120th ASEE Annual Conference & Exposition
FRANKLY, WE DO GIVE A D*MN
June 23-26, 2013

Paper ID #6289

Designing Active Learning Activities for On-line and Emerging Technology: A Report on Student's Perceptions of the Activities and Activity Refinement

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Designing Active Learning Activities for Online and Emerging Technology: A Report on Student's Perceptions of the Activities and Activity Refinement

Abstract

The authors of this paper have been designing, with student input, appropriate active learning techniques for online use as well as for use with new and evolving technologies. These instructional activities are largely collaborative in nature and are based on classic active learning strategies, as suggested in the research literature for face-to-face instruction. This paper discusses the implementation of active learning strategies designed or adapted for online and hybrid classrooms, modified to employ emerging collaborative technology as well as the use of technologies not available earlier for the purpose of teaching technical graphics concepts.

Activities for this ongoing study were selected from analyses of best practices identified in the research literature on both active learning and virtual learning. This paper is a continuation of a previous exploratory study and paper that discussed preliminary results. This paper discusses the refinements made to these activities following initial attempts to use them with students in both face-to-face and online settings as well as findings based on a variety of feedback data. Data sources used to refine instructional design included student surveys; discussion forum posts; project rubric analyses; peer, self, and instructor assessment data; and instructor observations.

This report represents the research team's second phase of exploration of active learning strategies in an hybrid and online environment and using emerging technologies. Phase one piloted the initial design of strategies that were untested and untried. The piloting of these activities allowed the team to identify weaknesses in the available technology for collaboratively developing digital technical graphics as well as the instructional presentation and implementation strategies employed when using them.

Introduction

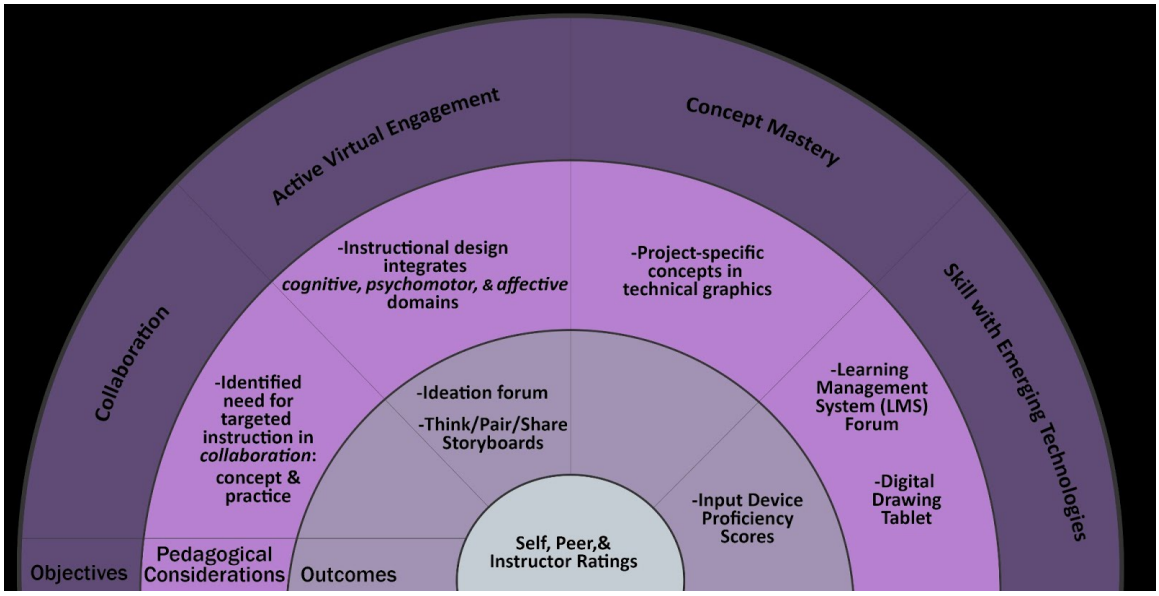
Active Learning is "The process of having students engage in some activity that forces them to reflect upon ideas and how they are using those ideas. Requiring students to regularly assess their own degree of understanding and skill at handling concepts or problems in a particular discipline. The attainment of knowledge by participating or contributing. The process of keeping students mentally, and often physically, active in their learning through activities that involve them in gathering information, thinking, and problem solving"[1]

Best practices for online instruction seen in recent literature include a focus on

interactivity, skillful use of technology, a clear understanding of both technical and interpersonal expectation;[2] as well as providing prompt feedback, increased time on task, and adapting instruction to the needs of diverse learners.[3] Dickenson, Burgoyne and Pedler (2010) defined Virtual Action Learning (VAL) as "action learning which takes place in a virtual environment . . . via a range of enabling, interactive and collaborative communication technologies."[4] The importance of effective design knowledge-sharing as well as methods for promoting collaborative design learning were explored by Wang, Shih, & Chen.[5]

The goal of this work is to assimilate preliminary data gathered during an exploratory pilot phase into instructional recommendations for affecting hybrid and virtual active learning in technical graphics education. Recommendations include targeted objectives, pedagogical considerations surrounding those objectives, and related desirable outcomes or indications, as appropriate. Figure 1 illustrates the hierarchy of these recommendations as they inform this team's approach to teaching technical graphics.

Figure 1. Virtual Active Learning in Technical Graphics Education: Objectives, Pedagogical Considerations, and Outcomes.



Purpose of this Research

The importance of developing successful instructional strategies for teaching technical graphics concepts in online and hybrid classroom environments is increasing alongside the evolution of what a classroom can look like. Concurrently, the value of using emerging technologies to teach content while enhancing student engagement has been demonstrated.[6,7] Both K-12 and post-secondary education have seen hybridizations of face-to-face and online formats, and distance education has become an option for students at almost every level. Because collaboration has

been identified in the research literature as a fundamental component of active learning, collaborative strategies and technologies are of particular interest. While suggestions for promoting student collaboration are abundant, the success of such attempts can be difficult to measure. Instructional design for virtual active learning is needed, which authentically integrates objectives in the cognitive, psychomotor, and affective domains within the field of technical graphics.[8] This work addresses such integration; for instance, through the processes described in this paper for design ideation and posting to the group forum, students are asked to generate ideas and evaluate the work of teammates (cognitive domain); create designs using software and the digital tablet (psychomotor domain); and collaborate in a variety of ways (affective domain). After piloting a variety of technologies and strategies in Phase I of this work, specific instructional objectives and approaches have been developed.[9] Student feedback and instructor observations as well as suggestions for future implementation are discussed.

Collaborative Instruction

As part of this study, collaborative learning (CL) techniques were employed in an attempt to improve student learning as well as provide them with experiences in working as part of a team. Most of the students that enroll in our classes are in a technology teacher education program, so experiences in collaborative education help provide them training in collaborative instruction as classroom practice.

The use of collaborative learning strategies has been around since the 1970's. Research in this field during the 1980's primarily focused on face-to-face collaboration in primary through higher education, but research on collaboration since the inclusion of the computers in the field has created a new area of research known as Computer-Supported Collaborative Learning (CSCL).[10]

According to Krug (2001), "The success of collaborative learning opportunities must be judged on the basis of their process, purpose, and products. It is self-evident how process is related to collaboration, for classroom methodologies must create a space for common endeavors among equal participants" (p 105).[10] Initial research in this instructional method focused on individual cognitive learning gain (1970-1990), whereas the rise of computer technology stimulated a shift in studying how group processes affects individual and group cognition (1990-present). At present, there are roughly two dominant foci in (CS)CL research: 1) understanding successful practices for collaborative learning, and 2) determining effective conditions for successful collaborative learning.

Assessment criteria for CL are shaped by the purpose of assessment. Assessment of collaborative instruction can be classified as summative or formative. Summative assessment ("assessment of learning") is outcome based and individualistic, it is isolated from the learning process, and it takes place at the end of a course or activity to judge how well a student performed. Summative assessment focuses strongly on the cognitive aspects of learning, often applies a single performance

score, and it is designed and conducted by the teacher. Formative assessment ("assessment for learning") is contextualized and aims to build a comprehensive picture of learners' characteristics. It is an integral part of a learning process and takes place several times during a course rather than only at the end. For this paper, the focus will be on formative evaluation, with the eye to improving and/or proving the instruction process to eventually improve the individuals' knowledge of the content taught as well as their understanding of collaborative process, but will also include some summative assessments as well.[10]

Assessment of individual students during collaborative activities can be problematic. Any instructor who utilizes this type of instructional strategy is well aware of some of the issues involved. To compensate for issues that arise when using collaborative education, assessment of the learning or product produced during the collaboration, must be structured to deal with these issues. One such issue related to assessing collaborative learning relates to "social loafing." Here grading by group rewards the loafer and harms the other members of his or her group. A number of strategies have been devised to deal with issues of this type, which include individual as well as group grading, but the percentages of each type of grade must be carefully examined to equalize the effects of both the group and the individual grading. [11]

Instructional Context

The pilot work utilized three courses: TDE 205, Concepts of Desktop Publishing and Digital Media; TED 552/752 Curricula for Emerging Technologies; and an online high school Visual Art 1 course.

- TDE 205 covers print design, readability, functionality, print media technology, and digital photography, and includes instruction in Adobe Illustrator, Photoshop, and InDesign. Students taking this course come from majors in Technology Engineering and Design Education, Marketing Education, and technical majors, such as engineering. One of the major goals of this course is teaching students how to work with real "clients" and, therefore, collaborative strategies are a good precursor to their interaction with their client for the final project, which must be an authentic project that produces a document or documents actually reproduced and distributed by the client.
- In TED 552/752, graduate students analyze advanced technologies and develop instructional programs for technology education curricula in secondary schools. Topics of study fall into the category of *Information and Communication technologies.*
- The online Art 1 course is offered through a state virtual public school. It is an introductory art course covering a variety of media and techniques including drawing, color, architecture, painting, photography, graphics, printmaking and sculpture.

Instructional design for Phase 2 was developed specifically for two sections of TDE 205; one section of GC 340, Concepts of Website Development; and one section of TDE 385/386 Robotics Education.

- GC 340 is an introduction to the essential elements of website development for students in Technology Education and Graphic Communications. Content focuses on planning and executing web sites for educational effectiveness, user interfaces, and site testing as well as web graphics. This course provides instruction in software appropriate for creating a website.
- TDE 385/386 is an introductory study of design and invention system control mechanisms and robot sensors. Ultimately, teams of four students design, create, program, and exhibit a robot that addresses a real-world issue. Throughout this process, students apply foundational skills developed in TDE 205 and GC 350.

Scope and Limitations

In all cases of this research, the number of participants is limited by class sizes. For instance, two sections of TDE 205 usually provide approximately 58 to 60 students for one segment of this research. Likewise, participants cannot not be randomly selected and are a 'selection of convenience.' Students self select their majors and, therefore, the classes they enroll in as part of their major. Activities investigated are also limited by time, due to class schedules and other course requirements. An additional limitation involved the use of different instructors for two sections of the TDE 205 course. To limit this effect, the same instructor provided the instructions to each class section. Although limiting factors, these issues are the reality of instructional environments and part of the educational process being studied.

Methods of Instruction and Assessment

I. Collaboration

During the pilot study, feedback on the student survey and instructor observations during the student collaborative projects indicated a lack of student understanding surrounding the concept of collaboration, a matter of increasing pedagogical importance since systematically showing evidence of student collaboration is becoming an expectation for K-12 teachers in the United States.[12,13] Therefore, direct instruction on working collaboratively for each specific project has been developed, as have both formative and summative assessment tools for group collaboration on graphics projects.

For example, the revised assignment plan and the methods of assessment for the collaborative work in the TDE 205 courses is listed below. This collaborative project requires students to produce a logo for fictitious product line and an individual set of labels for a series of products that are a subset of that line. The collaborative project assignment indicates the following steps:

1. Students will be divided into groups of three to four students.
2. The assignment will be described and discussed with the class as a whole.
3. The relevance of the assignment and the strategies being utilized are discussed with the whole class, giving students an opportunity to raise questions and discuss procedures.
4. The process of collaboration and responsibilities of students in each group will be discussed.
5. The whole class as a group will determine what aspects of the project need to be defined (definition of the problem) as well as the order in which these elements need to be completed.
6. Students will meet in their respective groups and determine a process for proceeding towards the end goals.
7. Groups will meet with the instructor and provide the instructor with a summary of the process they plan to follow in producing the product logo and labels.
8. Students will work in their groups with periodic consultation with their instructors, getting feedback from both.
9. Groups create a common logo that is also used as part of each individual student's portion of the group project.
10. Students then individually create a set of labels for two products that are a subset of the product line and an external container to hold one of these products. During this art of the assignment, students consult with each other and offer feedback on other members' designs.

Evaluation of the projects will include the following:

1. Self-evaluation of each student's effort and contribution to their group.
2. Peer evaluation of each student's effort and contribution to their group.
3. A portfolio of student work that shows the research they conducted on designs for similar product logos and labels, their mock-ups for possible designs for the logo and labels, and their final designs placed on appropriate containers as well as a written reflection and description of the work they and the group performed.
4. A critique and final evaluation of final label designs, which have been placed on appropriate containers, is made by the whole class.
5. A final evaluation of finished product designs is made by the instructor.
6. A survey with suggestions for improvement of the assignment and issues encountered.

The various objectives of collaborative aspects of this assignment are: To help students learn to collaboratively work with other individuals; To understand the collaborative process in the context of an educational setting; To prepare them to interact with the clients they will work with for their final project assignment; To gain an understanding of the advantages of feedback on their designs from other individuals; and To gain an understanding of the processes practiced by the graphics industry to create designs that represent a product. Some indicators that these objectives are being met include the students' portfolio of their work, their

written reflections, and observations by the instructor while they work in class as well as students' responses to a survey related to the assignment. Formative assessments are in the form of discussions with the members of the individual groups .[14]

II. Emerging technologies for virtual active learning

Pilot results were impacted by variability in students' competency and self-efficacy with the new tools presented to them under tight time constraints. In order to establish baseline student competency with, and thereby measure the effectiveness of, A) the digital tablet and stylus and B) the Moodle Discussion Forum as collaborative ideation tools, units of instruction, practice activities, and corresponding assessments have been developed for these tools to correspond with instruction in graphics concepts and software in TDE 205, GC 340, and TDE 385/386.

A. The digital tablet and stylus

Associated instructional objectives: To apply an understanding of design elements and principles to the development of digital graphics; To demonstrate proficiency with Adobe Illustrator and/or Photoshop, as per course requirements.

Pilot feedback indicated that many students found the digital tablet unfamiliar and difficult to use, and, therefore, they were hesitant to use it during the design ideation phase of their project development. Direct instruction was deemed necessary. As a result, tests of input device proficiency [15,16] will be administered to students in TDE 205 and GC 340 prior to software instruction in order to establish baseline scores for competence with the digital tablet and stylus (the Wacom Bamboo Create). A class set of tablets will be distributed for use during software instruction, and students will be able to check them out for independent work as well. Following the input device proficiency pre-test, a 60-minute lesson will be taught on the operation of the tablet prior to instruction in graphics software. To ensure adequate practice with the tablet, software instruction will then be delivered, with the requirement that students use the tablet during class. Software practice and completion of assignments outside of class can be done using the tablet or the mouse. At the conclusion of the design project (approximately five weeks following the pre-test), input device proficiency testing will be repeated.

B. The Moodle Discussion Forum

Associated instructional objectives: To share ideas with teammates; To evaluate the ideas of teammates; To document the development of ideas; To self-monitor team progress; To collaboratively build upon the ideas of teammates.

The discussion forum—also known as the discussion group, message board, online forum, etc.— has been acknowledged as the original digital learning community,

evolving alongside the internet itself, and even still untapped for the full potential it offers to hybrid and online education.[17] Differing from a blog in its expectation of interactivity and dialogue, rather than simply a place for posting archival material, and because multimedia files are easily embedded or attached, the discussion forum provides a valuable format for collaborative visual ideation.

Students in TDE 205 and GC 340 will be given direct instruction in the features of Moodle discussion forums, including basic access, organization, and posting. Students will contribute to a set of class expectations and norms for participation and quality that leads to the development of a standardized rating scale for each class's forum posts. Each student will be required to participate in an initial forum in which text and images are uploaded and then posts will be rated. Moodle offers a forum rating feature, and ratings by instructors and by students can be enabled. These forums, therefore, functioned periodically as formative assessments and also contributed to individual students' group collaboration, since the individual efforts of group members were visible to anyone viewing the forum. Groups will be asked to use the forum as a central hub for ideation, including hyperlinks, copies of conversations via chat applications, multimedia attachments and screenshots as they developed their designs.

III. Strategies for Virtual Active Learning and Engagement

Two virtual active learning strategies have been selected for further study based upon evidence of student engagement, measurable outcomes, and likely support of concept mastery in technical graphics education: 1) Think/Pair/Share, where "students think about a problem, discuss it with their neighbors, and then share it with the rest of the class."[18] They are encouraged to appreciate collective perspectives. Peer interaction is fundamental and provides immediate feedback; and 2) Collaborative Online Visual Ideation. A standardized approach to instruction, practice, and assessment has been developed for use in TDE 205, GC 340, and TDE 385/386.

A. Think/Pair/Share:

Associated instructional objectives: To identify and investigate an emerging technology; to interpret the technical information needed to design and implement curricula.

In the pilot phase of this research, emerging technology students were to *indicate* and *discuss* the central concepts, tools of inquiry, and structures of emerging technologies, and then *create* learning experiences that *make* these aspects of subject matter meaningful for students. Pairs work in a virtual environment; use contemporary educational technologies to collaborate, complete project, deliver an e-presentation using web 2.0 tools; assess all work and presentations.

To collaborate electronically, each pair of students created a tumblr account. Here, they would share text, images, videos, and more. One requirement of the assignment was to

create a storyboard following the design process, leading to completion of the final project. Since class was completely online, partners collaborated via tumblr where they determined the overall scope and sequence of their project. They divided concepts and tasks, then developed particular parts of the whole on their own. All notes and details were hand drawn in storyboard fashion. Images were taken of the work and uploaded to tumblr for continued collaboration.

A rubric was used for peer, self-, and instructor assessments of the collaborative electronic storyboard, the final project, and the electronic presentation. While content information was a significant portion of the grade, emphasis was placed on the use and application of content visuals. Additionally, students were asked to critique the developments of the final project and then recommend improvements final projects and the assignment itself.

B. Collaborative Online Visual Ideation

Associated instructional objectives: To generate possible design ideas; To develop graphics appropriate to an assigned task; To demonstrate evidence of collaboration by posting artifacts to a discussion forum; To evaluate and expand upon the ideas of teammates in design development.

Pilot work indicated that group ideation, or idea generation can be a challenging online task for students, particularly when it is done asynchronously. Group dynamics and time constraints can contribute to limited participation and to underdeveloped work. Students also reported not knowing what to include when asked to post evidence of their contributions to design development. Therefore, during a synchronous session, a presentation was given introducing a variety of acceptable methods of developing and sharing design ideas with teammates online. Discussion included goals for the ideation forum, suggestions for tools students may choose to use, a rating scale for forum contributions, and identification of artifacts for posting to the forum that both instructors and students felt were appropriate to the forum objectives. Table 1 presents a small selection of options.

Table 1. Ideation Forum Participation: Tools and Artifacts

Ideation Forum Objective	Applicable Tools	Appropriate Artifacts for forum posts
generation of design ideas	Freehand sketching; the Wacom Inkling; the synchronous, multiuser MultiDraw tool offered by http://www.queeky.com; pinboards at http://pinterest.com/, etc.	text posts, sketches (hand and digital), exemplars found online
development of graphics	Adobe Illustrator and Photoshop, SolidWorks, GIMP, the GNU Image Manipulation Program, Google SketchUp, Autodesk Cloud Services for students, etc.	image files at various stages of completion; i.e., , before/during/after screenshots

• demonstration of collaboration/participation • evaluation/expansion upon teammates' ideas	chat applications (Facebook, gmail, etc.), synchronous meeting archives, flowcharts/mindmaps from https://bubbl.us/, etc.	text posts, audio/video archive files, flowcharts, forum analytics (timeliness and number of posts and responses, responses to a teammates' thread), student summaries of contributions; peer and instructor ratings

Following instruction and practice in the basic tasks involved in participating in an online discussion forum, students used the Moodle forum during synchronous class meetings as well as asynchronously to develop ideas for design projects. Large design tasks (e.g., a line of product packaging) were broken down into smaller pieces with formative checkpoints as well as summative deadlines (e.g., a completed group logo design to later be placed on all product packaging).

Conclusions and Discussion

Considering the rapid growth and ubiquitousness of hybrid and exclusively virtual learning venues at the K-12 and post-secondary levels, policy affecting online and hybrid course education must be guided by continuous investigation and identification of best practices. Active learning strategies are well documented for the face-to-face classroom, but the research supporting active virtual learning is in its infancy. Instructional design recommendations for the purpose of promoting active virtual learning are needed, such that the cognitive, psychomotor, and affective domains are authentically integrated for the online environment. Such integration contributes to engagement and content mastery.

Phase 3 of this work will examine the success of refined strategies when teaching the same course content during summer and fall 2013. Additional student feedback and measures of student achievement will be gathered to determine whether these strategies made a significant difference in students' understanding and achievement in content areas of interest.

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