteria are: (a) participants must be age 24 or older, (b) participants must hold a valid student ID from the technical college, and (c) participants must have no prior experience installing concrete or clay pavers. Those failing to meet these criteria will not be included in the study.
Consenting	<p>The study will be described in its entirety to participants. Participants will be told that the purpose of the study is to investigate the impact of instructional techniques on learning how to install concrete pavers, not that it is to investigate the impact of reflective activities on skill adaptation. This incomplete disclosure poses no additional risk to participants and was decided on to limit or reduce threats to internal validity, e.g., demand characteristics, compensatory rivalry, and resentful demoralization.</p> <p>Participants will be asked to sign an informed consent form, which includes the following information: (a) the study's title, (b) the PI's information, (c) the study's description and purpose with incomplete disclosure, (d) the study's procedures, (e) the study's risks and benefits, (f) and the study's compensation and confidentiality.</p>
Assessing	To assess reflective propensity in order to equate conditions, participants will complete the Kolb Learning Styles Inventory version three (KLSI 3.0). The KLSI 3.0 evaluates a learner's propensity toward one of four learning styles: (a) diverging (introverted/feeling), (b) assimilating (introverted/intuition), (c) converging (extraverted/thinking), and (d) accommodating (extraverted/sensation). Divergent and assimilative learners are thought to use reflection more often in learning than accommodative and convergent learners.
Matched Random Assignment	Participants will be identified according to three blocking variables: (a) gender, (b) age, and (b) reflective propensity. They will then be matched with others along these variables and randomly assigned to one of three conditions.
Instruction / Modeling	Participants will watch a 25 minute video describing and demonstrating how to install a 90-degree herringbone patterned concrete paver walkway.
Reflective Activity 1	<p>Participants will take part in one of three reflective activities, depending on condition. Each activity will be audio recorded.</p> <p>The non-reflective activity will feature a reading aloud procedure, which is thought to load abstract working memory and prevent the acquisition of further explicit knowledge. At the start of each reflective activity interval, participants in this group will be asked to read aloud for 20 minutes from a Writing Composition Handbook (Hairston & Ruszkiewicz, 1996). During this time, the research assistant will take notes that are inconsequential to data analysis. The research assistant will state "continue" if participants pause from reading aloud for longer than 2 seconds.</p> <p>Those in the experimental 1 condition will engage in reflective dialogue (with a reflection focus) with the research assistant. A series of 12 questions will be asked that</p>

	<p>focus on course content and the process of problem-solving.</p> <p>Those in the experimental 2 condition will engage in reflective dialogue (with a critical reflection focus) with the researcher assistant. A series of 12 questions will be asked that focus on identifying and/or challenging hidden assumptions inherent in the course content.</p>
Practice / Feedback	<p>Participants will be asked to install a 25 square foot 90-degree herringbone patterned paver walkway, adhering to the methods discussed and demonstrated in the presentation. This will occur within a prepared area in the classroom. The researcher will provide verbal feedback and model techniques if needed.</p>
Reflective Activity 2	<p>Participants will take part in one of three reflective activities, depending on condition. Each activity will be audio recorded.</p> <p>The non-reflective activity will feature a reading aloud procedure, which is thought to load abstract working memory and prevent the acquisition of further explicit knowledge. At the start of each reflective activity interval, participants in this group will be asked to read aloud for 20 minutes from a Writing Composition Handbook (Hairston & Ruszkiewicz, 1996). During this time, the research assistant will take notes that are inconsequential to data analysis. The research assistant will state “continue” if participants pause from reading aloud for longer than 2 seconds.</p> <p>Those in the experimental 1 condition will engage in reflective dialogue (with a reflection focus) with the researcher assistant. A series of 12 questions will be asked that focus on course content and the process of problem-solving.</p> <p>Those in the experimental 2 condition will engage in reflective dialogue (with a critical reflection focus) with the researcher assistant. A series of 12 questions will be asked that focus on identifying and/or challenging hidden assumptions inherent in the course content.</p>
Novel Application Task	<p>Participants will be asked to install a 20 square foot 45-degree herringbone paver walkway. A photograph model will be provided. No further guidance, instructions, or feedback will be given. This task will take place in a second prepared area within the classroom.</p>
Debriefing	<p>After completion of the novel application task, participants will be fully debriefed, thanked, paid \$40 for study participation, and dismissed from the study.</p>

Hairston, M., & Ruszkiewicz, J. J. (1996). *The Scott Foresman handbook for writers* (4th Ed.). New York, NY: Harper Collins.

b) How will the data be collected (check all that apply):

- ☐ Interview? (submit a copy)
☒ Observations? (briefly describe)
☐ Standardized tests? (if yes, list names, provide descriptions, and samples of tests not in common usage.)
☐ Archival data
☐ other (describe)

4. DATA

a) How will the data be recorded (notes, tapes, computer files, completed questionnaires or tests, etc.)?

Final novel application task projects will be quantitatively assessed using the following behavioral observation data: (a) time to completion, (b) number of paver joints exceeding industry standard tolerance ($> 3/16''$ or $< 1/16''$), (c) number of bond lines deviating $1/4''$ or greater from true, (c) number of pavers installed upside down, and (d) number of chipped or cracked pavers installed. Time to completion will be recorded using a standard stopwatch measuring to 1/1000 of a second. Number of paver joints exceeding industry standard tolerance will be recorded using an electronic caliper with accuracy to ± 0.001 inch. Number of bond lines deviating $1/4''$ or greater from true will be recorded using a mason's string line and standard tape measure. The number of pavers installed upside down, as well as the number of chipped or cracked pavers, will be recorded by visual inspection. All data will be entered immediately in an electronic spreadsheet at the study's location. No personally identifiable information will be recorded.

Data will be reported in aggregate form using inferential statistics to determine differences between conditions. No personally identifiable information will be reported.

Audio recorded data will be transcribed and coded for reflective identifiers. The aggregate number of reflective identifiers in each condition will be used to describe participant characteristics. No personally identifiable information will be reported.

b) Who will have access to the gathered data and how will confidentiality be maintained during the study, after the study, and in reporting of results?

Only the principle investigator, Barbara J. Daley, PhD., and the research coordinator, Kevin Roessger, will have access to the gathered data.

No personally identifiable information will be recorded that links audio data, behavioral observation data, and assessment data to the participant. Participants will be assigned a numeric identifier that will accompany each form of data. At no point during screening, assessment, or data collection phases will the participant's name be recorded. All study data will be stored on a password protected computer.

At the completion of the study, however, participants, names will be recorded and linked to their numerical identifier when they sign the receipt for the \$40 Visa gift card. This is done to adhere to level 3 payment confidentiality requirements. These receipts with the participant's name, signature, and numerical identifier are scanned and saved on a different password protected computer at a different physical location for record keeping purposes (e.g., taxes, research audit). At no point will receipts with participants' names be stored together with study data.

For a person, then, to obtain payment receipts and study data and thus connect names to numerical identifiers, they would have to know exactly which files they were looking for and obtain access to two different password protected computers at two different physical locations.

Participants' names will not be referenced when reporting study results. Data will only be reported in aggregate form.

- c) What are the plans for the data after completion of this study, and how and when will data be maintained or destroyed?

Study data (with only numerical identifiers) will be kept on a password protected computer for a period of five years. Receipt data (with signatures, names, and numerical identifiers) will be kept on a separate password protected computer at a different location for a period of two years.

5. BENEFITS, RISKS, COSTS

- a) What are the anticipated benefits to the subjects, the mission of Milwaukee Area Technical College, and others?

Study participants will benefit by learning how to install concrete pavers.

The information gathered in this study will also be particularly beneficial to stakeholders in the field of construction education, which is experiencing a growing advocacy for reflective activities in its learning settings. Educators, instructional designers, and program planners will be able to making better informed decisions regarding the use of these activities in learning settings. A greater understanding may also help decision-makers identify the immediate and long-term benefits of using reflective activities in their courses. In turn, this may lead to more effective courses and workshops for adult learners seeking specific, demonstrable occupational skills.

A greater understanding of this issue may be most beneficial to the learners themselves. Although learners are not this study's primary audience, the inclusion of effective learning activities, or the removal of ineffective ones, will yield courses that better serve those seeking specific, demonstrable occupational skills. This is particularly critical when learners' abilities to perform such skills have considerable consequences for themselves, their organizations, and their clients and/or customers. Nowhere is this more apparent than in occupations that rely heavily on both the systematic and adaptable performance of complex occupational tasks (e.g., plumbers, surgeons, bricklayers, computer programmers, or airline pilots). In addition, findings may be useful to adults seeking to gain work-related skills and knowledge through informal educational avenues.

Such benefits have the potential to positively affect a large number of adult learners and their clients by precipitating changes in pedagogical approaches to adult work-related learning, which result in more effective work practices.

MATC will also benefit by helping further its mission of providing quality educational and training opportunities and services to its students. This research will take important steps toward achieving higher quality learning opportunities by demonstrating the effectiveness or ineffectiveness of educational activities used in career and technical education contexts.

b) If participants are to be paid or reimbursed in some way for their participation, what compensation will be offered? How will payment be made and scheduled?

Participants will be given a \$40 Visa gift card after completing the 2.5-hour study. Participants must complete the study in its entirety to receive this incentive.

c) Describe the type and degree of risk, including minimal, that participants will be exposed to.

Discussed with safeguards in table below.

d) What safeguards will you use to eliminate or minimize these risks?

Discussed with risks in table below.

ACTIVITY	RISK/SAFEGUARDS
Recruiting	There are no perceived risks associated with this activity.
Screening	This activity may pose privacy risks. To safeguard against such risks, screening interviews will be conducted over the phone and a participant's information will be assigned a numerical identifier; names or student identification numbers will not be recorded.
Consenting	There are no perceived risks associated with this activity.
Assessing	This activity may pose privacy risks. To safeguard against such risks, KLSI 3.0 assessments will be conducted in a private room and participants' scores will be attached only to their numerical identifier.
Matched Random Assignment	There are no perceived risks associated with this activity.
Instruction / Modeling	There are no perceived risks associated with this activity.
Reflective Activity 1	<p>Audio recording of this activity may pose privacy risks. To safeguard against such risks, only participants' numerical identifiers will be stated during recording. Participants will be told exactly when recording begins and ends.</p> <p>This activity may pose psychological risks to the participant. When engaged in critical reflection, participants may uncover assumptions underlying their understanding of course content that occasion psychological stress. To safeguard against such risks, the research assistant will stop the activity if he notices the participant exhibiting psychological stress beyond what would be reasonably expected in a higher education course. In such instances, participants will be instructed to visit the Counseling Office in Room S209 at the Downtown Milwaukee Campus.</p>
Practice / Feedback	<p>This activity may pose physical risks to the participant. Participants will be required to bend repeatedly at the waist and knees. Participants will also be required to lift up to 12.4 pounds repeatedly. Such risks, however, are no greater than those experienced in other MATC hands-on courses (e.g., bricklaying and masonry, preparatory plumbing, carpentry, medical assistance, and nursing).</p> <p>To safeguard against physical risks, the physical requirements of the study will be accurately described in recruitment materials and in the informed consent</p>

	<p>procedure. Instruction phases of the study will provide directions on safe material handling and correct installation postures. Participants will be provided with gloves and eye protection. The researcher will immediately stop the activity if participants attempt to lift more than 2 pavers (12.4 pounds) in a single instance.</p> <p>In the unlikely event that a participant injures him/herself, the MATC public safety office will be contacted in room M274. MATC public safety officers are trained as medical emergency first responders. If more advanced care is needed, the dispatcher will contact 911.</p>
Reflective Activity 2	<p>Audio recording of this activity may pose privacy risks. To safeguard against such risks, only participants' numerical identifiers will be stated during recording. Participants will be told exactly when recording will begin and end.</p> <p>This activity may pose psychological risks to the participant. When engaged in critical reflection, participants may uncover assumptions underlying their understanding of course content that occasion psychological stress. To safeguard against such risks, the research assistant will stop the activity if he notices the participant exhibiting psychological stress beyond what would be reasonably expected in a higher education course. In such instances, participants will be instructed to visit the Counseling Office in Room S209 at the Downtown Milwaukee Campus.</p>
Novel Application Task	<p>This activity may pose physical risks to the participant. Participants will be required to bend repeatedly at the waist and knees. Participants will also be required to lift up to 12.4 pounds repeatedly. Such risks, however, are no greater than those experienced in other MATC hands-on courses (e.g., bricklaying and masonry, preparatory plumbing, carpentry, medical assistance, and nursing).</p> <p>To safeguard against physical risks, the physical requirements of the study will be accurately described in recruitment materials and in the informed consent procedure. Instruction phases of the study will provide directions on safe material handling and correct installation postures. Participants will be provided with gloves and eye protection. The researcher will immediately stop the activity if participants attempt to lift more than 2 pavers (12.4 pounds) in a single instance.</p> <p>In the unlikely event that a participant injures him/herself, the MATC public safety office will be contacted in room M274. MATC public safety officers are trained as medical emergency first responders. If more advanced care is needed, the dispatcher will contact 911.</p>
Debriefing	<p>This activity may pose privacy risks. In keeping with level 3 payment confidentiality requirements, participants' names will be recorded and linked to their numerical identifier. To safeguard against such risks, participants' names will be kept separate from behavioral observation data and assessment data. Payment receipts with name and numerical identifiers will be scanned and saved on a password protected computer. All salient study data will be linked only with a participant's numerical identifier and kept in a separate location.</p>

e) What are the costs, if any, to the participants (monetary, time, etc.)?

Participants will not be responsible for any costs related to this research study.

6. INFORMED CONSENT

a) How will the study be explained to the participants and by whom?

The study will be explained during initial phone screenings. When the participant arrives at his/her scheduled time, the research assistant will go over the informed consent form in detail with the participant. At the conclusion of the study, the participant will be fully debriefed.

b) Attach informed consent form(s) and any instruments you will use in the study.

The phone screening script, informed consent form, and debriefing form are attached.

CERTIFICATION

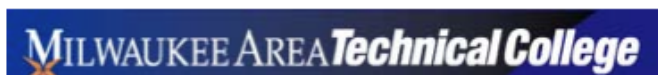
In submitting this proposed project and signing below, I certify that: I will conduct the research as presented and approved. I will meet all responsibilities of the research investigator, including obtaining and documenting informed consent and providing a copy of the consent form to each participant. I will present any proposed modifications in the research to the Institutional Review Board for review prior to implementation; seek approval renewal after one calendar year if needed, and will report to the Institutional Review Board any problems or risks to participants.

Kevin Roessger
Investigator/Research Coordinator

Signed:_____ Date:_____

Barbara J. Daley, PhD.
Supervising Faculty/Principle Investigator

Signed:_____ Date:_____



Institutional Review Board

Memorandum

To: Kevin Roessger

From: Yan Wang, Ph.D., Chair
Institutional Review Board (IRB)
Milwaukee Area Technical College

Re: IRB Approval Letter

Title: Investigating the impact of formal reflective activities on skill adaptation in a work-related instrumental learning setting

Date: February 14, 2013

After review of your IRB request on study titled "Investigating the impact of formal reflective activities on skill adaptation in a work-related instrumental learning setting", the IRB at MATC approved your request. This approval is effective for one year.

If you have any questions or if your plans for human subject involvement change substantially from those approved by the IRB, please contact the IRB chair at 414- 297-8509 or email to wangy@matc.edu.










Please note that it is the principal investigator's responsibility to promptly report to the IRB any changes in the research project, whether these changes occur prior to undertaking, or during the research. In addition, if harm or discomfort to anyone becomes apparent during the research, the principal investigator must contact the IRB chair. Upon completion of the study, please submit a Statement of Closure.









Additionally, if MATC students' records are needed for the study, it is the principal investigator's responsibility to submit a copy of your request to the Registrar, Sarah Adams, at 414-2976595 or adamss4@matc.edu, to assure compliance to FERPA, the student privacy act. Clearance from the IRB does not override the privacy protections of FERPA because FERPA does not have a research exception.




Thank you for your cooperation and best wishes for a successful project.



Cc: IRB committee members


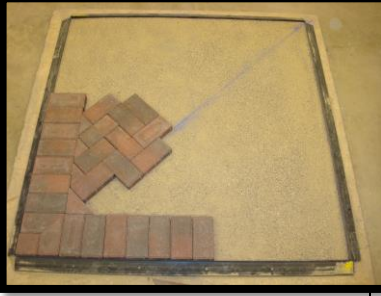



Appendix B: Data Photographs

INTERFERENCE CONDITION		
		
P9: Male. 40+. Reflective.	P17: Male. 40+. Non-reflective.	P20: Male. 40+. Reflective.
		
P18: Male. 30-39. Non-reflective.	P22: Male. 30-39. Reflective.	P24: Male. 30-39. Reflective.
		
P26: Male. 24-29. Reflective.	P35: Male. 40+. Non-reflective.	P33: Female. 40+. Non-reflective.

		
P34: Male. 40+. Reflective.	P40: Male. 40+. Non-reflective.	P50: Female. 30-39. Non-reflective.
		
P51: Male. 30-39. Reflective.	P38: Male. 24-29. Non-reflective.	
REFLECTION CONDITION		
		
P5: Female. 40+. Non-reflective.	P7: Male. 30-39. Non-reflective.	P6: Male. 40+. Reflective.

		
P11: Male. 24-29. Reflective.	P13: Male. 40+. Reflective.	P23: Male. 30-39. Non-reflective.
		
P30: Male. 40+. Reflective.	P31: Male. 24-29. Non-reflective.	P41: Male. 40+. Non-reflective.
		
P42: Male. 30-39. Reflective.	P45: Male. 30-39. Reflective.	P43: Male. 40+. Reflective.
		
P47: Female. 30-39. Non-	P25: Male. 40+. Non-	

reflective.	reflective.	
CRITICAL REFLECTION CONDITION		
		
Male. 40+. Reflective.	P3: Male. 24-29. Reflective.	P10: Male. 30-39. Non-reflective.
		
P2: Male. 30-39. Reflective.	P12: Male. 40+. Non-reflective.	Female. 40+. Non-reflective.
		
P14: Male. 30-39. Reflective.	P19: Male. 24-29. Non-reflective.	P32: Male. 40+. Reflective.

		
P36: Male. 40+. Non-reflective.	P55: Male. 40+. Reflective.	P48: Male. 40+. Non-reflective.
		
P15: Male. 30-39. Reflective.	P27: Female. 30-39. Non-reflective.	

KEVIN M. ROESSGER

EDUCATION

2010 to Summer 2013 (expected)

University of Wisconsin-Milwaukee, Milwaukee, WI

Dissertator, Distinguished Graduate Fellow, Urban Education

- Focus Area: Adult and Continuing Education
- Cumulative GPA: 3.98
- Dissertation: Investigating the impact of formal reflective activities on skill-adaptation in work-related instrumental learning settings.
- Advisor: Dr. Barbara J. Daley

2008 to 2010

University of Wisconsin-Milwaukee, Milwaukee, WI

Master of Science, Administrative Leadership

- Focus Area: Adult & Continuing Education
- Cumulative GPA: 3.96

1999 to 2002

University of Wisconsin-Milwaukee, Milwaukee, WI

Bachelor of Arts, Psychology

- Cumulative GPA: 3.93

PROFESSIONAL/TEACHING EXPERIENCE

2010 to Current

University of Wisconsin-Milwaukee, Panther Academic Support Services

Project Assistant/Online Tutoring Coordinator

- Oversaw the growth of PASS's online tutoring program from 5 sessions and 50 student visits in Spring 2010 to 150 sessions and 1000 student visits in Fall 2012.
- Designed and implemented a four-module training program for online peer tutoring, focusing on developing tutor competency using web-conferencing tools, interactive whiteboard technology, and online interactivity strategies.
- Developed first- and second-tier training objectives for peer tutor evaluation.
- Successfully trained over 200 peer tutors in the use of synchronous web-conferencing technology and interactive whiteboard tools.
- Designed and implemented online tutoring scheduling system used to coordinate over 150 online tutoring sessions and 1000 student visits per semester.
- Interviewed, managed, and directed two technology assistants in daily operations and maintenance of online tutoring program.
- Conducted two quantitative research projects evaluating the impact of online tutor training on peer-tutors' attitudes toward distance learning and computer anxiety.

- Served on hiring committee for graduate technology project assistant. Duties included: selecting applicants, scheduling interviews, contacting references, and participating in interviews.
- Adapted tutor training program to focus on online student services and delivered two hybrid training sessions to UWM non-academic staff.

2013

University of Wisconsin-La Crosse, Massive Open Online Course (MOOC)

Online Tutor and Instructor Trainer

- Designed and developed online training program for instructors and tutors participating in the College Readiness Math Massive Online Open Course (MOOC) sponsored by the Bill & Melinda Gates Foundation.
- Delivered training program via Blackboard Collaborate to 12 instructors and tutors, focusing on web conferencing tools, iPad integration, and interactivity strategies.
- Authored training manual consisting of 38 first and second tier objectives and supplementary job-aids.

2011 to 2012

Synchronous Communication Subcommittee, University of Wisconsin-Milwaukee

Co-chair

- Served as co-chair of the Synchronous Communication Subcommittee of the 2011-12 University of Wisconsin-Milwaukee Online Student Support Services Working Group.
- Developed a report and action plan for university-wide implementation of Blackboard Collaborate and other synchronous communication tools for student services units, included a proposed timeline, best practices, and resources.

2011

University of Wisconsin-Milwaukee, Department of Administrative Leadership

Ad Hoc Instructor—Instructional Design & Teaching Strategies (online)

- Monitored online group discussion for quality and critical discourse between learners.
- Oversaw group instructional design team projects from design through delivery phases, offering timely feedback and guidance throughout.
- Carried out all learner and team evaluations throughout course.
- Quantitative course evaluations exceeded department means in all areas: content, instructor, and methods. Overall evaluative mean of 4.88 (1-5 scale) exceeded department overall evaluative mean of 4.30.

2011

University of Wisconsin-Milwaukee, Department of Administrative Leadership

Guest Lecturer—Principles and Foundations of Adult Education (online)

- Delivered four online synchronous lectures for traditional adult learning theories unit, covering the principles and assumptions of radical behaviorism and functional contextualism and how each may be conceptualized in an adult learning context.
- Facilitated online group discussion, posting three primary questions per week and following up with guiding questions to promote active discussion.

- Selected all course readings for the unit.

2007 to 2010

School for Advanced Segmental Paving, Franksville, WI

Lead Instructor

- Served as principle instructor for the following courses: *Foundation Skills for Paver Construction*; *Foundation Skills for Segmental Retaining Wall Construction*; *Hardscape Chemical Certification*; and *Steps, Landings, and Elevations*.
- Designed, developed, implemented, and evaluated curriculum for two courses: *Foundation Skills for Segmental Retaining Wall Construction*; and *Steps, Landings, and Elevations*.
- Served as principle program planner for *Paver Training for Industry Professionals* course delivered at 2008 Hardscape North America Tradeshow in Nashville, TN.
- Co-hosted *Foundation Skills: Instructional Training Video for Concrete & Clay Pavers*.
- National Concrete Masonry Association certified “Train the Trainer” instructor.
- Member of 2008 Hardscape North America program steering committee.

PEER-REVIEWED ACADEMIC JOURNAL ARTICLES

Roessger, K. M. (2012). Toward an interdisciplinary perspective: A review of adult learning frameworks and theoretical models of motor learning. *Adult Education Quarterly*, 62(4), 371-382. doi: 10.1177/0741713612436598

Roessger, K. M. (2012). Re-conceptualizing adult education's monolithic behaviorist interpretation: Toward a new understanding of radical behaviorism. *International Journal of Lifelong Education*, 31(5), 569-567. doi: 10.1080/02601370.2012.700647

Dvorak, J. & Roessger, K. M. (2012). Examining the impact of web conferencing training on peer tutors' attitudes toward distance education. *Quarterly Review of Distance Education*, 13(1), 31-38.

Roessger, K. M. (2013). But does it work? Reflective activities, learning outcomes, and instrumental learning in continuing professional development. *Journal of Education and Work*. doi: 10.1080/13639080.2013.805186

PEER-REVIEWED BOOK CHAPTERS

Dvorak, J., & Roessger, K. M. (2012). Online tutor training. In K. Agee & R. Hodges (Eds.), *CRLA handbook for training peer tutors and mentors* (pp. 288-291). Mason, OH: Cengage Learning.

PEER-REVIEWED BOOK REVIEWS

Roessger, K. M. (2011). A review of Meyer, Land, and Baillie's, Threshold Concepts and Transformational Learning. *Journal of Transformative Learning*, 8(4), 286-288. doi: 10.1177/1541344611428505

PEER-REVIEWED CONFERENCE PRESENTATIONS

September 27, 2010

Roessger, K. M. (2010). Adult learning perspectives and motor learning models: An investigation of commonalities. Presented at the 29th Annual Midwest Research to Practice Conference in Adult, Continuing, Community, and Extension Education. Michigan State University. East Lansing, MI.

September 27, 2011

Roessger, K. M. (2011). Using building and construction trades training to empower African American adult learners in a changing urban economy. Presented at the 30th Annual Midwest Research to Practice Conference in Adult, Continuing, Community, and Extension Education. St. Charles, MO.

October 1, 2011

Roessger, K.M. (2011). Using online tutor training to change peer-tutors' distance learning attitudes and distance learning tool self-efficacy. Presented at the 26th Annual National College Learning Center Association Conference. Indianapolis, IN. Poster Session.

November 4, 2011

Roessger, K. M. (2011). Reflective practice: What is its impact on instrumental learning in continuing professional education contexts? Presented at the 60th Annual American Association for Adult and Continuing Education International Conference. Indianapolis, IN.

April 24, 2012

Dvorak, J., & Roessger, K. M. (2012). Implementing blended synchronous peer-tutoring using whiteboard and web-conferencing technology. Presented at the 9th Annual Sloan Consortium Blended Learning Conference. Milwaukee, WI.

November 8, 2012

Dvorak, J., & Roessger, K. M. (2012). Developing your own online tutoring program: Administration and tutor training. Presented at the College Reading and Learning Association Conference. Houston, TX.

April 18, 2013

Dvorak, J., Roessger, K. M., & Bohn, R. (2013). Implementing online and blended learning support using web-conferencing technology. Presented at the Office of Professional and Instructional Development Spring Conference. Madison, WI.

NON-PEER-REVIEWED CONFERENCE PRESENTATIONS

February 12, 2011

Roessger, K. M. (2011). Implementing an online synchronous peer-tutoring program. Presented at the Access to Success Conference. University of Wisconsin-Milwaukee. Milwaukee, WI.

April 26, 2011

Dvorak, J., & Roessger, K. M. (2011). Expanding online tutoring services using your own tutors. Presented at the Wisconsin Learning Assistance Network 5th Annual Meeting. University of Wisconsin-Oshkosh. Oshkosh, WI.

MANUSCRIPTS UNDER REVIEW

Roessger, K. M. The impact of reflective activities on instrumental learning in adult work-related education: A critical review of the empirical research. Manuscript under review.

AWARDS/HONORS

Dean's Honor List. University of Wisconsin-Milwaukee. 5/30/2000

Dean's Honor List. University of Wisconsin-Milwaukee. 5/29/2001

Leopold Schepp Foundation Scholarship. Leopold Schepp Foundation. New York, NY. 6/1/2001

Dean's Honor List. University of Wisconsin-Milwaukee. 6/15/2002

Graduation with Honors in the Major. University of Wisconsin-Milwaukee. 12/22/2002

Summa Cum Laude Graduate. University of Wisconsin-Milwaukee. 12/22/2002

Chancellor's Graduate Student Award. University of Wisconsin-Milwaukee. 6/1/2010

Distinguished Graduate Student Fellowship. University of Wisconsin-Milwaukee. 3/19/2012

Singer Scholarship. University of Wisconsin-Milwaukee. 5/31/2012

SERVICE

2012

30^h Annual Midwest Research to Practice Conference in Adult, Continuing, Community, and Extension Education.

Reviewer