Success in Asynchronous Courses Through Increasing Student's Social Presence

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Online education has fundamentally altered the educational landscape, enhancing accessibility and flexibility for learners. However, a notable limitation of asynchronous learning modalities is the diminished interpersonal engagement inherent in traditional face-to-face pedagogical contexts. This empirical inquiry investigates the impact of deliberately integrating highly interactive instructional activities within online asynchronous developmental mathematics courses. Three principal thematic categories emerged through the iterative design process of these activities. Each category is delineated and exemplified, followed by exploring course policies conducive to student achievement in interactive learning contexts. Following a grounded theory approach, this study scrutinizes course outcomes alongside student and instructor evaluations at the semester's end. Findings suggest incorporating social interactive activities yields positive effects on course outcomes.

Keywords: social presence, online pedagogy, developmental math

INTRODUCTION

Online asynchronous developmental mathematics courses have been offered in higher education for some time; mathematics educators were some of the first to offer e-learning to their students (Zucker, 2006). Homework and instruction in online developmental mathematics courses were often facilitated through web-based homework systems that provided drill and practice environments (Spence & Usher, 2007). Most instruction was given over video, through an online textbook, or simulation and animation (e.g. interactive examples) (Luik, 2007; McCoy, 1996). As online courses evolved, it became apparent that asynchronous math courses had much lower success than their in-person counterparts (Jaggars, Edgecombe, & Stacey, 2013).

A developmental mathematics department at a public and open enrollment institution analyzed institutional course results by modality and student success metrics for many semesters. During the review of these courses, it was determined that the pass rates were always lower for the asynchronous sections than the in-person sections (see Table 1). This coupled with the rise of online classes, led faculty at this institution to investigate possible solutions to the online success disparity.

TABLE 1
PASS RATES OF COURSE BY MODALITY

Courses	Face to Face	Online
Prealgebra	70.18%	55.77%
Intermediate Algebra	70.69%	60.05%
Quantitative Reasoning	77.97%	67.59%

Note: Pass rates are from Fall semester 2019. Pass rate is defined as the number of students with a C or higher divided by the number of students who were enrolled in the course.

It has been shown that social presence on the part of the instructor (LaBarbera, 2013) and peers (Mayes, 2011) can improve students' perceived satisfaction and increase retention rates (Hegeman, 2015). The feeling of support can increase success in online courses (Jaggars, Edgecombe, & Stacey, 2013). A new course shell was developed, and interactive activities, discussions, and greater instructor presence were embedded in the course to address the achievement disparity.

This study measured the course satisfaction and achievement of students in the high social presence course compared to their peers in courses with no intentional interaction. Students' satisfaction was measured using the results of an end-of-semester course evaluation form. Student success was measured using standard methods of grade reporting and grades on the common final exam.

SOCIAL PRESENCE

The asynchronous online math courses did provide content and skills practicing, much in the same way that in-person classes did. However, the human portion of the course, or the relationships between the students, their peers and the instructor was very different in the online environment. This human aspect of courses was referred to as "social presence."

Social presence was first defined by Short and Christie (1976) as the "degree of salience of the other person in the (mediated) interaction and the consequent salience of the interpersonal relationships." Other definitions have been used in subsequent work, but in essence social presence is the feeling that an individual is "real" during course communication (Richardson & Swan, 2003). Social presence develops in three relationships. The relationships of instructor to student, student to peers, and student to self (Davis, 2017).

Social presence has been shown to positively influence students' motivation (Huang, 2017), course and instructor satisfaction (Horzum, 2017), actual and perceived learning (Russo & Benson, 2005), retention (Richardson, Maeda, Lv, & Caskurlu, 2017) and success ((Lee & Recker, 2021). Increased social presence also increased student interaction with the course and content (Tu & McIssac, 2002). These attributes make social presence a very important addition to online courses.

ACTIVITY DEVELOPMENT

Creativity was needed during the creation of the course activities to provide a level of interaction that led to meaningful discussions between students. Particularly in the developmental courses, discussion prompts and ideas necessarily fell outside of the normal course content. Most content questions in developmental mathematics did not lead to meaningful discussions among the students as the questions tended to be either incorrect or correct and did not spur discourse.

Questions, prompts, and assignments at the higher levels of Bloom's taxonomy promote more interactions between students (Ertmer, Sadaf, & Ertmer, 2011). This led to activities developed in three main categories: 1) metacognitive, motivational and study skills, 2) Open-ended problems, games, or creative problem-solving activities, 3) real-life projects with reflective discussion. To raise the level of interaction within the activities, students were asked to synthesize plans, assess the benefits and limitations of a model or study skills, and defend their decisions using the data they developed.

Metacognitive, Motivational and Study Skill Activities

Metacognitive activities have been shown to lead to deeper, more durable, and more transferable learning (Bransford, Brown, & Cocking, 2000). Using these activities early in the course exposed students to study skills they may not have been previously taught or mastered. Ideas of metacognitive assignments may include test preparation, note taking, time management and utilization of campus resources. Assignments encouraging reflection about their learning and attitude can provide a medium for meaningful peer-to-peer interaction.

Example Activity 1: Why Do You Need to Learn Math?

Student Learning Objective. Students will analyze their math attitude and contrast their math beliefs with scientific information about a person's innate mathematics ability.

Prompt. How many times have you heard somebody say, "I'm not a math person"? How many times have you said, "I'm not a math person"? Watch the video below to learn about some of the benefits of learning math, science debunking the idea that math ability is genetic, and a broader understanding of how studying math can help the overall health of your brain.

Assignment. Students watched a video that presented scientific information about mathematics and the human brain. The video particularly emphasized the idea that there was not a math gene. Students answered three reflections questions and then were asked to provide meaningful responses to at least two other students.

Open-Ended Problems, Games, or Creative Problem-Solving Activities

Creative problem-solving activities are mathematical activities that can provide intellectual challenges that enhance students' mathematical development. Such problems promoted students' conceptual understanding (Mayer, 2006), fostered their ability to reason (Muin, Hanifah, & Diwidian, 2018), communicate mathematically (Tambunan, 2019), and captured their interests and curiosity (Pasani, 2018). Problem solving often consisted of much trial and error, and felt frustrating for many students. Students learning to problem solve always began feeling stumped, constantly reworking portions of the assignment, and searching for a "road map" to get to the solution. The road map development built mathematical prowess (Apino & Retnawati, 2018) and aided students learning through the course, making the struggle worthwhile. Problem-solving activities can consist of games, puzzles, or open-ended mathematics problems.

Example Activity 2: Rule of 24

Student Learning Objective. Students will experiment with the order of operations to solve a basic puzzle.

Rules. The game of 24 is a number game where you take four numbers and use them to get to 24 (Marecek, Anthony-Smith, & Mathis, 2020). You are given four numbers. Using any arithmetic operation between each number, you must use the given numbers to arrive at 24. You must use each number exactly once. This is a great way to see why the order of operations matters.

Assignment. Students are given two sets of four numbers. They are asked to post their solutions for both sets using proper notation. After posting, they were assigned to check at least two peer's posts, using order of operations.

Real-Life Projects With a Reflective Discussion

Real-world assignments are important in mathematics courses (American Mathematical Association of Two-Year Colleges, 2006) and give students a place to connect the content with their real lives (Albert & Antos, 2000). Including a reflective discussion after the assignment connected the real-word math with peers. Students discussed problem solving strategies, their conclusions, and their struggles. In addition, assignments required analysis of a situation or decision making. Real-world assignments can consist of determining how much money is lost by skipping class once, purchasing a car, or developing a study schedule.

Example Activity 3: Percent & Budget

Student Learning Objective: Students will develop a budget for a specific paycheck. They will analyze their resulting budget using percentages to form a conclusion about the merits and weaknesses of the budget.

Prompt: Financial experts do not necessarily agree on the specifics of budgets, but there are generalities that they all tend to agree on. Some suggest a simple 50/30/20 rule, where 50% of the budget goes towards living expenses and necessities, 30% towards wants, and 20% towards debt and savings.

You were recently hired full-time at a company. Below is a pay stub from your new job.

TABLE 2
EXAMPLE ACTIVITY 3: DEVELOP A BUDGET BASED ON A PAYCHECK

	EMPLOYEE NAME/ ADDRESS		SSN	REPORTING PERIOD	PAY DATE	# 7848
Worker, Bee				05/28/2019 - 06/10/2019	6/11/19	Employee # 12345678
INCOME	RATE	HOURS	CURRENT PAY	DEDUCTIONS	TOTAL	YTD TOTAL
GROSS EARNING	Salary		$1,730.77	STATUTORY DEDCUTIONS		
				FICA - MEDICARE	$25.10	$276.10
				FICA - SOCIAL SECURITY	$107.31	$1,180.41
				FEDERAL TAX	$210.39	$2,314.32
				STATE TAX	$86.54	$951.92
YTD GROSS	**YTD DEDUCTIONS**		**YTD NET PAY**	**TOTAL**	**DEDUCTIONS**	**NET PAY**
$19,038.46	**$4,722.75**		**$14,315.71**	**$1,730.77**	**$429.34**	**$1,301.43**

To spend wisely, you'll first need to create a monthly budget. Although budgets vary, use the following monthly expenditures as a basis for your budget: rent ($800/month), utilities ($150/month), groceries ($400/month), clothes ($100/month), other costs ($400/month).

Assignment. Students determine what percentage of their monthly income is in each of the given categories. Using percentages, they will compare their results to the ideal given in the problem. They compute their student loan payment and determine if it was affordable. They reflect on their financial situation and respond on a discussion board to what they learned about budgeting. They also reply to two peers.

Course Policies

While developing the activities, pedagogical considerations were made to foster student success (DeNoyelles, Mannheimer Zydney, & Chen, 2014). Students were notified early in the semester that discussions were expected. Details about the graded discussions were written in the syllabus. The discussion boards and activities were a priority in class design (DiPietro, Perdig, Black, & Preston, 2008). To signify the importance of the activities in the course the activities were given a percentage of the grade that was 10% of the overall grade. The assignments were required (An, Shin, & Lim, 2009) and graded based upon rubrics (Salter & Conneely, 2015) that guided the students' responses to the discussion and their interactions with their peers.

The instructors took an active role on the discussion boards and often commented on the discussion and by doing so increased the interaction within the discussions (Rovai, 2007). Responding to discussion threads and individual student posts was made a priority by instructors, as it helped students see the instructor as real (Hew, 2015) and promoted their social presence. Instructors responded to and highlighted good responses and explained why the response was receiving attention.

While students could often find those who agree with them, they also gained experience interacting with others with different viewpoints, a skill not often built into math classes (Nussbaum, Hartley, Sinatra, Reynolds, & Bendixen, 2002). A portion of the assignment's grade was given to civility in responses to foster a positive and safe environment.

By using activities that promote metacognitive awareness, as well as games, open-ended, and real-world problems, discussions were more forthcoming and had more depth. Required video responses and group work also increased peer interaction and a greater individualization of the course.

METHODS

The developed course shell was instituted in three sections of a developmental mathematics course. These three sections were compared against other offered course sections that had no specific treatment for social presence.

We evaluated the effectiveness of the activities and student satisfaction using an analysis of end-of-semester student rating of instructor (SRI) surveys, course pass rates, and the required departmental final exam results. Course pass rates are defined as the number of students with a C or better over the number of students enrolled in the course.

The SRI survey is an institutional survey administered in all courses. The comments from the SRI survey for both the treatment and control groups were analyzed using thematic coding. Specifically, themes about the instructor being real, feelings of community, seen by their peers or the instructor, or the activities in general were notated.

After the implementation of the new course activities, the institution moved online due to the Covid-19 pandemic. At the beginning of Spring semester 2020, 80% of the developmental mathematics courses at this institution were offered in person. By Fall 2020 37% of developmental mathematics courses were offered in person. The shift online by the occurrence of the pandemic impacted the results of our survey and courses in general as many students found themselves in an overwhelmingly different life situation.

RESULTS

The comments from the SRIs gave insight into students' attitudes towards the pedagogical changes. Several students commented specifically on the course design and the positive effects on their connection to the course and the material. Some sample comments include, "I was able to make connections and found out how this can be useful in everyday life" and "The online discussion questions really helped me understand the material better." Specific comments indicated that the students felt connected to their instructor, such as "Constant communication was key, and I felt that our professor did a wonderful job." There were no negative comments regarding the course activities, the instructor, or the course design. Control course students mentioned the consistency in instructor responses, but there were no specific comments about connections to others or course material.

The SRI comments from the treatment group had increases in the areas of "instructor availability," "work collaboratively," and "instructor helped" compared to courses not participating in the study. Areas with similar scores from non-study courses included "instructor provided feedback" and "developed essential skills."

The SRI numerical data between the treatment group and control group are shown in Table 3.

TABLE 3
STUDENTS RATING OF INSTRUCTORS (SRI) SCORES

Question	Rating for Treatment	Rating for Control
Instructor helped	4.62	4.56
Challenged to think in a new way	4.72	4.67
Developed essential skills	4.69	4.67
Instructor provided feedback	4.78	4.23
Instructor was available	4.78	4.38
Worked collaboratively	1.63	1.5
Connect to community	1.71	2
Response rate	59%	39.10%

Note: Scores are done on a 5-point Likert scale. The SRI survey is anonymous and offered to all students at the end of the semester.

The final exam scores and final grades analysis revealed no statistically significant differences between the treatment and control groups, indicating a lack of discernible impact attributable to the experimental intervention on academic performance outcomes.

Qualitative and quantitative data from multiple sources were analyzed to determine students' perception of online learning in a math course designed with high social presence.

LIMITATIONS AND DISCUSSION

The data does indicate a slightly positive result by including highly interactive course activities. It is beneficial to include these activities in asynchronous courses to gain back some of the social presence that is lost in the online classroom, but the activities and course structure must be well-designed. Students tended to fall back to comments such as, "Your idea is great, thanks for sharing," rather than meaningful interactions with their peers. Instructor presence in the discussions was vital for students to gain meaning from the assignments.

Finding activities and content to drive discussion in a developmental math course was difficult. While creative problem-solving and other problems promote social presence, it was not always possible to find relevant problems for students to complete. Students needed well-written and non-trivial prompts to participate in the discussion in a way that indicated they were engaged. These types of activities require many iterations, involving much refining and polishing.

The technology used could be improved. Discussion boards have a place in the current pedagogy of asynchronous courses, but they can feel outdated to students. Perhaps using boards designed to be more like common social media sites or feeling more organic to students could have provided a more engaging course environment.

The instructors of the treatment section did find that their workload went up considerably with the increased expectation of being highly present in their course. Asynchronous courses taught with high social presence require a commitment of time that instructors may find overwhelming. Maintaining a presence in online discussion boards, providing comments to specific students, grading the posts and assignments, and touching base with students regularly takes considerable work. Teachers of asynchronous courses may need to initiate conversations about distributing workload, especially as being highly socially present becomes more standard.

One limitation of this study was that the results of the survey and grade analysis were likely influenced by COVID-19 and the rapid move to online for all courses, affecting our ability to draw specific conclusions about the influence of the increased communications from the instructor and the sense of community in the course. The data may also have been influenced further by the policy change of allowing students to choose a pass or fail option at the end of this semester. Although very few individuals chose to take the pass/fail grade option, it may have swayed the opinions and attitudes of some students.

The treatment group was created in a course that generally had between 3 and 4 asynchronous sections taught in any semester. Comparison between the in-person sections, the treatment sections and the control sections became difficult due to the lower number of sections that is innate in the course offerings.

CONCLUSION

Social presence is an important facet of any asynchronous online course. Interactive course activities increase the students' social presence and their success in the course. In mathematics courses, especially at the developmental level, developing course activities that are interactive can be difficult, but were possible. Participants were able to build relationships with their instructors and peers. Throughout the semester, students developed their own identity in the course and saw their instructor and peers are real people using metacognitive activities, games, creative problem-solving and real-world problems combined with online discussion boards to share thoughts and results.

Course design was important to ensure that the discussion boards allowed for meaningful interactions. This included instructor participation. The instructors highlighted thoughtful insights, required the activities, assigned a meaningful percentage of the grade to the assignment category, and provided clear instructions and rubrics. Students were encouraged to provide meaningful responses and to engage with each other. Instructors created course policies, such as giving the activities a meaningful percentage of the grade, that encouraged students to participate in the activities and to engage in discourse.

Discussion board topics that were based on real-life gave more meaning to students. Topics that had open-ended prompts encouraged more active thinking and participation. Discussion board topics also included analysis and decision-making wherever possible.

It was indicated through student course evaluations that students responded positively to the interactive activities. Student surveys contained comments reporting that the instructor was more available and provided meaningful feedback compared to student evaluations from students without these activities. Other measures showed no statistically significant results.

REFERENCES

Albert, L.R., & Antos, J. (2000). Daily journals connect mathematics to real life. *Mathematics Teaching in the Middle Schools*, *5*(8), 526–531.

American Mathematical Association of Two-Year Colleges. (2006). *Beyond Crossroads: Implementing Mathematics Standards in the First Two Years of College.* Mephis, TN.

An, H., Shin, S., & Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. *Computers & Education*, *53*(3), 749–760.

Apino, E., & Retnawati, H. (2018). Creative problem solving for improving students' Higher Order Thinking Skills (HOTS) and characters. In *Character Education for 21st Century Global Citizens* (p.8). London. https://doi.org/10.1201/9781315104188

Bransford, J.D., Brown, A.L., & Cocking, R.R. (2000). *How people learn: Brain, mind, experience, and school.* Washington, D.C.: National Academic Press.

Davis, A.M. (2017). How do we establish social presence within Online Mathematics Coures. *Hawaii International Conference on Education.* Honolulu, HI.

DeNoyelles, A., Mannheimer Zydney, J., & Chen, B. (2014). Strategies for creating a community of inquiry through online asynchronous discussions. *Journal of Online Learning & Teaching*, *10*(1).

DiPietro, M., Perdig, R.E., Black, E.W., & Preston, M. (2008). Best practices in teaching K-12 online: Lessons learned from Michigan Virtual School teachers. *Journal of Interactive Online Learning*, *7*(1), 10–35.

Ertmer, P.A., Sadaf, A., & Ertmer, D.J. (2011). Student-content interactions in online courses: The role of question prompts in facilitating higher-level engagement with course content. *Journal of Computing in Higher Education*, *23*(2–3), 157.

Hegeman, J.S. (2015). Using instructor-generated video lectures in online Math courses improves student learning. *Online Learning*, *19*(3), 70–87.

Hew, K.F. (2015). Student perceptions of peer versus instructor facilitation of asynchronous online discussions: Further findings from three cases. *Instructional Science*, *43*(1), 19–38.

Horzum, M.B. (2017). Interaction, structure, social presence, and satisfaction in online learning. *Eurasia Journal of Mathematics, Science and Technology Education*, *11*(3), 505–512.

Huang, Y.-M. (2017). Exploring students' acceptance of team messaging services: The roles of social presence and motivation. *British Journal of Educational Technology*, *48*(4), 1047–1061.

Jaggars, S., Edgecombe, N., & Stacey, G. (2013). *What we know about online course outcomes. Research Overview*. Colulmbia University. Community College Research Center.

LaBarbera, R. (2013). The relationship between students' perceived sence of connectedness to the instructor and satisfaction in online courses. *Quarterly Review of Distance Education*, *14*(4), 209.

Lee, J., & Recker, M. (2021). The effects of instructors' use of online discussion strategies on student participation and performance in university online introductory mathematics courses. *Computers & Education*, *162*, 104084.

Luik, P. (2007). Characteristics of drills related to development of skills. *Journal of Computer Assissted Learning*, *23*, 56–68.

Marecek, L., Anthony-Smith, M., & Mathis, A.H. (2020). *Prealgebra 2e*. OpenStax.

Mayer, R.E. (2006). The role of domain knowledge in creative problem solving. *Creativity and Reason in Cognative Development*, pp. 145–158.

Mayes, R. (2011, March). Themes and Strategies for transformative online instructions: A review of literature. *Global Learn*, pp. 2121–2130.

McCoy, L. (1996). Computer-based mathematics learning. *Journal of Research on Computer in Education*, *28*, 439–460.

Muin, A., Hanifah, S.H., & Diwidian, F. (2018). The effect of creative problem solving on students' mathematical adaptive reasoning. *Journal of Physics: Conference Series*, *948*(1), 012001.

Nussbaum, E.M., Hartley, K., Sinatra, G.M., Reynolds, R.E., & Bendixen, L.D. (2002). Enhancing the quality of online discussions. Paper presented at the *Annual Meeting of the American Educational Research Association* (New Orleans, LA, April 1-5, 2002).

Pasani, C.F. (2018). The use of problem-sovling as a method in the teaching of mathematics and its influence on students' creativity. *International Journal of Engineering Research and Technology*. Retrieved from http://eprints.ulm.ac.id/id/eprint/3864

Richardson, J., & Swan, K. (2003). Examining social presence in online courses in relation to students' perceived learning and satsifaction. *Journal of Asynchronous Learning Networks*, *7*(1), 68–88.

Rovai, A.P. (2007). Facilitating online discussions effectively. *The Internet and Higher Education*, *10*(1), 77–88.

Russo, T.C., & Benson, S. (2005, Janurary). Learning with invisible others: Perceptions of online presence and their relationship to cognitive and affective learning. *International Forum of Educational Technology and Society*.

Salter, N.P., & Conneely, M.R. (2015). Structured and unstructered discussion forums as tools for student engagement. *Computers in Human Behavior*, *46*, 18–25.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. London: John Wiley & Sons.

Spence, D., & Usher, E.L. (2007). Engagement with mathematics courseware in traditional and online remedial learning environments: Relationship to self-efficacy and achievement. *Journal of Educational Computing Research*, *37*(3), 267–288.

Tambunan, H. (2019). The effectiveness of the problem solving strategy and the scientific approach to students' mathematical capability in high order thinking skills. *International Electronic Jounral of Mathematics Education*, *14*(2), 293–302.

Tu, C.-H., & McIssac, M. (2002). The relationship of social presence and interaction in online classes. *The American Journal of Distance Education*, *16*(3), 131–150.

Zucker, A. (2006). Development and testing of "Math Insight" software. *Journal of Educational Technology Systems*, *34*, 317–386.