

## **AC 2009-1032: THE IMPACT OF REFLECTIONS IN SERVICE LEARNING AND OTHER UNDERGRADUATE TEAM PROJECT LEARNING**

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# The Impact of Reflections in Service Learning and Other Undergraduate Team Project on Learning

**Keywords:** reflections, service learning, multidisciplinary team project learning

## Abstract

These analyses were designed to assess the relationships between written reflective thinking exercises and general learning outcomes in undergraduate multidisciplinary teams that were oriented toward service learning projects or other kinds of projects. Much of the literature on service learning assumes that engaging in reflections is an essential aspect of the educational process, and that engaging in service learning promotes higher level reflective thinking; however, there is little evidence that compares service learning projects with non-service learning projects to test this assertion. We compared learning outcomes for (1) students engaged in service learning projects who a) completed 3 written assignments which each contained one or two reflective thinking questions, or b) did not have this assignment as part of their project work; (2) students engaged in service learning teams and students engaged in other types of teams; (3) service learning teams that did reflections and non-service learning teams that did reflections; and (4) students engaged in service learning teams and students engaged in other teams that did not do reflections. The data were drawn from approximately 800 students who engaged in campus-wide multidisciplinary projects (average size of 12) during the fall 2006 and spring 2007 semesters. Four independent samples t-tests were conducted to assess differences in levels of reflective thinking (where such data were available) and self-assessed competence in communication, teamwork, ethical awareness, and project management. Contrary to expectations, service learning projects do not appear to increase the students' perceptions of their own performance. Nor could we find any evidence that engaging in the Reflection exercises enhanced self-assessed competence in the domains assessed.

## Foundational Research on Reflective Thinking

The concept of reflective thinking has been developed in several theories, empirically supported and almost universally accepted within the field. The foundational theories are in the work of John Dewey<sup>4</sup>, William Perry<sup>11</sup>, and King and Kitchener<sup>8</sup>.

John Dewey was a psychologist, a philosopher, and a voice for educational reform. He saw reflection as an integral part of education and life itself. Dewey described reflection as "an intentional endeavor to discover specific connections between something which we do and the consequences which result"<sup>4</sup>. His philosophies began the progressive movement in education and influenced all modern educational theories in American in one form or another.

William Perry conducted pivotal research on the development of students over the course of their four years at a university<sup>11</sup>. The result of Perry's diligent work and many hours of interviews was a scheme for understanding how college students come to their beliefs about knowledge and

knowing, and how this understanding influence the cognitive processes of thinking, reasoning, and understanding. Perry’s model is used to explain how people view truth and knowledge, which is only one part of Reflective Thinking models. Perry’s scheme was a pre-cursor to King and Kitchener’s work as well as Lynch and Wilcott’s<sup>10</sup> research on the subject. These researchers have expounded upon the work done by their predecessor and used their findings to produce a more rounded view on the subject. When comparing the models or stages of development (see Figures 1 & 2) it is clear that they do not disagree with one another; on the contrary, King and Kitchener’s work began with studying Perry’s theories and contemplating how to validate Perry’s findings<sup>8</sup>.

Figure 1:  
Perry’s Developmental Stages<sup>11</sup>

Position	Description
1. Basic Duality	Assumption of dualistic structure taken for granted, unexamined. Right vs. wrong, we vs. others, good vs. bad. All problems solved by adherence: obedience, conformity. Will power and work should bring congruence of action and reward. Multiplicity not perceived. Self defined by membership.
2. Multiplicity Pre-Legitimate	Multiplicity perceived, but as alien or unreal. Alien is error and otherness. Assimilated to authority.
3. Multiplicity Subordinate	Multiplicity perceived with some implications. Authority may not have answers yet, because absolutes are not yet in view. Trust in authority is not threatened.
4. Multiplicity Coorelate or Relativism Subordinate	Duality restructured in complete terms. “Everyone has a right to their own opinions,” or “This is how they want us to think.”
5. Relativism Correlate, Competing or Diffuse	World divided into areas where authority has answers and where relativism must be used.
6. Commitment Foreseen	Relativism accepted for secular purposes; commitment needed as a logical necessity for action.
7. Initial Commitment	Acceptance of origins in self’s experience and choices.
8. Orientation in Implications of Commitment	Tensions between feelings of tentativeness and finality.
9. Developing Commitment(s)	Commitment expended or remade in terms of growth. Balances developed between action and reflection, etc.

Figure 2  
King & Kitchener Levels of Reflective Judgment Thinking<sup>8</sup>

Stage and Description
1. Knowing is limited to single concrete observations: what a person observes is true.
2. Two categories for knowing: right answers and wrong answers. Good authorities have knowledge; bad authorities lack knowledge.
3. In some areas, knowledge is certain and authorities have that knowledge. In other areas, knowledge is temporarily uncertain. Only personal beliefs can be known.
4. Concept that knowledge is unknown in several specific cases leads to the abstract generalization that knowledge is uncertain.
5. Knowledge is uncertain and must be understood within a context; thus justification is context specific.
6. Knowledge is uncertain but constructed by comparing evidence and opinion on different sides of an issue or across contexts.
7. Knowledge is the outcome of a process of reasonable inquiry. This view is equivalent to a general principle that is consistent across domains.

King and Kitchener's book *Developing Reflective Judgment*<sup>8</sup> summarizes the results of over fifteen years of their own research, which hinged on many previous psychologists and philosophers' work. Like Perry, they also used extensive interviews to examine the development of thinking and reasoning skills. The result of their research and theory building is a seven stage model of reflective judgment (Figure 2). Although King and Kitchener use the term reflective judgment, when we use the term reflective thinking we are referring to reflective judgment. King and Kitchener's work provides the groundwork for other models of assessment of thinking and reflection

#### Research on Reflection and Service-Learning

Batchelder and Root<sup>1</sup> conducted a study at a small mid-western liberal arts college which had implemented a program to integrate service in the standard courses. Their goal was to promote public responsibility, social consciousness, and civic participation among the students. They recruited 236 students to participate in their study and 96 students from various majors participated in the comparison of the effects of service-learning course versus non-service-learning courses. Forty-eight of the participants were in service-learning courses, and the remaining forty-eight were in courses with similar content and taught by the same professor, but did not include service-learning exercises. The students in both the experimental and control group were assigned to write in their journals a response to two problematic situations. The researchers controlled for content-specific development by having the students choose one scenario relating to course material and one situation not relating to their course material. The responses to situations were then coded for pro-social decision-making, pro-social reasoning, and occupational identity processing. This exercise was used at the beginning of the semester and the end to compare the development over time. The students were also asked to complete an evaluation of their course.

The results of Batchelder and Root's study indicated that there was little difference in the increase of pro-social decision-making, pro-social reasoning, or occupational identity processing skills of the two groups of students, but there were other significant results of the study. There

was a large correlation between instructor quality and almost all the positive outcomes. The study also found that autonomy was the strongest predictor of pro-social reasoning. They concluded that freedom from authority promotes more mature reasoning skills. The students who participated in the service-learning exercises showed a much greater resolution to act in spite of acknowledged uncertainty and greater awareness of complexity and multi-dimensional social problems than the control group of students.

Similar results have been found in studies that use class participation as a measure. One such study was conducted by J.A. Buss (1994) and is particularly interesting because it sought to resolve many of the methodological problems. One extremely important facet was that they used quantitative methods for coding the student responses and had an inter-rater reliability of 0.88 which is reasonably high.

Eyler and Giles' book, *Where's the Learning in Service-Learning?*<sup>9</sup> is an insightful resource into the current research that has been done. This includes a comprehensive review of literature on all aspects of service-learning as well as multiple studies of their own. The authors describe three of their studies designed to assess the impact of service-learning. The first study consisted of a pre- post-semester survey of 1500 students, 1100 of whom participated in service-learning and 400 who did not, from 20 colleges and universities across the United States. The second study consisted of in-depth pre- and post-semester problem solving interviews with 66 students from 6 universities. The third study was comprised of data from 65 in-depth interviews of college students from 6 institutions that explore student views of the nature of reflection in service-learning. Each study controlled for multiple variables including race, gender, previous experience, closeness to faculty, and test-retest complications. Each study used rubrics and guidelines with which to evaluate the students' progress. One important note for our purposes is that the researchers based their interviews on the reflective judgment theory developed by King and Kitchener, but they did not use the Reflective Judgment Interview (RJI) for their purposes because they wanted to integrate problems the participants faced in their service-learning projects into the interview. Instead, the responses were rated using a system which relies heavily upon King and Kitchener's research, but was created by Cindy Lynch, who has done extensive research on reflective judgment measurements.

The results of this study were diverse and encompassed many aspects that are important to service-learning, but are too expansive to discuss here and do not relate to our topic at hand. The findings pertaining to reflective thinking showed that service-learning alone was not a predictor of change in reflective thinking. Although there was no statistically significant growth in the reflective thinking scores over the semester, there was a slight increase in some of the student's reflective thinking scores. The predictor for this change was a high level of service and learning integration within the classroom; these minor changes did not occur in classes where there was no service or where the service was not well integrated into the course and academic material. This is consistent with a study done by Reed and associates on the effect of short term service-learning experiences that showed that some of the benefits of service-learning can begin to emerge with only 8-10 hours of service.<sup>12</sup> The highly integrated classes regularly participated in reflection exercises and intense discussions about the work they were doing.

## Engineering Related Literature

Researchers from Rowan University<sup>3</sup> have reported on their efforts to improve metacognition among their engineering teams through structured writing and the use of the Learning Connections Inventory. The sample was thirty-two chemical engineering students and five students from other engineering disciplines. Participation was voluntary, but students were not selected by the researchers. The students were split into twelve teams and assigned to a control or experimental group. There were four categories of groups, and each group received a different stimuli. Category I received training with the Learning Connections Inventory (LCI) which consisted of a discussion about what different learning styles meant and how they can work together. Category II teams participated in structured writing assignments throughout the course that were designed for the students to discuss key concepts, concerns, and analogies for the material as well as focus on barriers to completing the project, team issues, and prioritization. Category III teams received both the LCI training and the structured writing assignments. Category IV was the control group and they received neither LCI training nor structured writing exercises. Student attitudes and performance were assessed using a rubric that evaluated technical awareness, future work proposed, meaningful error analysis of project, and drawing appropriate conclusions from the findings. The outcome of the study showed that the LCI training was extremely beneficial for the teams; the teams that received it did remarkably better on almost all rubric topics. However, the impact of reflection was inconclusive. There was a slight (approximately 0.2 on a 4.0 scale) difference between the teams that had structured writing exercises and teams without it. This study is important to consider because it is a qualitative study that was conducted to enhance metacognitive skills. Although the metacognitive skills are quite different than reflective thinking skills, they still rest on the same premises.

The Engineering Projects in Community Service (EPICS) Program was developed at Purdue University and resembles [our program]. The EPICS program allows undergraduate engineering students to aid community service agencies with technical assistance. Reflection is integrated into each milestone the team completes.<sup>13</sup> Milestones include (1) developing a semester plan, (2) meeting with project partners, (3) submitting personal goals for the semester, (4) writing progress reports, (5) submitting design reviews, (6) preparing a final report, and an end of the semester reflection. Each milestone encompasses reflective activities as well as the activities that happen within the classroom such as written or oral reports, class discussions, and seminars. There are approximately 8 exercises outlined in this report that provide opportunities for structured and intentional reflection outside of the classroom. The reflections exercises, first introduced in spring of 2003, were evaluated to determine the students' level of reflective thinking as outlined by King and Kitchener. The 2004 report concluded that most students were in the pre-reflective to quasi-reflective level of reflective thinking at the end of the semester. They did not evaluate results throughout the semester or compared them to each other, nor have they published more outcomes of semesters since then, but it is clear that they received similar results as Perry's research. This is the only study found that specifically addressed reflections of engineers.

## Summarizing Previous Research

Many of the studies did not intentionally set out to measure reflective thinking, but they were designed to measure other constructs such as pro-social decision-making and reasoning, or metacognitive abilities. The reason these studies measured portions of reflective thinking is that they were measuring constructs that are also identified in the reflective judgment model of King and Kitchener. The term reflection is used so widely that the meaning gets lost and it can be used to describe all sorts of activities. For example, many people would not have considered the activities of Rowan University's programs<sup>3</sup> reflections. They are included in this synthesis of literature because they are measuring how well people could frame difficult problems and the extent to which they could conclude that there was an appropriate next step to solve an ill-structured problem like teamwork and personal relationships.

Research pertaining to engineers is important because engineers primarily use systematic problem solving which emphasizes methodical techniques which are necessary to tackle most engineering problems.<sup>9</sup> Engineering issues often have ethical, human, or environmental impacts and require a critical perspective that engineers need to have. This critical perspective that is necessary is gained through reflective thinking. This is done by asking the same types of questions everyone else must ask during reflection, but engineers rarely want to participate in reflective activities because it seems unsystematic and outside of most engineers' comfort zones. The reality is that reflective thinking is paramount to everyone's ability to frame questions and come to conclusions to problems that have messy answers. Taking the opportunity to step back and evaluate what you are doing and why it is important is as important as the problem solving methodology you use.

One challenge when discussing reflections in service-learning is that the connection for most educators is already there. They see no need to test whether or not reflection works – they just assume it does.

One important factor to examine in each of the studies is the reliability of the findings. With the exception of Perry,<sup>11</sup> King and Kitchener,<sup>8</sup> and Eylers and Giles' research<sup>5</sup>, the methods for grading or evaluating reflective thinking levels have not been tested, which leaves the reliability of their methods of evaluation in question. All of the studies are quasi-experimental at best and although this is better than a descriptive article, most did not control for all the secondary variables that could be affecting the dependent variables. Some of the studies were well designed and controlled for secondary variables that could affect the results such as gender, race, test-retest, and previous experience. These studies are much more reliable, but no study controlled for every variable. For example, Batchelder and Root's study<sup>1</sup> and the Rowan University's research<sup>3</sup> controlled for differences in instructors, but the others did not.

Overall, the research tells us that reflecting upon a situation or problem promotes understanding of the problem, how it affects others, what the possible outcomes are, and which outcome is the best choice for a particular situation. It allows students to understand that the world is not methodical and that evaluating a situation in terms of others produces better results most of the time.

## **A Comparison of Reflection Exercises with Service Learning and Other Students**

### **Sample**

The participants for this analysis were involved in a team-based problem-solving course at a medium-sized Midwestern private university. The school requires undergraduate students from all disciplines to participate in two multidisciplinary team-based projects courses that focus on real world problems such as writing textbooks, designing affordable housing solutions for the world's rural poor, or developing an artificial pancreas.

The 198 students in the current sample are a non-random subset of students taking a multidisciplinary project team courses during the fall 2006 and spring 2007 semesters who agreed to complete Reflection assignments; 96 in the fall and 102 in the spring. Participation in this research project was optional, and the faculty instructors leading the teams self-selected to participate on behalf of the teams. Faculty instructors were recruited by employees of the university academic department responsible for coordinating the multidisciplinary project courses. Since students tend to enroll in these courses during their junior and senior years, most of the students in this sample are college juniors and seniors. Students who completed reflections were compared with students involved in similar project teams who did not complete reflections.

### **Measures**

During the fall 2006 and spring 2007 semesters, a subset of students completed 3 written assignments per semester that each contained one or two reflective thinking questions. The responses to the questions were coded into three levels of reflective thinking based on the Reflective Judgment Model developed by King and Kitchener.<sup>8</sup> Previous analyses<sup>6</sup> indicated that most students were operating at the quasi-reflective level or the pre-reflective level; very few measured at the reflective level.

The primary outcome measurement used to evaluate the effectiveness of the projects was the self-assessment tool. This assesses how each individual student feels about their accomplishment of the overall program objectives: communication, teamwork, ethical and multicultural awareness, and project management. The questionnaire provides a definition of each learning objective, and 10 statements assessing competencies under that domain; responses are on a 5-point scale. The tool is administered to all of the students in the program at the end of the semester. Only the responses of students who consented to participate in the research study are included in any of the analyses of service-learning or reflective thinking activities.

### **Analyses and Results**

Four independent samples t-tests were conducted to evaluate the hypothesis that service-learning projects and/or engaging in formal reflection exercises promote higher self-assessments of competence in students in our program. The four t-tests compared: service learning teams that did reflections vs. service learning teams that did not do reflections; service learning teams vs. non-service learning teams, none of which did reflections; service learning teams that did reflections vs. non-service learning teams that did reflections; and service learning teams that did not do reflections vs. non-service learning teams that did not do reflections. The outcome variable in the study was the self-assessment measurement of the student.

The t-test between service learning teams that did reflections and service learning teams that did



not do reflections was not significant  $t(127.36) = 0.306, p = 0.760$ , (Mean difference = 0.063). The 95% confidence interval for the difference in means ranged from 0.342 to 0.467. Cohen's  $d$  indicated that students on service learning teams that did reflections scored about 0.05 standard deviations higher on the self-assessment than students on the service learning teams that did not do reflections. This difference is small and unstable. It is likely that there is no practical difference between these two groups in their scores on the self-assessment.

The second independent samples  $t$ -test was conducted to evaluate whether students on service learning teams scored higher on the self-assessment measure than students in non-service learning teams. The  $t$ -test was not significant  $t(197.90) = -1.002, p = 0.317$  with a mean difference of -0.115. The 95% confidence interval for the difference in means ranged from -3.403 to 0.111. Cohen's  $d$  indicated that students on service learning teams scored about 0.09 standard deviations lower on the self-assessment than students on non-service-learning teams. This difference is slightly larger and more stable than the first comparison, but it is still very likely there is no difference between these two groups in their scores on the self-assessments and that the difference is due to sampling or random error.

The third independent samples  $t$ -test was conducted to evaluate the hypothesis that Service learning teams that did reflections scored higher on the self assessments than non-service-learning teams that did reflections. The  $t$ -test was not significant,  $t(173) = -0.862, p = 0.390$  and the mean difference = -0.133. The 95% confidence interval for the difference in means ranged from -0.438 to 0.172. Cohen's  $d$  indicated that students on service learning teams that did reflections scored about 0.114 standard deviations lower on the self-assessment than students on non-service-learning teams. Once again, the difference is a bit larger than the previous tests, however, it is also more unstable, and it is likely that there is no real difference between the two groups in their scores on the self-assessment.

The final independent samples  $t$ -test conducted was evaluating whether the students who were on service learning teams that did not do reflections scored higher on the self-assessment than students on non-service-learning teams that did not do reflections. The  $t$ -test was not significant,  $t(123.53) = -0.780, p = 0.437$  with a mean difference of -0.117. The 95% confidence interval for the difference in means ranged from -0.415 to 0.181. Cohen's  $d$  indicated that students on service-learning teams that didn't do reflections scored about 0.087 standard deviations lower on the self-assessment than students on non-service learning teams that didn't do reflections. This is, once again, a small, fairly unstable difference that is likely to have occurred due to chance and is unlikely to be an actual difference between the two groups.

## Discussion

The data analysis shows that neither participation in service-learning projects nor engagement with formal reflections increase the students' perceptions of their own performance through the self-assessment measurement. This is contradictory to our hypothesis at the beginning of the project; however, after studying some of the literature that has been produced on the topic, our hypothesis changed to incorporate the new information which stated that there was no statistical significance in reflective thinking levels produced by involvement in service-learning projects. There is, however, still hope for benefits from the service-learning projects if extended long-term. While the outcomes assessed were not related to type of project (service learning or other)

or involvement in reflections, there may well be benefits of service-learning projects such as civic responsibility, motivation, and communication skills that we did not measure. In addition, the use of reflections may be equally beneficial for service learning and other types of teams.

There were however, some limitations on our study. For example, the sample includes students who were volunteered to participate by their professor. Most professors did not choose to participate and there could be a difference between the professors who chose to have their teams participate and the professors who did not have their teams participate. This would not be accounted for in our study. Other factors include the non-random selection and non-random assignment of participants to groups which is problematic, but unavoidable in the academic community. Another issue that was problematic but unavoidable was the acceptance and full participation of the students and professors who were included in the study. Thus reflective activities were not fully integrated into the course.

Additional research is needed to compare reflective thinking between engineering students and other students. This would help professors understand how to involve students in reflective exercises more effectively. Another avenue that should be examined further is the use of reflective thinking exercises in groups versus individual exercises such as writing assignments. There is also a significant gap in the quantitative research on baseline levels of reflective thinking of service-learning and non-service-learning projects, as well as the differences that occur when reflective thinking is promoted. This could help support theories that service-learning projects naturally generate more reflective thought and therefore increase reflective thinking levels.

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