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INFORMATION SYSTEMS EDUCATION JOURNAL

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The Impact of Teaching Approaches and Ordering on IT Project Management: Active Learning vs. Lecturing

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Abstract

This study explores the difference between both active learning and lecturing to teach Scrum project management in a university setting. The goal was to understand if one approach results in higher perceived learning over the other. Additionally, lesson ordering was examined to determine student preference of lecturing prior to or after an active learning exercise. Results suggest that students perceived they learned more from the active learning exercise compared to the lecture. Students preferred the active learning exercise compared to the lecture and found the active learning to be more engaging. Recommendations based on these findings are to use active learning exercises to teach Scrum project management in conjunction with lectures on the topic and to order the lessons with the lecture first followed by the activity.

Keywords: Scrum Project Management, Agile Project Management, Active Learning, Learning Styles, Pedagogy

1. INTRODUCTION

University faculty often desire to increase engagement of students in the classroom. One approach that has been successful is active learning. Active learning can engage students in the process of thoroughly learning a topic leading many educators to urge increased use of this approach (Bonwell and Eison, 1991). Furthermore, active learning exercises can engage students in higher-order thinking tasks such as analysis, synthesis and evaluation (Bonwell and Eison, 1991) which may help when approaching concepts that students may have little exposure to outside the classroom.

The traditional model of instruction, the lecture or transmission model, is more focused on remembering than internalization and deep understanding (Richardson, 1997). Alternatively, other approaches such as the constructivist approach to learning encourages students to engage, work, take ownership, and understand material by adding to known knowledge and building on new knowledge by exploring possibilities (Clark, 2008). This approach leads students to move beyond remembering material to more meaningful higher-order tasks. This study examines how an active learning exercise can engage students more thoroughly to understand project management in an information systems university setting.

The context for this study is Scrum project management (Schwaber and Beedle, 2002), where students learn the principles, roles, activities and iterations used to manage the system development life cycle. Scrum has been taught in both a lecture format and active learning activities. However, the challenge with

teaching Scrum, especially to undergraduates, is many students have no prior work related experience and may have a difficult time understanding the topic. Thus, this study aims to explore how alternative approaches to teaching Scrum (i.e. active learning) may increase a student's perception of learning.

The students in this study were exposed to two approaches to learn Scrum project management concepts: lecture and active learning. This study examines student perceptions of these two approaches to the topic. Lecture is an example of aural learning style and activity lessons are example of kinesthetic learning style. Students were split into two groups some had the activity first followed by the lecture, while others had the lecture first followed by the activity. The goal was to examine differences in their perceptions of the lessons. The lessons cover a portfolio approach to the material as the content was covered through multiple methods (Lage et al., 2000). Student surveys were collected and analyzed to answer research questions about the lessons. The research questions examined in the current study include:

- What is the preferred approach for learning the Scrum, the active learning exercise or the lecture?
- Do students perceive they learn more during the activity or the lecture?
- What is the preferred order of the lessons - activity followed by lecture (AL) or lecture followed by activity (LA)?
- Is the activity or the lecture more engaging?

A post-hoc analysis was completed to determine how the preferred approach to learning was related to students' perceptions of their learning. We examined whether students who preferred one approach to learning (activity or lecture) perceived that they learned more in that approach, were indifferent to the approach, or whether they perceived they learned more in the other approach.

2. LITERATURE REVIEW

Active learning is a broad term for instructional methods that engage students through meaningful learning activities that require students to solve a problem or task (Prince, 2004; Bonwell and Eison, 1991). The task should be sufficiently complex that higher-order thinking is involved like analysis, synthesis and evaluation (Bonwell and Eison, 1991). Bonwell and Eison (1991, p. iii) define active learning as, "involving students in doing things and thinking about what they are doing."

Active learning can be further broken down based on the approach taken by the faculty and includes *collaborative learning, cooperative learning and problem-based learning* (Prince 2004). Collaborative learning is a group-based active learning technique where students work together in small groups to complete a common objective (Prince, 2004). A core element of collaborative learning is that students are working and interacting with each other instead of working individually. Cooperative learning is similar to collaborative learning where tasks are completed in small groups with the additional aspect that student progress is assessed at the individual-level (Prince, 2004). Students in cooperative learning settings will learn in a group, but are individually accountable for their learning outcomes. Problem-based learning is a technique where relevant problems are used to provide context and motivation for the learning objective (Prince, 2004). Problem-based learning often requires a student to apply their knowledge to solve a problem through self-directed learning (Prince, 2004).

A collaborative approach was used in this study for the active learning exercise where students worked together in small groups of three to four students to complete tasks using Scrum project management. The teams completed tasks from a sprint backlog following Scrum practices. Students were not assessed on their individual progress on the tasks but were to complete these activities to learn the process. The tasks were structured so that higher-order thinking would be involved and students could move beyond the mechanics to why the process works, and under what conditions Scrum is effective.

Teaching style and student learning styles work well when they are closely matched (Lage et al., 2000; Bishop and Verleger, 2013). When mismatches occur between teaching and student learning style a portfolio approach can be used (Lage et al., 2000). There are many different student centered learning styles and approaches to understanding learning style cited in the literature (Bishop and Verleger, 2013; Van Zwanenberg et al., 2000). Using multiple teaching styles in the classroom has been shown to increase student performance (Lage et al., 2000). Lujan and DiCarlo (2006) note that most first-year medical students preferred learning material through two or more presentation styles.

Fleming (2001) extends Eicher (1987) neuro-linguistic model into a sensory model known as VARK. Where VARK represents Visual (V), Aural

(A), Read/Write (R) and Kinesthetic (K). VARK is a learning style based on perceptual modes and instructional preference. This model is a preferred method for collecting, organizing, and interpreting information received (Hawk and Shah, 2007). In the VARK model, the visual learners prefer diagrams, charts, flow charts, graphs, different designs and pictures. Aural learners prefer lecture, topic discussions, group discussions, and seminar attendance. Read/ write learners prefer reading books and texts, handouts, articles, taking notes, and writing essays. Kinesthetic learners prefer real-life examples, physical activities, field trips, trial and error, constructing, working with models, laboratories, hands-on approaches, and collection of samples to understand problems and provide solutions for problems. Fleming's VARK questionnaire encourages learners to improve their learning by understanding their preferred modes of communication (Hawk and Shah, 2007). This study asked students to indicate their preferred method of learning and in which lesson they perceived they learned the most after both lessons were completed.

The research here followed a portfolio approach where students had both a lecture and an active learning session. This approach should allow more students to have the lessons presented in a manner that matches their learning style. A portfolio approach may also have the added benefit of increased student performance. According to Fleming (2006) any learning style that motivates learners to think about the way they learn, enhances learning since it is a step towards better understanding of the learning process. Fleming (2001) reports in his study when instructors match learning activities with students learning preferences, the students' performance improve in their courses since preferred learning modes bring flexibility for instructors and students so that both can change their behavior.

The research will also examine the relationship between the preferred lesson (presentation style) and student perceptions of learning. The lecture portion used an aural style and the activity used a kinesthetic style. The goal of using these multiple styles is to encourage deeper and higher-order learning.

3. RESEARCH METHOD

An online survey was used to collect the data for this study. Surveys from 155 students were collected over 2 semesters from five classes. Data was collected from three senior level information systems analysis classes and two introduction to management information systems classes. All sections were taught by the same instructor.

Study Design

The study was designed such that classes were randomly selected to one of two conditions: (1) activity first followed by the lecture (AL) or (2) lecture followed by the activity (LA).

The active learning exercise involved students folding origami using Scrum project management to complete the tasks. The folded origami represented software under development where students and instructor could measure progress of each task (user story). Students were provided packets of origami instructions and origami paper. Students formed groups of three to four students for the activity. Instruction about the Scrum process were provided and included a description of the product backlog (all the diagrams in the origami packet) a sprint backlog (a subset of the product backlog to be completed in a sprint), *day length* (for the purpose of the exercise, a day was 5 minutes), iteration length, scrum roles and daily questions. Students made estimates for the tasks in the sprint backlog, would hold a daily meeting and work through the *day* folding their origami. Progress would be measured after the iteration completed and adjustments could be made according to the Scrum process. A complete description of the exercise is beyond the scope of this paper.

Surveys were given to students after both the first and second lessons. Of the 155 students participating in the study, only 125 completed both surveys which resulted in dropping the 30 students who completed just one of the two surveys. The final participant count across the conditions was 41 students in the AL group and 84 students in LA group.

Survey questions were asked regarding the preferred method of delivery, perceptions of learning, and preferred order of delivery (AL or LA). All questions were scaled on a seven-point Likert-type scale. The survey did not use a forced choice design, i.e. a survey respondent could say they had no preference for method of delivery, perception of learning, or preferred order of delivery. A final question was asked to determine the level of engagement for the lesson (See Appendix A for a complete list of questions).

4. RESULTS

The analysis was performed using JMP Pro 13 from SAS. Results for each item were kept in their appropriate nominal or ordinal form throughout the analysis. For the first three questions, preferred method of delivery, perceptions of learning, and preferred order of lessons, the responses remain in nominal form (e.g. for preferred method of delivery the response could be lecture, exercise or no preference). Non-parametric testing was performed to determine if statistical difference were found for the research questions. Chi-square ($\chi 2$) tests were performed and, where appropriate, Fisher's exact test was performed. Chi-square test and contingency tables were used to investigate student preferences and engagement. Fisher exact test was used to calculate more precise probabilities in situations where the sample size yields less than 5 expected values per cell.

Preferred Lesson

To answer the first research question, we asked students which lesson they preferred or if they liked them both about the same. Results suggest the activity was preferred by most students (69.6%), followed by those who had no preference (20.8%) then those who preferred the lecture (9.6%). $\chi 2$ probability results were <.0001 indicating that the null hypothesis is not supported. Thus, the results suggest that the answer to the question concerning preferred approach is that students preferred the activity more than the lecture (see Figure 1).

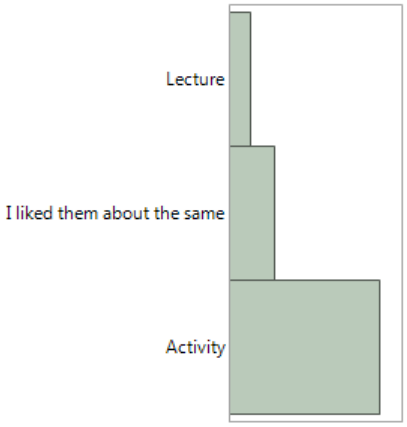

Figure 1: Preferred Lesson

Perceived Learning

Our next research question attempts to answer the question of perceived learning based on the approach. Results suggest the students perceived they learned the most during the activity compared to lecture. 45.6% of students perceived they learned most in the activity, 31.2% perceived they learned about the same in both the activity and lecture, and 23.2% perceived they learned more in the lecture. $\chi 2$ probability results were <0.0080 indicating that the null hypothesis is not supported (see Figure 2).

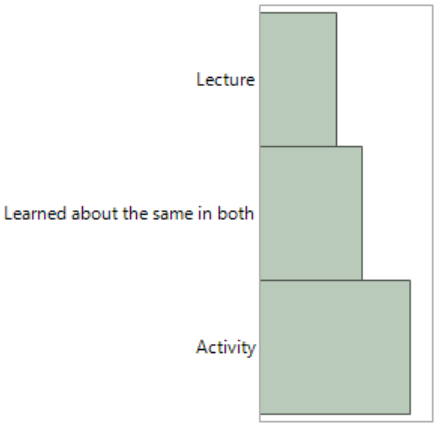

Figure 2: Perceived Learning

Preferred Order of Lessons

The next question is whether students have a preferred lesson ordering. Students preferred the order of the lessons to be lecture followed by the activity. 50.4% preferred lecture followed by the activity. 32.8% preferred the activity followed by the lecture. 16.8% showed no preference. $\chi 2$ probability results were <0.0001 indicating that the null hypothesis is not supported (see Figure 3).

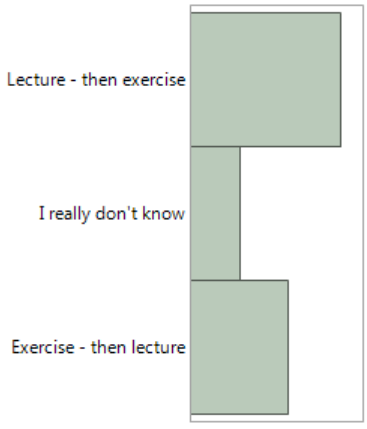

Figure 3: Preferred Order of Lessons

Furthermore, to ensure there was not difference based on ordering effects, we examine the difference between those who received the lecture first to those participating in the activity

first. Results show that the preferred lesson (lecture/activity/no preference) did not vary (in a statistically significant way) based on the order that students experienced the lessons. The preferred lesson was the activity for both groups. The activity was favored by 69.6% of all students. Students who had the lecture first liked the activity at a higher rate than those who had the activity first (73.8% vs. 61.0%), but the difference is not statistically significant. χ2 probability results were <0.1200 indicating that the null hypothesis is supported. Fisher's Exact Test probability was 0.1239 and also indicates no statistically significant difference are present (see Figure 4).

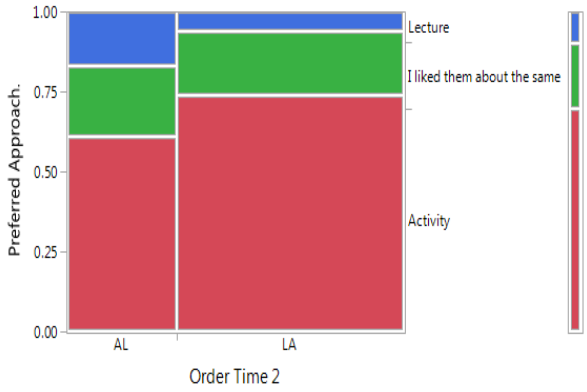

Figure 4: Preferred Lesson by Order

Perceptions of Learning by Order

A similar analysis was conducted concerning learning perceptions to answer whether those who had the activity→lecture condition (AL) perceived they learned more compared to those who had the lecture→activity condition (LA). There was no statistically significant difference between learning perceptions across the two conditions. In other words, those who had the AL condition did not perceive they learned more (or less) than those who had the LA condition

Students in both groups said they learned the most in the activity. The activity was selected by 45.6% of students as the lesson by which they learned the most. In fact, those who had the lecture first (LA) perceived they learned the most through the activity compared to those who had the activity first (AL) (51.2% vs. 34.1%). However, the difference is not statistically significant as the χ2 probability results were <0.1929 indicating that the null hypothesis is supported. Fisher's Exact Test was 0.1874 and indicates no statistically significant difference (see Figure 5).

Figure 5: Perceptions of Learning by Order

Preferred Order of Lessons by Order

The results in this section determine whether students who experienced one order of instruction indicated that they would prefer the same order of instruction or indicated that they would prefer to have experienced a different order. For example, did students who experienced the activity followed by the lecture have a preferred order of lessons that is different from students who had the lecture followed by the activity?

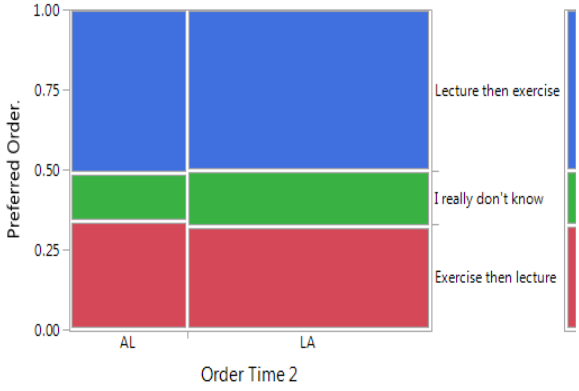

Figure 6: Preferred Order of Lessons by Order

Students who had the activity→lecture did not prefer a lesson ordering different from students who had the lecture→activity in a statistically significant way. A majority of students (50.4%) said that the preferred order of lessons was to have the lecture then the activity. Students who had the lecture first perceived that the best order was lecture then activity at a lower rate than students who had the activity first (50.0% vs. 51.2%), but the difference is not statistically significant. χ2 probability results were <0.8976

indicating that the null hypothesis is supported. Fisher's Exact Test was 0.9341 and also indicates no statistically significant differences. See Figure 6.

Lesson Engagement

The last research question focuses on what was more engaging, the activity or lecture. To examine this, the results are broken down across the times they received each lesson. Recall that a post lesson survey was conducted after each lesson at time 1 and time 2. Thus, the results below will first discuss engagement after the first lesson followed by a discussion of engagement following the second lesson.

The results across both conditions (AL and LA) after lesson 1 suggest that those receiving the activity first found it to be very engaging (50% of students strongly agreed that the activity was engaging). This is compared to those receiving the lecture first where only 7.2% of students strongly agreed that the lecture was engaging. These results were found to be statistically significant suggesting the active learning exercise to be much more engaging. Students in the activity group strongly agreed that the activity was engaging. χ2 probability results were <0.0001 indicating that the null hypothesis is not supported. Fisher's Exact Test probability was < 0.0001 and also indicates statistically significant differences are present (see Figure 7).

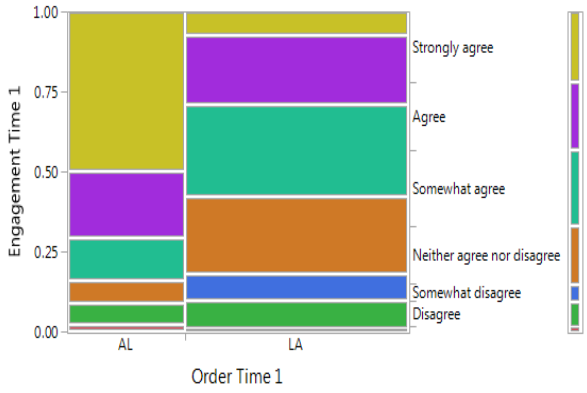

Figure 7: Engagement First Session by Order

The lesson 2 results found that 47.7% of students who had the activity in the second class strongly agreed that the activity was engaging whereas only 18.6% of students who had the lecture in the second class strongly agreed that the lecture was engaging. Again, this was statistically significant supporting the prior lesson 1 results that student engagement was strongest for activity based learning compared to lecture. Students in the activity group strongly agreed that the activity was engaging. χ2 probability results were <0.0003 indicating that the null hypothesis is not supported. Fisher's Exact Test probability was < 0.0001 and indicates statistically significant differences are present (see Figure 8).

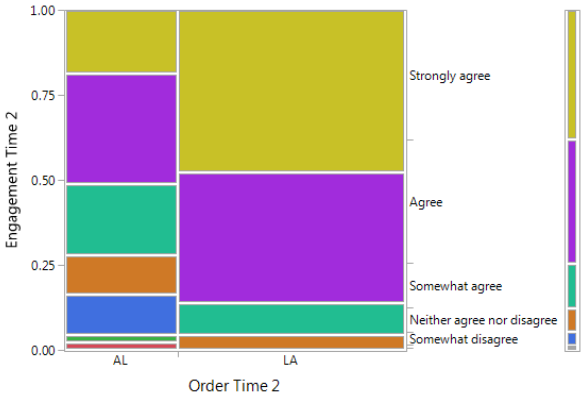

Figure 8: Engagement Second Session by Order

Preferred Lesson and Perceptions of Learning Relationship

Finally, a post-hoc analysis was conducted to understand the relationship between preferred lesson (activity/lecture/no preference) and perceptions of learning (learned more in lecture/activity/learned about the same in both approaches). The analysis found that students perceived that they learned the most in the activity (45.6%) compared to the lecture (23.2%) and compared to those who said they learned about the same amount in each lesson (31.2%). Thus, there is a statistically significant difference between the preferred lesson and where the student perceived they learned the most. Students who preferred the activity (69.6% of learners) perceived that they learned the most in the activity (62.1%), whereas 23.0% felt they learned the same in both approaches and 14.9% felt they learned more in the lecture.

A minority of students (9.6%) preferred the lecture to the activity or had no preference, but of these students 58.3% of them felt they learned more in the lecture. Students who preferred the lecture chose the activity as the lesson where they learned more at lower levels (14.9%). Students who said they had no preference in lesson (20.8%) said they learned about the same amount in both lessons at a higher level (57.7%). χ2 probability results were <0.0001 indicating that the null hypothesis is not supported. Fisher's Exact Test probability was < 0.0001 and also indicates statistically significant difference are present (see Figure 9).

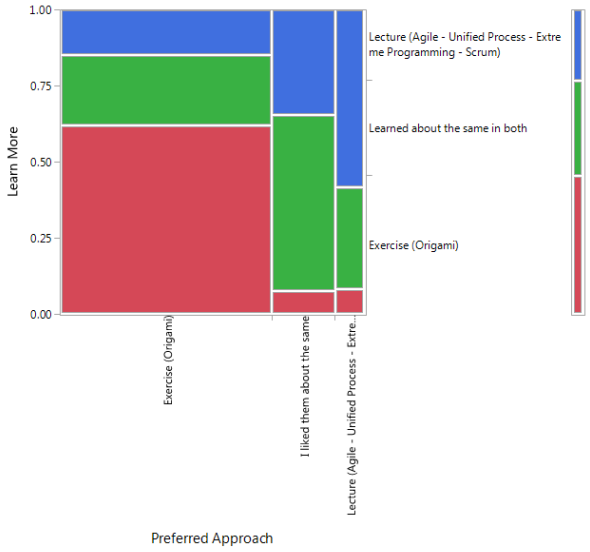

Figure 9: Preferred Lesson and Learning Relationship

5. DISCUSSION

The purpose of this study is to determine preferred method of instruction, ordering of the lessons, and perceptions of learning.

A clear majority of students (69.6%) preferred the activity lesson for Scrum project management. A small minority of students (9.6%) preferred the lecture to the activity and approximately one fifth of students (20.8%) were indifferent to the method - they liked the activity and lecture at about the same level. These results are consistent with Bonwell and Eison (1991), where more students prefer active learning to lecture methods.

Students perceived that they learned the most in the activity (45.6%), and about a quarter (23.2%) perceived they learned more in the lecture. Approximately 1/3 of students (31.2%) were indifferent to where they learned the most - they perceived that they learned about the same amount in the lecture and the activity. These results indicate that a portfolio approach may be used to match student learning styles with an appropriate method. Every learner prefers one or combination of different perceptual modes from the VARK learning style (Hawk and Shah, 2007). When instructors bring different learning styles such as, kinesthetic and aural described in VARK more students are able to learn more effectively (Alkhasawneh, Mrayyan, Docherty, Alshram, Yousef, 2008). The lessons on project management included a lecture component that focused on aural learning and an activity that focused on kinesthetic learning.

Aside from preferred method of instructions, the results of the study also suggest that ordering may play a role in student learning. Approximately half of the students (50.4%) would prefer the lessons to be ordered with the lecture first followed by the activity. This is compared to less than one third of students (32.8%) preferring the activity first and 16.8% of students were indifferent. Providing the lecture first would fit the flipped classroom style of instruction where students learn about the concepts first and then delve deeper into the material in the classroom. There are advantages and disadvantages to either approach. Students were less engaged in the lecture portion than the activity (see Figures 7 & 8) so they are more passive about the instruction. Student who had the lecture→activity may not realize the importance of the material because they are less engaged. It is somewhat easier to engage the students who had the activity→lecture during the lecture because they were more engaged, overall, in the lesson. The lecture becomes more cogent to the learner when the student experienced the activity first. A potential downside to the activity→lecture is that some amount of preparation must be completed before the students can start the activity so that the lesson can be learned. The game mechanics must be easy enough to learn and complex enough that the activity reflects a real-life situation and still have the student learn from the experience (Baker et al., 2005).

Several analyses were performed to determine whether the ordering of the lessons (AL or LA) had statistically significant differences on the preferred approach, students' perceptions of learning, and the preferred order of the lessons. Students who had the lecture→activity preferred the activity at higher levels (73.8%) compared to those who had the activity→lecture (61.0%), but the differences were not statistically significant. In general, we can say that the experience of having activity→lecture or lecture→activity did not change a student's preference for the activity over the lecture. The number of students who expressed no preference for both groups is similar - approximately 20% of students liked both approaches about the same. The lecture was the preferred approach by larger percentages of students who were in the activity→lecture cohort (17.1%) compared to the lecture→activity cohort (6.0%) but this difference was not statistically significant. This may be similar to the trade-offs discussed above, the lecture may be more cogent

to those who experienced the activity first, but not so much so that the lesson order preference changed from activity to lecture or vice-versa in a statistically significant manner.

Analysis on whether the lesson order (AL or LA) affected the student perceptions of learning was not statistically significant. The distributions in terms of where students thought they learned the most by lesson was more evenly distributed. Overall, students indicated that they learned the most in the activity (45.6%), followed by stating they learned about the same in both (31.2%), then the lecture (23.2%). Those who had the lecture→activity thought they learned more in the activity (51.2%) compared to the activity→lecture group (34.2%) but this difference is not statistically significant. Those who had the activity→lecture had higher levels stating that they learned more in the lecture (29.3%) compared to the lecture→activity group (20.2%) but this difference is not statistically significant. The distributions for the activity→lecture group were much more evenly distributed regarding their perceptions of where they learned the most. In the activity→lecture group, 36.5% said they learned about the same in both lessons, 34.2% said they learned more in the activity and 29.3% said they learned most in the lecture. The distributions for the lecture→activity group were much less evenly distributed regarding their perceptions of where they learned the most, the majority (51.2%) said they learned the most in the activity. The remaining members in the lecture→activity group, 28.6% said they learned about the same in both lessons and 20.2% said they learned most in the lecture. Overall, it appears that the activity was where students felt they learned the most and that the lesson order did not have a statistically significant impact on where students perceived the learned the most.

Analysis showed that actual lesson ordering (AL or LA) on the preferred lesson order (activity→lecture or lecture→activity) had little impact how the students preferred lesson order. That is, a majority of the students (50.4%) felt that the content should be delivered with the lecture first then the activity. Only small differences exist between those who experienced activity→lecture or lecture→activity in the classroom.

The post-hoc analysis regarding the students who experienced different lesson orders revealed only small differences in their perceptions in terms of their preferred ordering (activity or lecture), where students felt they learned the most content (activity or lecture), and lesson order (lecture followed by activity or activity followed by lecture). Students generally preferred the activity, felt they learned the most in the activity, and preferred the lesson order to be lecture followed by activity.

The analysis found statistically significant differences in the relationship between the preferred lesson (activity/lecture/no preference) and student perceptions of where they learned the most (activity, lecture or learned about the same in both approaches). Students who preferred the activity felt they learned the most in the activity, students who were indifferent to the approach felt that they learned about the same in both lessons, and those who preferred the lecture felt they learned the most in the lecture. In terms of class size, it is important to note that most students (69.6%) preferred the activity compared to the smaller group who preferred the lecture (9.6%), and 20.8% of students who were indifferent.

Students who preferred the activity perceived they learned the most in activity (62.1%). There were students who preferred the activity and said that they learned about the same in both lessons (23.0%), and students who said they learned the most in the lecture (14.9%). Students who had no preference for activity or lecture (20.8%) felt they learned about the same in both approaches (57.7%), then the lecture (34.6%), then the activity (7.7%). And students who preferred the lecture (9.6%) felt they learned the most in the lecture (58.3%). There were students who preferred the lecture and said that they learned about the same in both approaches (33.3%), and students who said the learned the most in the activity (8.4%). Students who preferred one lesson type and then stated that they learned more in the other lesson type were a minority of students. Generally speaking, if students preferred one lesson type they said they learned more in that lesson type. Using activities in the classroom will likely increase student perceptions that they are learning more in the classroom, perhaps because they are more engaged with the material. A small minority of students of approximately 10% preferred the lecture to the activity. Students who preferred the lecture have a 58.3% probability that they learned more in the lecture, where students who preferred the activity had a 62.1% probability that they learned the most in the activity. Students who were indifferent to the approach have a 57.7% probability that they learned about the same in both approaches. These results support that

diversity in teaching styles may increase student performance (Lage et al., 2000; Lujan and DiCarlo, 2006).

Analysis on engagement with the activity and lecture show that students were more engaged with the activity at statistically significant levels. Levels of engagement were collected after each class session. 50% of students who had the activity in the first class strongly agreed that the activity was engaging. 7.2% of students who had the lecture in the first class strongly agreed that the lecture was engaging. There are statistically significant differences in how the lesson (activity or lecture) engaged the students where students were more likely to strongly agree that the activity was engaging. Similar differences exist for the second class session. 47.7% of students who had the activity in the second class strongly agreed that the activity was engaging. 18.6% of students who had the lecture in the second class strongly agreed that the activity was engaging. There are statistically significant differences in how the lesson (activity or lecture) engaged the students where students were more likely to strongly agree that the activity was engaging. Higher levels of engagement are expected in active learning environments and these findings are consistent with the expectations (Prince, 2004; Bonwell and Eison, 1991).

6. LIMITATIONS

There are many active learning methods like co-operative learning, problem-based learning, flipping (inverting) the classroom, inquiry-based learning, guided classroom discussion, etc. that were not investigated in this research. It would be difficult to draw definitive conclusions beyond teaching Scrum project management as an active learning exercise. Project management approaches may be particularly well-suited to active learning, as evidenced by the more than 150 agile games available online (see TastyCupcakes.org for additional examples). Additionally, the results are consistent with past research on active learning and constructivist approaches where student engagement is increased through these approaches (Bonwell and Eison, 1991; Richardson, 1997).

There may be ordering effects which may limit the generalizability of the results. The approach taken in this research did not attempt to have students who were part of the activity→lecture group gain exposure to the concepts prior to the active learning exercise. Potentially, flipping the classroom for the activity→lecture students may diminish or eliminate the need to have the lecture in a classroom setting. Flipping the classroom may have prepared the students better for the activity that students completed. The activity was designed to be quick to understand but more familiarity with the content may have been helpful. However, our results suggest that which group the students were assigned to did not have a significant impact on their perceptions.

The instructor who taught both the activity and lecture may be better at facilitating active learning exercises then lectures. It was not the goal of the instructor to have a low engagement lecture but other instructors may be better at this approach. Students have different learning styles with which they are comfortable and teachers have different aptitudes with different teaching styles (Lage et al., 2000).

Another potential limitation may be comprehensiveness of the activity. The lesson covering Scrum project management was not meant to be comprehensive. Rather, it was designed as a primer on the subject, thus the lesson did not cover everything required to effectively use the method. The lesson covers basics of roles, activities and processes for team members. The product owner task was controlled by the instructor and did not attempt to cover all of the decision making for product owners in Scrum.

Finally, this research measures student perceptions of learning, not actual learning. All questions are a self-assessment in which students provide their perceptions of learning about the activity and lecture lessons. The students' assessment about their learning may be more tied to their preferred approach then their actual learning. This limitation can be addressed by including objective measures of learning outcomes in the future. This research does not investigate a causal relationship between the preferred lesson and perceptions of learning.

7. CONCLUSION

This study examines multiple aspects of active learning and lecture approaches in a university setting. The context for this study is instruction on Scrum project management (Schwaber and Beedle, 2002) to undergraduate students. Most students preferred the active learning exercise compared to the lecture. The results are consistent with the literature (Bonwell and Eison, 1991; Lage et al., 2000) where students tend to prefer active learning to lectures.

Most students perceived that they learned more in the activity compared to the lecture. The results show a diversity in student learning styles; while most students preferred the activity, a minority of students preferred lecture and these students felt that they learned more in the lecture compared to the activity. The results support using a portfolio approach to teaching the material where multiple methods are used to cover the material. Students preferred the content to be ordered with the lecture first followed by the activity rather than having the activity first followed by the lecture. This approach would be similar to approaches by instructors advocating a flipped classroom approach (Lage et al., 2000; Bishop and Verleger, 2013). Students found the activity to be a more engaging activity compared to the lecture as expected in an active learning approach (Bonwell and Eison, 1991; Prince, 2004). Recommendations based on this research would be to include active learning exercises to teach project management approaches, deliver the content with a lecture first followed by the activity, and continue to teach with a lecture session and an active learning session. Students likely moved beyond the basics of remembering information to higher-order thinking like analysis and evaluation by delivering these lessons through both active learning and lecture formats.

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A Appendix: Related Survey Questions

1. Did you prefer the lecture or exercise more?
   (a) Exercise (Origami)
   (b) Lecture (Agile - Unified Process - Extreme Programming - Scrum)
   (c) I liked them about the same
2. Where did you learn more?
   (a) Exercise (Origami)
   (b) Lecture (Agile - Unified Process - Extreme Programming - Scrum)
   (c) Learned about the same in both
3. What order would you prefer the classes to be in?
   (a) Exercise - then lecture
   (b) Lecture - then exercise
   (c) I really don't know
4. This exercise/lecture was engaging
   (a) Strongly disagree
   (b) Disagree
   (c) Somewhat disagree
   (d) Neither agree or disagree
   (e) Somewhat agree
   (f) Agree
   (g) Strongly Agree

B Perceptions of Learning by Preferred Approach

The figures show the relationship between students who had a stated preference for the delivery of the content (prefer activity, prefer lecture, and no preference) and where the student perceived they learned the most. See Figures 10, 11 and 12. Students who preferred the activity indicated they learned the most in the activity (Figure 10). Students who had no preference for the approach indicated the learned about the same in both approaches (Figure 11). Students who preferred the lecture indicated they learned the most in the lecture (Figure 12).

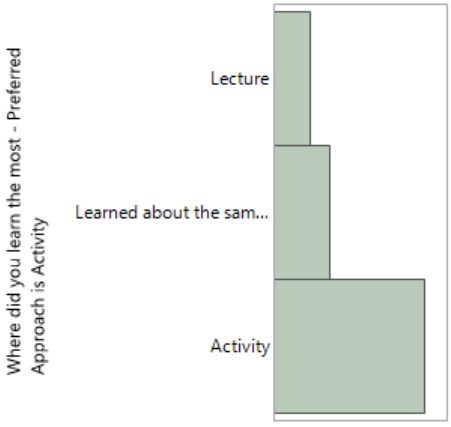

Figure 10: Perceptions of Learning Students who Preferred the Activity

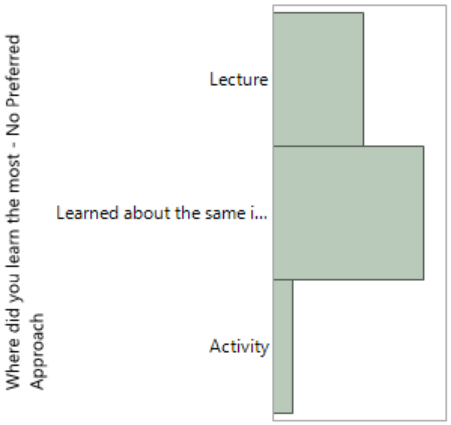

Figure 11: Perceptions of Learning by Students who had No Preference

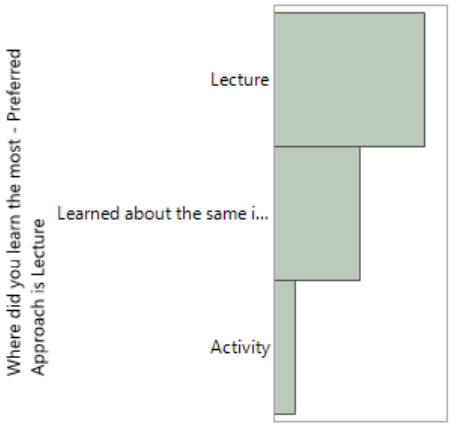

Figure 12: Perceptions of Learning by Students who Preferred the Lecture