ASSESSING REFLECTIVE JUDGMENT SCORES OF ASSOCIATE AND BACCALAUREATE DEGREE RADIOGRAPHY STUDENTS

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Abstract

**Purpose:** Reflective judgment skills are qualities that colleges want their students to possess upon graduation from the academic institution. A lack of reflective judgment skills may become a significant problem in radiography educational programs because the American Registry of Radiologic Technologists (ARRT) added situational judgment questions to the certification examination in January 2007. The purpose of this study is to assess changes in radiography student reflective judgment skills and to identify relationships between these skills and the students’ age and level of education.

**Method:** This descriptive longitudinal survey research design utilized the RCI, a standardized instrument used to measure reflective judgment skills. The cohort for this study is the specific population of radiography students graduating in 2011 from The Ohio State University, Virginia Commonwealth University, Columbus State Community College, and Central Ohio Technical College who participated in the survey. The questionnaire was administered twice using a pre-test/post-test design over an 8 month period (at the beginning and end of their first year in the professional program) to measure changes in the reflective judgment skills of the radiography students.

**Results:** The findings indicated that there was no variation in reflective judgment scores when looking at level of education, age, and 8 months of clinical experience. However,
the older associate degree students did have a mean score higher on the pretest over the bachelor degree students. The bachelor degree students were able to gain in their reflective judgment scores from pretest to posttest.

**Conclusion:** All students were in the quasi-reflective judgment stage at the pre-test and remain in the quasi-reflective stage on the post-test. The limitations to this study were a small sample size, research design and short length of time between pretest and posttest.
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Fields of Study

Major Field:  Allied Medical Profession
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Chapter 1
Introduction

Background to the Problem:

Reflective judgment describes the reasoning individuals construct when confronted with ill-defined questions. Therefore many radiation science educators strive to develop educational activities to increase reflective judgment in order to better prepare graduates to address situated or reflective judgment questions. Due to the amount of core curricular content students are required to master to meet national radiography accreditation standards, many educators are limited in the amount of time they can devote to provoking ill-defined questions in the classroom. However, the clinical educational environment may create the appropriate environment to foster reflective judgment.

Radiography educational programs provide a unique experience for the students through extended involvement in clinical courses. Most radiography students begin clinical coursework shortly after enrollment in the professional program and the experience extends until the students graduate. The clinical courses may be an excellent venue to help students gain reflective judgment skills because every patient and clinical situation is different. For example, an ill-structured problem may occur when the student encounters a patient with a skeletal fracture requiring an alteration to routine positioning methods. Since the clinical environment offers such varied educational experiences, there is a need to examine the reflective judgment scores of radiography students to
examine if clinical courses promote the students’ ability to analyze and rationalize ill-structured questions faced in the professional work environment.

Radiography programs are offered at both the associate degree and bachelor degree educational levels. The type of student enrolled in an associate degree program varies considerably, as an individual may have minimal college experience or an extensive educational background. In addition, the ages of these students tend to vary. Students enrolled in a bachelor degree program typically enroll in the radiography program during the junior year of college. Although, the clinical experience and radiography core course requirements are equivalent in both groups, the reflective judgment scores may be different when these two groups of students are compared due to differences in age and level of education.

**Significances of the Problem:**

Reflective judgment and critical thinking skills are qualities that educators want their students to possess upon graduation from a post-secondary academic institution. A report by the Association of American Colleges states: "In the final analysis, the challenge of college, for students and faculty members alike, is empowering individuals to know that the world is far more complex than it first appears, and that they must make interpretive arguments and decision-judgments that entail real consequences for which they must take responsibility and from which they may not flee by disclaiming expertise" (1991, pp. 16-17). By the time a student graduates college they should have increased their reflective judgment and research indicates that senior level post-secondary students have outperformed freshman when using the RCI, with the senior students outscoring the post-secondary freshman by 18 to 20 percentile points (Pascarella & Terenzini 2005).
Most students entering college place in the lower quasi-reflective judgment stage and reach a higher level within the quasi-reflective judgment stage upon graduation from an undergraduate program.

The lack of educational strategies to increase reflective judgment skills may become a significant problem in radiography educational programs, not only in clinical practice, but also because the certification examination added situational judgment questions (SJT) in January 2007. According to the American Registry of Radiologic Technologists (ARRT) website, “each SJT starts with a scenario describing an ethical problem or work-related conflict, followed by 4 to 7 possible solutions. Candidates are required to select 2 answers from those given – one to indicate the most desirable solution and one to indicate the least desirable solution.” Therefore, the ARRT is now placing emphasis on reflective judgment skills.

Limited studies have been conducted regarding gains in radiography students’ reflective judgment skills at either the associate or baccalaureate levels of education. Since it is important for all college students to gain reflective judgment skills, more information must be gathered specific to radiography students. Also, with the addition of situational questions on the ARRT examination, it is relevant to find out if radiography students are gaining reflective judgment skills necessary to perform competently in professional practice. Therefore, the purpose of this study is to assess changes in radiography student reflective judgment skills and to identify relationships between these skills and the students’ age and level of education.

Objectives:
The purpose of this study was to assess radiography student reflective judgment stages at the beginning of their clinical education and following completion of the first year of clinical courses. Reflective judgment was assessed through the administration of the Reasoning about Current Issues Questionnaire (RCI); a standardized instrument which is scored by professionals specialized in reflective judgment. Demographic information regarding the students’ age, educational background, and degree sought was also obtained.

**Research Questions:**

The research questions for this study are as follows:

1. Is there a change in the radiography students’ reflective judgment stage as measured by the RCI between the pre-test and the post-test administered at the completion of the first year of clinical experience?

2. Is there a relationship between the type of degree program and the reflective judgment stage as determined by scores received on the RCI?

3. Is there a relationship between the students’ age and the reflective judgment stage as determined by scores received on the RCI?

**Research Approach:**

This descriptive longitudinal survey research design utilized a standardized instrument, the Reasoning about Current Issues Questionnaire. The questionnaire was administered to a cohort of radiologic students at the associate degree and baccalaureate degree levels as a pretest prior to beginning clinical educational assignments and as a post test upon completion of the first year of clinical experience.

**Definition of Terms:**
- Well-Structured Problems: The solutions are agreed upon by experts in the field.

- Ill-Structured Problems: The best solutions *not* agreed upon by experts in the field.

- Reflective judgment: describes the reasoning an individual constructs to explain an ill-defined question and their assumptions about knowledge.

- Educational level: Associates degree is awarded when a student completes an area of study usually lasting two years. Bachelor’s degree is awarded when an undergraduate completes a major usually lasting four years.

**Theoretical Framework:**

According to Knowles, there are five principles of adult learning characteristics: self-concept, experience, readiness, orientation, motivation (Knowles, 1980). Self-concept is when an adult moves from dependency to self-direction. Self-direction can help an adult gain reflective judgment, because they will think beyond the information taught in the classroom and reflect on their experiences. Experience can aid in adult learning when individuals draw upon their experiences to gain knowledge. Adults need time to reflect on these experiences so they can connect it to the knowledge they have learned to real life experiences. Readiness is when an adult is developmentally ready to learn new information. Adults will need learning opportunities in which they can develop reflective judgment skills. Orientation occurs when an adult applies what they have recently learned. Motivation occurs because adults want to learn from their mistakes and they choose to continue to learn (Knowles, 1980). These five principles of adult learning can be applied to radiography students when they are in clinical situations.
Dewey (1933, 1938) provides some of the earliest thoughts on reflective judgment. He proposed that people make reflective judgments to bring closure to ill-structured questions where an answer is uncertain. Individuals cannot make reflective judgments unless they believe the situation has uncertainty. According to Dewey, reflective judgments are based on an individual’s ability to evaluate and judge existing data and apply it to the ill-structured question at hand and then be able to defend their answer as most reasonable. (King & Kitchener, 1994; Dewey, 1933, 1938)

The theoretical framework for this study was based on the works of King and Kitchener (1994) which were based on the theory proposed by Dewey. King and Kitchener (1994) developed the Reflective Judgment Model (RJM) which describes how a person grows from adolescence to adulthood in the way they understand knowledge and defend their beliefs of ill-structured questions. King and Kitchener (1994) have identified the following seven stages of progression:

Pre-Reflective Thinking (Stage 1, 2, and 3)

- **Stage 1:** Knowledge is assumed to exist absolutely and concretely; it is not understood as an abstraction. It can be obtained with certainty by direct observation.

- **Stage 2:** Knowledge is assumed to be absolutely certain or certain but not immediately available. Knowledge can be obtained directly through the senses (as a direct observation) or via authority figures.

- **Stage 3:** Knowledge is assumed to be absolutely certain or temporarily uncertain. In areas of temporary uncertainty, only personal beliefs can be known until
absolute knowledge is obtained. In areas of absolute certainty, knowledge is obtained from authorities.

Quasi-Reflective Thinking (Stages 4 and 5)

- **Stage 4:** Knowledge is uncertain and knowledge claims are idiosyncratic to the individual since situational variables (such as incorrect reporting of data, data lost over time, or disparities in access to information) dictate that knowing always involves an element of ambiguity.

- **Stage 5:** Knowledge is contextual and subjective since it is filtered through a person’s perceptions and criteria for judgment. Only interpretations of evidence, events, or issues are known.

Reflective Thinking (Stages 6 and 7)

- **Stage 6:** Knowledge is constructed into individual conclusions about ill-structured problems on the basis of information from a variety of sources. Interpretations that are based on evaluations of evidence across contexts and on the evaluated opinions of reputable others can be known.

- **Stage 7:** Knowledge is the outcome of a process of reasonable inquiry in which solutions to ill-structured problems are constructed. The adequacy of those solutions is evaluated in terms of what is most reasonable or probable according to the current evidence, and it is reevaluated when relevant new evidence, perspectives, or tools of inquiry become available. (King & Kitchener, 1994)

This reflective judgment model should be applied to students at the post-secondary level so they may create new evidence, perspectives, or tools to evaluate ill-structured problems. Many high school students are in the pre-reflective judgment stage
in which they gain and believe the knowledge of authorities. If students were to stop at this stage of development, the world could change to a dictatorship, because we would only believe in what the authorities said. (King & Kitchener, 1994) Traditional-age college students have been tested in twenty studies and were demonstrated to be within the quasi-reflective judgment stage. This indicates that college students are able to understand that questions have an element of ambiguity and subjectivity (King & Kitchener, 1994). Therefore, it is important for reflective judgment to be applied in colleges so that the world, as a whole, can gain new knowledge and perspectives.

**Limitations:**

Limitations of this study include a small sample size; therefore the results of this study may only be generalized to the cohort of radiography students enrolled in the participating colleges. In addition, assessing changes in reflective judgment requires a period of time to allow the learner to progress through each stage, thus this study is limited to 8 months of progression. The internal validity threats include history (unexpected events that may occur between the pre- and posttest that may affect reflective judgment) and testing due to the pre-test/post-test study design. The pretest may enable the students to score higher on a posttest because they could become familiar with the process and the questions. Therefore, a raise in scores could be due to testing and not reflect any changes due to maturation, degree or years of college.
Chapter 2
Literature Review

Reflective judgment is a quality that colleges would strive for their students to achieve by the time they graduate. The reflective judgment model developed by King and Kitchener (1994) is a tool college and academic programs can use to gauge the development of their students. Many studies have been conducted using this theoretical model to research how college experiences, age and degrees affect reflective judgment outcomes. However, at this time there is a lack of information on associate degree versus bachelor degree radiography students.

Reflective Judgment and Educational Attainment

A college student can learn to make reflective judgments if provided with contextual support and an opportunity to practice. A study by Kitchener, Lynch, Fischer and Wood (1993) supports this claim, as the results of their study showed that students were able to raise their reflective judgment scores when they had contextual support and practice. Teachers who are able to support, engage students in ill-structured issues, create opportunities to analyze different viewpoints, teach strategies in data collection, and encourage students to practice will help their students gain reflective judgment. If a student can learn to appreciate different viewpoints in their own discipline, they are more likely to appreciate different viewpoints on a wide range of controversies. Also, if a student learns to understand research and the strength of evidence, they will be able to think critically about ill-structured issues (King, 2000). Therefore, a student enrolled in
college can improve reflective judgment skills when they are provided with support and practice.

A study by Meyer (2004) reported doctoral-level students’ reflective judgment skills during an online discussion. This study also supports the claim that a student’s needs contextual support. The responses to the online discussion showed that the largest number of postings with 30.6% were stage 3, because they were asked to write a personal reflection or experience. The next highest amount of responses was in stage 6 with 24.5%, because the students had to write a pro and con argument. This study shows that by requiring the student to think about ill-structured problems a teacher or course can help the student engage in higher stages of reflective judgment.

There are an abundant amount of general studies conducted on college students demonstrating gains they acquire in their reflective judgment skills from freshmen year to graduate student study. A ten-year longitudinal study on reflective judgment was conducted from 1977 to 1987 by King and Kitchener (1994). The educational levels of the 1977 group were high school junior, college juniors and doctoral students. The initial results showed that the high school students preformed as pre-reflective thinkers with a mean score of 2.77, college juniors preformed as quasi-reflective thinkers with a mean score of 3.76 and doctoral students were close to reflective judgment with a score of 5.67. As the study progressed though the 10 years, each student group was able to raise their reflective judgment scores. The high school juniors had the most to gain and by 1987, they had a mean score of 5.29 which put them in the quasi-reflective thinking stage. The college juniors stayed in the quasi-reflective thinking stage with a mean score of 5.05. The doctoral students were able to achieve reflective judgment by 1987 with a mean
score of 6.21. These results may have been able to happen because of the students’ commitment to education. Of the initial high school juniors only one student didn’t receive a college degree. As for the initial college junior and doctoral students the majority of them finished their degrees (King & Kitchener, 1994). These results suggest that with a commitment to education individuals reflective judgment skills will increase slow and steadily over time. However, the study was conducted over 10 years with no control group so some of the increase in scores could be due to maturation.

Traditional-age college students have been tested in twenty studies. The freshman is these studies had a mean reflective judgment score of 3.6, sophomores had a mean score of 3.6, juniors had a mean score of 3.7 and senior had a mean score of 4 (King & Kitchener, 1994). In another study, seniors have outperformed freshman when using the RCI. The groups were matched to have essentially the same ACT scores. The seniors were able to outscore the freshman by 18 to 20 percentile points (Pascarella & Terenzini, 2005). There are no studies evaluating reflective judgment scores of associate degrees verses bachelor degrees but the evidence of these research studies suggest that there may be a difference because of maturation.

A study by Whitmire (2004) focused on undergraduates and their information-seeking behavior. This study had a very small sample group of twelve subjects. Of the twelve students, seven were pre-reflective thinkers and five were quasi-reflective thinkers. There was a link between the students’ reflective judgment scores and their information-seeking behavior. The pre-reflective thinkers thought that the websites that appeared first in their search were of highest quality. The quasi-reflective thinkers were more skeptical and looked for government and educational organizations. Therefore,
teachers at an associate degree college where the students are typically at a lower educational level may have to stress more attention to certain topics like information-seeking behavior because of lower reflective judgment skills.

**Reflective Judgment and Educational Discipline**

There are conflicting reports regarding type of degree sought by a student having an effect on their reflective judgment skills. A person seeking a mathematic type major will be better at solving well-structured problems because they are taught to solve problems with a high degree of certainty. The person seeking a social science major will be better at solving ill-structured problems because they are engaged in problems that have a lower degree of certainty. This would lead us to conclude that a social science major would outperform other majors on a reflective judgment interview because these students have practice at solving ill-structured problems (Fischer, & Pruyne, 2002).

King, Wood and Miners (1990) found conflicting results. They did find that social science graduates students had a mean reflective judgment score of 5.17 and mathematic science graduate students had a mean score of 4.36. This difference is attributed to the fact that social science majors practice solving ill-structured problems which provides them with more of an opportunity to develop reflective judgment skills. However, they also found that there was no significant difference between seniors in social science and mathematics majors. There needs to be more research preformed to know why there is a difference in graduate students because of discipline and no difference between seniors.

The reason why seniors in the social science and mathematics majors did not score differently may be due to the fact they cannot generalize their knowledge to
different ill-structured problems. For instance, a radiography student will become knowledgeable about how to deal with imaging a patient’s skeletal fracture only after multiple repetitions. This means that after several repetitions and regression of the ill-structured problems of radiography, the student will gain a high level of reflective judgment within the discipline. The students’ ability to answer ill-structured problems in one discipline does not mean they have to same high ability to answer ill-structure problems in an unrelated discipline. The student needs to build reflective judgment skills for many different tasks and situations before they can generalize their ability to answer ill-structured problems over all domains. (Fischer & Pruyne, 2002)

A study by Castle (2006), sought to find out if second year and third year radiography students self perception of their critical thinking skills and reflection were comparative to their actual written assessment. The students in the study perceived their critical thinking skill higher than demonstrated by written assessment, as only a small attempt to use critical discussion was reflected in their work. The author concluded that the lack of critical thinking and reflective judgment incorporated into the curriculum lead to lower written scores and suggested the classroom setting should incorporate case studies, observations and clinical scenarios (Castle, 2006). This study indicates that radiography students need the repetition of the ill-structured clinical scenarios to possible gain critical thinking and reflective judgment skills.

There are many benefits that clinical experiences provide for radiography students while in the educational program. These include increased motivation to learn, increased confidence in their professional practice, engaging in real life scenarios, and gaining reflective and critical thinking skills. The clinical experience enables the student to
enhance their reasoning and decision making skills because of the various ill-structured clinical scenarios. There are three main clinical models a student may be placed. The instruction and clinical experience are at separate instructions in the external model. The students’ course work and clinical experiences are done at the hospital in the internal model. A classroom instructor teaches in the clinical setting and technologist teaches in the classroom in the bridging model. The bridging model may be the best advocate for creating an environment where the students are able to effectively gain the benefits of the clinical experience. Students in this type of clinical environment considered their clinical experience significant, beneficial, and had no initial fears starting the clinical experience. The students form the internal and external models had initial fears and increased stress about their interpersonal relationships with technologist lead to a negative affect on their clinical experience (Fortsch et al., 2009). Therefore, it is not only important that radiography students engage in the clinical setting but have a clinical environment that is supportive and promotes student success so they can feel comfortable in thinking of a solution to ill-structured problems.

A study conducted by Boyd (2008) sought to find out if a clinical curriculum would help dental students gain more reflective judgment. The clinical experience has high levels of uncertainty and many different situations in which a variety of ill-structured problems can exist. At the beginning of the year, the students had a mean reflective judgment score of 4.89 and by the end of the year the students had a mean reflective judgment score of 5.59. They were almost able to increase their scores by a whole stage. Other studies had between three months and one year of time laps between testing and their results showed only a .02 to .19 reflective judgment stage increase.
(King & Kitchener, 1994) The reason for the dental students to gain almost a whole stage in a year could be attributed to the clinical environment or convenience sampling. It is thought that the clinical curriculum could help reflective judgment scores, because students have to rely on themselves to guarantee the best quality of care for the patient. They can no longer be dependent on the professor for the right answers when they are in the clinical setting. Radiography students will not be dependent on the professor in the clinical setting, but in the first year of the program they will have the mentorship of registered technologist and clinical instructors. First year radiography students will be in ill-structured situations but a clinical instructor will be there to help them figure out a solution.

There are limited studies conducted that deal specifically to the radiologic technology profession. I would propose that the radiography students will have a gain in their reflective judgments scores from when they enter the program to the end of their first year in the program. The reason for their increase in reflective judgment scores could be because of their engagement in a clinical curriculum. Also, the radiography major is a split between a biologic/physical science and social science major. As radiographers, we have to know variations in patient anatomy, the physics and mechanics related to the production of x-rays, as well as exhibiting a high ability in patient care skills. Radiographers are similar to social science majors in terms of the clinical setting because they have to deal with a variety of patients. For example, a radiography student may have to image an autistic patient and the manner in which they communicate and perform the examination may have to be altered from the way they were taught in class. The student will have to learn how to adapt to the patient. Therefore, radiographers may
score higher because they are similar to social science majors that deal with ill-structured problems.

**Reflective Judgment and Age**

There have been six studies where non-student adults were compared to college students to help provide a control for age (Glatfelter, 1982; Glenn & Eklund, 1991; Josephson, 1988; Kelton & Griffith, 1986; King, 1986; King & Kitchener, 1994; Lawson, 1980). The results showed that the adults who are not enrolled in college had a mean reflective judgment score from 3.5 to 3.7. The mean reflective judgment scores for college students were from 4.0 to 5.2. The results show that college reflective judgment is gained through education and not controlled by age. Age alone can not lead to higher scores but life experience as one grows older could contribute to an increase in ability.

A study by Glenn and Eklund (1991) was performed to demonstrate the contrast between college educated and non educated adults. Their study was comprised of individuals that were at least sixty-five years of age with different educational backgrounds. The individuals whose highest level of education was high school had a mean score of 3.7. The individuals with doctorate degrees had a mean score of 5.2. Since the high school educated adults had reflective judgment scores closer to the average college student means that their life experiences did help to increase their scores. This suggests that the older non-traditional associate degree students may have similar scores to the juniors in a radiology program, because their life experiences could contribute to a raise in their scores despite less education.

Non-traditional age college students do not appear to be different than the younger traditional age students. An overall mean score for non-traditional age and
traditional age freshman was 3.6 and both groups of seniors also scored the same with a 4.0 (King & Kitchener, 1994). Therefore, age and life experiences didn’t contribute to the non-traditional age students to score higher.

Fischer and Pruyne (2002) have gathered information regarding the range of ages the different stages of reflective judgment occur in educated adults. Pre-reflective judgment stage 3 is usually acquired in high school from age 12 to 17. Quasi-reflective judgment stage 4 is usually acquired from late high school to early college from age 16 to 23. Stage 5 can be acquired at early graduate school from age 19 to 30 and over. Reflective judgment stage 6 can be acquired in advanced graduate students by age 23 to 40 and over. Stage 7 can be acquired by advance graduate students by age 30 to 45 and over. However, there are many people that do not reach advanced levels of reflective judgment. Additionally, enrollment in post-secondary education does not guarantee higher achievement in reflective judgment. For example, the graduate math major is the earlier stated King, Wood and Miners (1990) study did not achieve higher reflected judgment scores than the senior math majors. If a student or an adult is not engaged in thought provoking ill-structured problems it will be harder for them to reach the higher stages of reflective judgment.

It has been reported that midlife may be a critical stage is developing reflective judgment (Fischer & Pruyne, 2002). There is no evidence to support this theory at this time. However, there is evidence that in middle adulthood an individual can have behavioral and brain changes. Research has shown that there is a major growth spurt in the process of myelination in adults 40s to 50s. This process promotes a better interaction between the brain’s pathways ways to develop higher reasoning and learning.
It has also been reported that adults in midlife have behavioral changes and are more reflective (Fischer & Pruyne, 2002). It cannot be concluded that midlife can cause an increase in reflective judgment because there is no evidence to support the claim, but given the information above it is could be possible.
Chapter 3  
Methodology

Research Design

This descriptive longitudinal survey research design utilized the RCI, a standardized instrument used to measure reflective judgment skills. The cohort for this study is the specific group of radiography students from The Ohio State University, Virginia Commonwealth University, Columbus State Community College, and Central Ohio Technical College, graduating in 2011, who participated in the survey. The questionnaire was administered twice using a pre-test/post-test design over an 8 month period (at the beginning and end of their first year in the professional program) to measure changes in the reflective judgment skills of the radiography students.

Research Questions

The independent variables are the educational level of the radiography program, and student age. The dependent variable is the students’ reflective judgment level as determined by scores received on the RCI.

The research questions for this study are as follows:

1. Is there a change in the radiography students’ reflective judgment stage as measured by the RCI between the pre-test and the post-test administered at the completion of the first year of clinical experience?

2. Is there a relationship between the type of degree program and the reflective judgment stage as determined by scores received on the RCI?
3. Is there a relationship between the students’ age and the reflective judgment stage as determined by scores received on the RCI?

Subject Selection

The participants were a convenience sample of the class of 2011 radiography students enrolled at The Ohio State University, Virginia Commonwealth University, Columbus State Community College, and Central Ohio Technical College. The sample consisted of 45 associate degree radiography students and 36 bachelor degree radiography students. The hours of supervised clinical education ranged from 256 to 320 between the administration of the pre-test and post-test. Clinical experiences were similar in all programs including completion of mobile and stationary radiographic and fluoroscopic radiology procedures in inpatient, outpatient, surgical and emergency department clinical rotations. During these clinical experiences all students encountered ill-structured problems of the many uncertainties that are associated with patient care and radiographic imaging.

Instrumentation

Development of Instrument

The standardized survey instrument used in this study is the Reasoning about Current Issues (RCI) questionnaire. “The RCI is a measure of reflective judgment that focuses on the capacity to recognize and endorse more epistemically sophisticated statements from among a range of alternatives” (Kitchener, King, and DeLuca, 2006). The students were asked to read a statement about chemicals in foods, causes of alcoholism, workforce preparation, immigration policy or determinants of sexual orientation (King & Kitchener, 2004). The survey design provides contextual support
which could lead the students to higher scores, because students read a series of
statements, evaluate these statements, and choose the statement they feel most closely
resembles their own belief. Wood, Kitchener, Jensen (2002) report the RCI with
Cronbach’s alpha values in a range of 0.7-0.8.

The RCI was administered electronically by allowing students to access the
survey online at http://www.reflectivejudgment.org/. The fees for purchasing the RCI
instrument include electronic access to the questionnaire, scoring of the responses by
experts employed by RCI, and resulting data for analysis. The questionnaire begins with
demographic questions (race, gender, age, ethnicity and educational level) followed by
three situational scenarios with ill-defined answers. Each participant first writes a short
statement about their response to the ill-structured problem. This is followed by asking
each participant to rank, in order, a series of statements indicating those statements
similar to their own views. Each statement corresponds to a stage of reflective judgment
and these rankings are used by an expert to calculate the participant’s RCI scores. RCI
scores range from 2 to 7 in accordance to the Reflective Judgment Model (RJM) stages.
The scores reflect the level of reasoning most often ranked as similar to their own
thoughts (Kitchener, King, DeLuca, 2006).

**Statistical Procedures**

Descriptive statistics reported include group means and standard deviations. A 2-way
ANOVA of the independent groups (α = 0.5) was conducted to determine if the
reflective judgment means of the pre-test and post-test differ during the first year of
clinical radiography experience. The relationship between the program educational level
and the reflective judgment level as determined by scores received on the RCI was
analyzed by a 2-way ANOVA and independent sample t-test. The relationship between student age and reflective judgment level as determined by scores received on the RCI was analyzed by a Pearson $r$. 
Chapter IV
Results

Demographics

A total of 45 associate degree radiography students and 36 bachelor degree radiography students were asked to participate in the study. In October 2009, a pre-test was administrated with 43 associate degree students and 16 bachelor degree students completing the RCI. The post-test was administrated in May 2010, where 33 associate degree students and 9 bachelor degree students completed the RCI. A total of 37 students completed both the pre-test and post-test.

Sixty four (N=64) students completed at least one of the two questionnaires and this sample was used to determine demographic characteristics of the sample. The 64 students were categorized as either male (39.1%) or female (60.9%) with majority being female. The student’s ethnicities were 82.8% Caucasian, 6.3% African American and 10.9% Asian. The range of ages amongst the students was 19 to 50 years old with a mode of 22 years and a median age of 24 years. The mean age of all participants is 26.9 with a standard deviation of 7.1. The mean age of the bachelor degree students is 23.8 and the associate degree students have a mean age of 28.2 (Table 1 and Graph 1).

1. Is there a change in the radiography students’ reflective judgment stage as measured by the RCI between the pre-test and the post-test administered at the completion of the first year of clinical experience?
A 2-way ANOVA of the independent groups \( (\alpha = 0.5) \) was conducted to determine if the reflective judgment means of the pre-test and post-test differ during the first year in a radiologic technology program. The 2-way ANOVA resulted in an F value of 0.006 and a significance value of 0.939. \textit{Therefore, these results concluded that there was no main effect between the pre-test and post-test of first year radiography students.} However, these scores reflect only 37 of the students who were able to complete both the pre-test and post-test. The mean scores of both groups also resulted in no significant results with the pretest mean RCI score of 4.87 and standard deviation (SD) of 1.01 and a post-test mean RCI score of 4.86 with a SD of 1.00. \textit{Therefore, within an 8 month time period radiologic technology students were unable to raise their RCI scores (Table 2).}

2. \textbf{Is there a relationship between the type of degree program and the reflective judgment stage as determined by scores received on the RCI?}

The relationship between the program educational level and the reflective judgment stage as determined by scores received on the RCI was analyzed by a 2-way ANOVA and independent sample t-test. The 2-way ANOVA was conducted on responses from the 37 students who completed both the pre-test and post-test. This resulted in an F value of 0.170 and a significance value of 0.683 between subject effects; and an F value of .537 and significance value of 0.469 within-subject effects. \textit{Therefore, this study concluded that there was no main effect between program educational levels of radiography students and RCI scores.}

An independent sample t-test (N=64) was also conducted because there
were more students completing the pre-test and to include the entire student sample scores.

The pre-test independent sample $t$-test score was 1.387 and the post-test resulted in $t = -0.924$. This indicates that there was no variation between program educational levels and RCI scores.

Additionally, mean RCI scores for the pre-test and post-test among the associate degree radiography students and the bachelor degree radiography students were analyzed. There were 43 associate degree students who completed the pre-test resulting in a mean RCI score of 4.96 with a SD of 1.01. There were 16 bachelor degree students who completed the pre-test resulting in a mean RCI score of 4.55 with a SD of 0.97. This indicates the associate degree students were nearly one half a RCI stage higher than the bachelor degree students prior to beginning the clinical educational component of the radiography program.

In analyzing the post-test RCI scores, 33 associate degree students completed the RCI resulting in a mean RCI score of 4.79 with a SD of 1.05. Nine bachelor degree students completed the post-test resulting in a mean RCI of 5.14. This data indicates the associate degree radiography students remained in the upper 4th stage, however the bachelor students increased their scores to the 5th stage, thus gaining over a half of a RCI stage within 8 months (Table 3, Graph 2).

3. Is there a relationship between the students’ age and the reflective judgment stage as determined by scores received on the RCI?
The relationship between student age and reflective judgment stage as determined by scores received on the RCI was analyzed by a Pearson $r$. A Pearson $r$ was also calculated resulting in $r = 0.205$ which indicates no variation. Therefore it can be concluded that there was no variation between student age and RCI level (Table 4).
Chapter V  
Summary and Conclusions  

Reflective Judgment and Educational Attainment

In this study, the RCI scores were consistent with previous studies regarding college students. Both the associate and bachelor degree students were able to score in the quasi-reflective judgment stages of 4 and 5 (King & Kitchener, 1994). For this population most associate degree students would not enter the professional radiography program at an entry freshman level due to the required program prerequisites. However the bachelor degree students most frequently enter the professional program at the junior level of education which equates to at least 1 additional year of post-secondary education, so one would expect to see a variation in RCI scores based on educational level. The results of this study showed no variation. This could be due the low response rate of the bachelor degree students, so the results are not accurately representing the ability of this group. The associate degree student’s higher pre-test RCI scores could have been due to life experiences before entering the radiography program.

The associate and bachelor degree students were analyzed as independent groups and there was a change in RCI scores which would be similar to the RCI score changes that are typical between freshman and junior students. The bachelor degree student’s pre-test scores were a half a stage lower and the post-test scores were a third of a stage higher than the associate degree students. The lower pre-test scores obtained by the bachelor degree students could reflect the students’ limited of life experiences. Whereas, the
higher post-test results of this same group may be a result of educational experiences specific to the baccalaureate program. Perhaps courses and clinical activities at the baccalaureate level require students to become actively engaged in problem solving and group activities that encourage reflective reasoning.

Studies conducted with a pre-test and post-test methodology between three months and one year of time lapse between testing showed only a .02 to .19 reflective judgment stage increase (King & Kitchener, 1994). The results of this study were not consistent with these results because the radiography students showed no net gain in RCI scores over an 8 month time frame. This could be due to the fact that it was conducted during the first year of the professional program making it difficult for the students to engage in the ill-structured problems because of limited knowledge and understanding of the profession. During the first year within the professional curriculum, students are still trying to understand the basics of the profession and could be less confident to engage in atypical clinical experiences. Therefore, they may be relying too heavily on the mentorship of registered technologist and clinical instructors instead of independently solving atypical clinical experiences.

**Reflective Judgment and Educational Discipline**

As predicted, radiography students did score similar to a social science major. Social science graduates students had a mean reflective judgment score of 5.17 and mathematic science graduate students had a mean score of 4.36. (King, Wood and Miners (1990) The results show that radiography students had a mean score of 4.87, which could be attributed to the patient interaction in their clinical experience making their learning similar to situations in the social science fields.
One explanation as to why radiography students did not score in a higher range may be they lack the ability to generalize their knowledge to different ill-structured problems at this point in their education because they have limited experience in solving complex and ill-defined issues. They gain a higher level of reflective judgment within the discipline only after many repetitions and confrontations with ill-structured problems within a radiologic clinical environment. At this early stage in their professional education, they may not have built reflective judgment skills and cannot generalize their ability to answer ill-structured problems over all domains. (Fischer & Pryne, 2002)

The results of this study were not consistent with the results in a study by Boyd (2008). He found that clinical experience was able to raise dental student’s reflective judgment score by nearly one stage, because the clinical experience has high levels of uncertainty and many different situations in which a variety of ill-structured problems can exist. However, it should be noted that dental students are at a post-baccalaureate level of education, thus the reason there was no variation in radiography pre-test and post-test scores may be due to the fact that this study focused on undergraduate students.

**Reflective Judgment and Age**

This study reported that there was no difference between student age and RCI score, which is consistent with reports by King and Kitchener (1994). Non-traditional age college students do not appear to be different than the younger traditional age students. However, the associate degree students’ increase in a wide variety of life experiences could have contributed to their scores being similar to that of bachelor degree students.
A potential reason why the associate degree students scored higher on the pretest could be because of their age. A study by Glenn and Eklund (1991) was performed to demonstrate the contrast between college educated and non educated adults. The non educated sixty-five year olds were able to score similar to college students which were contributed to their life experiences. Therefore, the life experiences of the older associate degree students could have contributed to a higher pretest score.

It has been reported that midlife may be a critical stage is developing reflective judgment (Fischer & Pruyne, 2002). There is no evidence to support this theory at this time. There were only a few associate degree students in their midlife so this study was not able to see if midlife students are more reflective in nature.

**Limitations**

There were several limitations to this study. The cohort for this study was the specific population of radiography students graduating in 2011 from The Ohio State University, Virginia Commonwealth University, Columbus State Community College, and Central Ohio Technical College. The small sample size limits the power of statistical analysis. Since these results are important to the radiography programs, replication with a broader range of students could be helpful to disseminate the information across the radiography student population.

In addition, assessing changes in reflective judgment requires a period of time to allow the learner to progress through each stage, thus this study is limited to 8 months of progression. This study showed that there was no variation in reflective judgment scores in 8 months, which may be because of the short time frame. In future studies, it would be
beneficial to conduct the study over a longer period to allow the learners a great potential ability to progress to higher RCI stages.

**Future Research**

A closer review of radiography didactic and clinical experiences should be made to understand and identify opportunities to increase students’ reflective judgment. Perhaps the mean score differences between the associate degree students and bachelor degree students relate to the educational programs rather than the individual students. This could be due to different teaching styles, course and laboratory activities, and prerequisite general education requirements. Didactic courses that engage students in case studies, observations, reflective journaling/writing papers, and clinical scenarios may enhance student performance on the RCI.

The clinical experiences of radiography students also vary among programs. The students may stay at one hospital or travel to several hospitals, be at a level one trauma hospital or a small town hospital and they may have a clinical instructor geared towards education or one that does not know how to teach. It would be important to research which clinical set up would foster reflective judgment. I think students will be able to gain the most in their reflective judgment if they have a clinical instructor that understands how they can help their students achieve reflective judgment. Clinical instructors could make sure students are involved in ill-structured clinical situations, practice scenarios during down time, and let the student think and reflect about their clinical experiences. A future study could be to train clinical instructors on ways to improve reflective judgment and see if it has an effect on student reflective judgment.
There are advantages to increasing radiography students’ reflective judgment scores. Not only could it help students with the situational questions on their ARRT registry, it is also imperative that radiographers use these reflective judgment skills when they enter the work force. Radiographers receive vary minimal employee orientation and a higher level of reflective judgment will help them make appropriate decisions regarding various patient care issues. Therefore, it is important for educators to understand that they need to engage the students to think reflectively and create a clinical experience that will help the student gain reflective judgment. Lastly, additional research is needed to identify those activities that best foster reflective judgment and incorporate them in didactic courses. In terms of the impact of clinical experiences on reflective judgment, more research is needed assessing the size and type of clinical facility and the role of the clinical instructor.
References


Appendix  
Findings  

Table 1: Age, Ethnicity, and Gender Demographics  

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Graft 1: Age Demographics

![Bar chart showing age demographics]

- Age
- Total # of Students
- Bachelors students
- Associate students

Legend:
- Bachelors students
- Associate students
### Table 2: RCI Pre-test and Post-test Scores

2-way ANOVA: Pre-test/post-test

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### Table 3: Program Education Level and RCI Scores

2-way ANOVA

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Independent sample t-test

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Mean scores

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### Table 4: Age and RCI level

Pearson r

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Graph 2: Associate vs. Bachelor Degree RCI Scores

![Bar chart showing RCI scores for Associate and Bachelor Degree students pre and post-test.](chart.png)