PERCEIVED AFFORDANCES OF A TECHNOLOGY-ENHANCED ACTIVE LEARNING CLASSROOM IN PROMOTING COLLABORATIVE PROBLEM SOLVING

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ABSTRACT

This study explored students and instructors' perceptions and experience of technology affordances in an technology-enhanced Active Learning Classroom (ALC) to promote students' collaborative problem solving. Multiple case studies were conducted. Five classes of 92 students and five professors participated in this study. The data sources were class observations, interviews, and pre- and post-surveys. The study showed that students' self-efficacy and confidence in completing problem-solving tasks increased over time. Additionally, it was found that some professors used the ALC to its potentials while others used it minimally. While both students and professors agreed about numerous benefits of ALCs for learning and instruction, how technology was used depended on the perceived purpose, needs and meaningfulness of the instructors.

KEYWORDS

Active Learning Classroom, Technology, Affordances

1. INTRODUCTION

In recent years, there has been a growing interest in designing technology-enhanced Active Learning Classrooms (ALCs) to facilitate collaborative learning (Kim & Hannafin, 2010, Montgomery, 2008). Research shows that "space matters" to enhance students' learning (Montgomery, 2008; Oblinger, 2006). ALCs are equipped with technology, such as large round tables, microphones, boards around the classroom edges, and large LCD screens, to promote interactive, student-centered learning (Walker, Brooks, & Baepler, 2011). In an ALC environment, students are placed on the spotlight of learning, engaging in critical thinking and problem solving through furniture arrangement and setting design while a professor is the coach instead of an information transmitter.

Evidence suggests that classroom features influence how students learn and how instructors teach (Brown & Long, 2006; Chism, 2006; Chism & Bickford, 2002; Lomas & Oblinger, 2006; Oblinger, 2006). Studies show that the ALCs have a positive impact on student learning outcomes (Brooks, 2010; Walker et al, 2011; Whiteside, Brooks & Walker, 2010), enhance students' conceptual understanding, improve their problem-solving skills and attitudes, increase motivation (Beichner et al, 2007; Dori et al, 2003), and enable instructors to align their teaching methods with classroom features accordingly (Walker et al, 2011; Whiteside et al, 2010). While research suggests that space matters, it also indicates that instructional approach matters. Some studies indicated that students made more gains in a team-based learning environment than in a lecture-based environment in the same ALC setting (Walker et al., 2011). However, the previous studies did not investigate what factors in an ALC influence or motivate student learning. Most of the research we found focuses on students' achievements (e.g., course grades, quizzes, exams, and homework) and less on students and professors' perceptions and experience of ALCs.

2. PURPOSE

The purpose of this study was to investigate the impact of the ALCs on students' learning and instruction, their perceptions of technology affordances, and their experience of technology for facilitating collaborative learning. It was also to understand instructors' instructional behaviors and instructional decisions in using technology. Ecological psychology (e.g., Gibson, 1979; Gibson & Pick, 2003) argues that individuals are information detectors who are capable of perceiving affordances in the environment and how they become apprised of these possibilities for action (Young, Barab & Garrett, 2000). Central to ecological psychology are the concepts of affordances and effectivities (Gibson, 1979; Gibson & Pick, 2003). The literature suggests that the space does not only facilitate students to collaborate on projects and engage in inquiry learning but also allows instructors to modify their teaching methods accordingly. It appears necessary to explore the following questions: 1) How do instructors choose to use technology to carry out their instruction? 2) What technology do students use to facilitate their collaborative problem solving? 3) What is the impact of ALCs on students' motivation and self-efficacy in solving problems? And 4) What are students' and instructors' perceptions regarding ALC affordances?

3. METHOD

Multiple case studies were conducted for this reseaerch. Five classes of 92 students (both undergraduates or graduates) and five professors from various disciplines (meteorology, biology, zoology, political science, and chemistry) participated in the study. Four professors were also interviewed. Each participating class was regarded as an individual case unit (Stake, 2005; Yin, 2002) and was examined through class observations, interviews, and surveys. Observations were conducted at different points of the semester, focusing on instructors' teaching approaches, class activities, use of technology in ALC, and the interactions between instructor and students and among students. The surveys were administered at the beginning and the end of the semester, asking students' perceptions about: intrinsic motivation, problem-solving confidence, and problem-solving skills related to their subject domain. Descriptive statistics were conducted on the observation data, which were also qualitatively analyzed and coded. The interview data were coded, interpreted, categorized, and triangulated with the observation data to identify themes.

4. FINDINGS

Figure 1 and Figure 2 demonstrate two contrasting cases – Case 1 (Zoology: 14 students, undergraduate and graduate) and Case 5 (Organic Chemistry, 24 undergraduate) with the percentage of time distribution in group work, individual work, lectures, student-instructor interactions, student presentations, and quizzes. The two representative cases were in contrast regarding the time spent for the class activities. Case 1 was much more balanced with time spent between instructor lecturing and students' activities, while Case 5 was largely dominated by expository and lectures. The other classes fall under either more student-centered learning (e.g., Case 1) or less student-centered learning (e.g., Case 5). At the same time, it was observed that Case 1 took full advantage of the ALC technology to promote their collaborative problem solving, while Case 5 only limited technology use to big screens, round tables and iPads. Furthermore, Case 1 instructor scaffolded students' problem-solving through many case studies and discussions, while Case 5 instructor mainly used technology to demonstrate concepts which were difficult for students to understand and to illustrate complex relationships among the concepts.

The survey results indicated that students achieved significantly higher confidence scores in the posttest (M_{pre}=308.10, SD=44.34; M_{post}=332.86, SD=32.58; $p < .05$), but there were no significant differences in the measures of perceived intrinsic motivation problem-solving skills.

Most students interviewed agreed that "the layout of the room and the synthesis of technology make group learning possible" (e.g., Case 4) and prompted them to work together more freely and to interact with the instructor more at ease. Some students (e.g., Case 5) indicated that they had "learned from multiple views and how to reach consensus" through collaborative learning.

Some other students (e.g., Case 4) mentioned that the app that downloaded to the iPad helped them to learn difficult concepts through the display of molecule structures and dynamic interactions of molecules. Overall, the students summarized the value of the ALC as “interactive, engaging, and effective.”

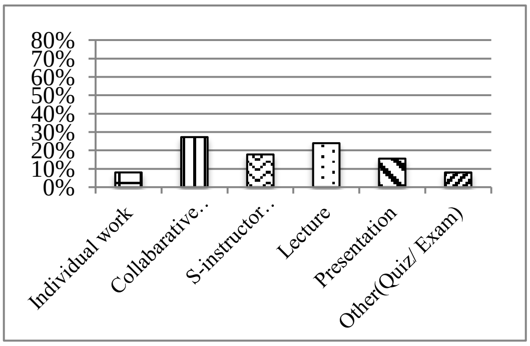

Figure 1. Class Time Distribution of Case 1

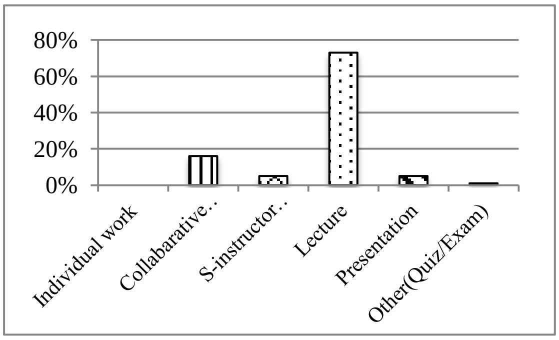

Figure 2. Class Time Distribution of Case 5

However, there were some concerns regarding the use of the ALC. One of the concerns was that there was often short of time for group activities given the current class structure (meeting 1 hour per class, 3 times per week), leaving little time for intensive group discussions or projects. Some other students also expressed the concern regarding those group members who did not prepare before class or contribute minimally to group projects. The interviews also indicated that some professors did not use technology to its full potentials, or some professors did not have adequate training in using the technology.

The instructors commonly recognized that by teaching in an ALC they were no longer confined to the podium; and that they could walk around easily to monitor and guide group activities, answer questions any time, and provide timely feedback. It gave them ample opportunities to identify students’ difficulties during class. In addition, the three instructors (Case 1, Case 2, and Case 4) really enjoyed the technology, which helped them to illustrate abstract concepts more easily. One instructor said that the document camera was very helpful for him to illustrate the domain content related to atmospheric physics, while the instructor of biochemistry indicated that the app downloaded to iPads helped him to illustrate the structure and the interactions of chemistry molecules to his students and to engage his students in manipulating and observing the molecules in 3D view, which was consistent with the feedback obtained from the students. The ALC technology helped the instructors to consider developing instructional strategies or learning activities that were aligned with the characteristics of ALCs (e.g., group activities or case studies). A professor said that the ALC was not just about technology or space, but rather “a new way of thinking of learning and instruction.” However, there were concerns about not having enough time to cover the content. A professor believed that it was his responsibility to “build the mental structure for the students; and then they could fill in the gaps.” Therefore, he found himself in a dilemma of offering more time for students’ group work or spending more time covering the course content. Two instructors indicated that appropriate use of the ALC depended on course content and class size. They believed that ALC seemed more suitable for small classes where group activities were more possible due to the constraints of time and class size. Some professors indicated that they did not know how to use all of the technology. As they learned more about different functions of the technology, they might be able to come up with more instructional strategies and student activities.

5. DISCUSSION AND IMPLICATIONS

It was found that there was a wide gap between professors who used the ALC technology to its full potential and those who only used it minimally. Some professors used the ALC more frequently for group work and collaborative activities, while others predominantly used the room for lectures, worrying about lack of time to cover course content if time would be spent for group activities. According to ecological psychology, ALC provides affordances for improving learning and instruction, but it relies on the ability of users to take actions. The users must perceive the meaningfulness of technology and consider their needs (Gibson, 1979; Gibson & Pick, 2003). In this research, the professors perceived the use of technology in different ways according to the nature and content domain of a course.

They were the ones who determined how to drive a class (Gibson, 1979; Gibson & Pick, 2003), which was contingent upon numerous factors, such as content domain, class size, course structure, and their personal views of learning and instruction.

The findings inform us that in the ALCs, active learning does not happen automatically; effective instructional design strategies are needed to make active learning happen. The use of ALCs requires a fundamental paradigm shift on both professors and students: a new way of viewing knowledge, learning and instruction. The study implies the necessity to provide extensive examples and trainings for professors on two dimensions (technological and pedagogical) and to reconceptualize "time" and restructure class schedule (e.g., changing three meetings per week into 1 or 2 meetings to provide students more time for group work)

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REFERENCES

Beichner, R. *et al*, 2007. Student-Centered Activities for Large Enrollment Undergraduate Programs (SCALE-UP) project. In E. Redish & P. Cooney (Eds), *Research-Based Reform Of University Physics* (pp. 1–42). American Association of Physics Teachers, College Park, MD.

Brooks, D. C., 2010. Space Matters: The Impact of Formal Learning Environments on Student Learning. *In British Journal of Educational Technology,* Vol. 42, No. 5, pp 719-726.

Brown, M., & Long, P., 2006. *Trends In Learning Space Design*. In D. Oblinger (Ed.), *Learning spaces* (pp. 9.1-9.11). DC: EDUCAUSE, Washington.

Chism, N., 2006. Challenging Traditional Assumptions And Rethinking Learning Spaces. *In Learning spaces B2 - Learning spaces*. EDUCAUSE, Boulder, CO.

Chism, N., & Bickford, D., 2002. *The Importance of Physical Space In Creating Supportive Learning Environments*. Jossey-Bass Inc Pub, USA.

Dori, Y. et al, 2003. Technology for Active Learning. *In Materials Today*, Vol. *6*, pp44–49.

Gibson, J.J., 1979. *The Ecological Approach To Visual Perception*. Houghton Mifflin, Boston.

Gibson, E. J. & Pick, A. D., 2003. *An Ecological Approach To Perceptual Learning And Development*. Oxford University Press, New York.

Kim, M. C., & Hannafin, M. J., 2010. Scaffolding Problem Solving in Technology-enhanced Learning Environments (TELEs): Bridging Research and Theory with Practice. *In Computers & Education,* Vol. 56, No. 2, pp 403-417.

Lomas, C., & Oblinger, D. (2006). Student Practices and Their Impact on Learning Spaces. In D. Oblinger (Ed.), *Learning Spaces*. EDUCAUSE, Washington, DC.

Montgomery, T., 2008. Space Matters: Experiences of Managing Static Formal Learning Space. *In Active Learning in Higher Education*, Vol. 9, No. 2, pp 122-138.

Oblinger, D., 2006. Space as a Change Agent. In D. Oblinger (Ed.), *Learning Spaces*. EDUCAUSE, Washington, DC.

Stake, R., 2005. Qualitative Case Studies. In N. Denzin & Y. Lincoln (Eds.), *The Sage Handbook Of Qualitative Research.* Sage, Thousand Oaks, CA.

Walker, J. D. et al, 2011. Pedagogy and Space: Empirical Research on New Learning Environments. *In Educause Quarterly,* Vol. 34, No. 4.

Whiteside, A. L. et al, 2010. Making the Case for Space: Three Years of Empirical Research on Learning Envrionment. *In Educause Quarterly,* Vol. 33, No. 3.

Yin, R. K., 2002. *Case Study Research: Design and Methods* (3rd Ed.). Sage Publications, Thousand Oaks, CA.

Young, M. F. et al, 2000. Agent As Detector: An Ecological Psychology Perspective On Learning By Perceiving-Acting Systems. In D. H. Jonassen & S. M. Land (Eds.), *Theoretical Foundations Of Learning Environments.* Lawrence Erlbaum Associates Publishers, Mahwah, NJ US.