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**LITERATURE REVIEW**

**Peer Review as a Solution for Scalable Online Education in Creative Domains**

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**INTRODUCTION**

In recent years the number of students choosing to obtain a higher education online has sky-rocketed. Online degree options make higher education readily available to a broader range of individuals. Now, students with demanding full-time careers, family responsibilities, and transportation constraints can easily apply and begin taking classes online. According to a U.S. News and World Report article, students from "…more than 4,700 colleges and universities, more than 6.3 million students in the U.S. – most of whom were undergraduates – took at least one online course in fall 2016…" [1] Also, web applications such as Canvas and Black Board make teaching online classes easier and more effective.

Even with advancements in educational web applications, some skepticism still surrounds the idea of online education. In my experience, I've encountered coworkers who view online degrees as "lesser" than traditional degrees. When these skeptics think of traditional higher education, they imagine one-on-one communication with professors, in classroom lectures, in-classroom exams, collaboration with other students, and personalized feedback on course work. In contrast, when they think of online education, they imagine very little communication with professors, PowerPoint slides without lectures, the potential for cheating on exams, no collaboration with other students, and computerized feedback on course work. I believe their concerns are valid, especially in fields such as music, design, and creative arts where feedback and constructive criticisms require a more "human touch." In technical domains like computer science and engineering, feedback on design, algorithm choice, or user-interface is also extremely valuable.

Instructor interaction is expensive for universities, and peer interaction is generally coupled with classroom schedule and location constraints. How can peer and instructor feedback be made scalable in online education? How can students provide feedback to each other when they may live in different states or on opposite sides of the world? In the article "Peer and Self Assessment in Massive Online Classes," a group of research scientists from Stanford University and Coursera, Inc., collaborated to answer these questions "…with the first use of peer assessment in a massive online class. It is the largest use of peer assessment to date." [2]

According to Chinmay Kulkarni, "One approach for scaling assessment and peer learning would be for students to evaluate their peers' work. Peer assessment potentially enables large classes to offer assignments that are impractical to grade automatically. Furthermore, human grading more easily provides context-appropriate responses and better handles ill-specified constraints." [2, 3] However, even with peer-review in online courses, are students qualified to give feedback to their classmates? [2] Given that most students attending online universities also work full time, would they even be interested or motivated to give peer-review assessments? This article studies the quality of peer-review feedback in comparison to instructor feedback through two iterations.

In the first iteration, students are asked to critique and grade their classmates' work. In the second iteration, researchers look at three social scenarios for improving peer-review accuracy. In one student sample group, students receive feedback on the quality, veracity, and possible bias of their peer-review after reviewing the results of the first peer-review iteration. In the second group, students receive out-of-the-box scripts to use as feedback. In the third group, researches use data analysis to improve the quality of student peer-review feedback. Researchers then compare these results to the instructor provided feedback, and the overall accuracy of each scenario are measured.

**IMPORTANT IDEAS**

**Essentials Characteristics of an Online Education Environment**

Traditionally, art, design, architecture, and other creative fields take place in a design studio, where students work in a shared environment and with an instructor present to provide guidance. There are three essential characteristics that a virtual studio should support. [2] First, solutions should be open-ended. [2, 4] In real-world design, creativity plays an integral part in developing a solution, and in reality, there may be many right answers. [2, 4, 5] Second, students should learn the fundamentals of good design. [6] Third, feedback should be qualitative and summative.

In traditional studios, students can collaborate, share ideas, critique each other's work, and participate in creative building discussions. [2, 7] "The ability to generate a wide variety of potential solution ideas is generally accepted as a key precursor to creative design outcomes. In fact, most measures of creative thought assess creativity in terms of how many possible solutions are generated to a given prompt, as well as the originality of the solution in terms of how different the solutions are from one another." [7]

**Benefits of "Living Laboratories" in Peer Review and Online Collaboration**

Human-Computer Interaction (HCI) is a field of research that deals with "technologies that augment human intelligence." [8] Ed H. Chi at the Palo Alto Research Center, Augment Social Cognition Group, suggests two ideas that are starting to change commonly held beliefs in HCI. The first is that mobile devices can be just as effective as traditional desktop computers. The second is that educational applications can be effective for groups as well as single users. This type of community-based education application provides an ideal "living laboratory" to study human to computer interactions and peer-review scenarios. [2, 8]

To better enable and study students' peer-review behavior a graphical user interface design studio was used to allow students to share work, collaborate, and critique each other's work. [2, 8] "Studios provide an open, shared environment for students to work. This copresence provides social motivation and facilitates peer learning through visibility of work." [2, 9] This living laboratory user interface is a topic of interest to both computer scientists and psychologists, and it is a popular topic in HCI. [8]

**Distributed Tutored Video Instruction and the Efficacy of Four Learning Mediums**

The living laboratory, described by Ed H. Chi, is a type of Distributed Tutored Video Instruction (DTVI) environment where students can meet in a virtual environment. [8, 10] Research scientists at Microsoft studied the overall effectiveness of four types of learning environments: text chat, audio conference, video conference, and face-to-face communication. The results show that text chats are not effective in improving student learning. Audio and video conference methods improve student learning only when students participate in small discussion groups with a facilitator guiding the discussion. Throughout the video lecture, the facilitator pauses the video and engages the students in a discussion. However, students watching video lectures individually, do not show an increase in learning [2, 8, 10].

**The Value of Peer-Assessment in Online Education**

Cognitive scientists believe that when students are actively engaged in learning, asking questions, answering questions, and participating in discussions, they are more likely to comprehend and retain information. [2, 7, 11] Donald Chinn from the University of Washington, in his article "Peer Assessment in the Algorithms Course," investigates the influence of peer assessment on improving critical thinking skills of students in a computer science algorithm course. Chinn studied the peer-review scenario of where one student solved problems while other students critiqued, evaluated, and discussed the student's solution. [11] He found that merely assessing another student's work did not increase the reviewers critical thinking skills. However, communication between students and evidence-based reviews and discussions did improve the students' critical thinking skills.

**CONCLUSION**

To measure the success of the peer-review experiments, researchers compared peer-review grades to staff grades in two iterations. As one would expect, researchers found that staff grades had less variance than peer-review grades. [2] They found that this variance in staff grades was very similar to that of in-person staff grades. Overall, students had a positive experience with the peer-review system. Many students completed more peer-review assessments than they even needed to for the class. "Forty-two percent of students cited seeing other students' work as the biggest benefit of peer assessment; 31% reported learning how to communicate their ideas as a benefit." Researchers also found that students became better graders as the semester progressed.

As mentioned in the introduction, three tests were used to study the overall accuracy and benefits of peer-review feedback. In the first scenario, students receive feedback on the quality of their grading. [2] This resulted in a decrease in grading errors and better accuracy in peer-reviews. It also reduced the rate of "patriotic grading." Patriotic grading occurred when students from the same country were graded more favorably than students from other countries. For example, students from the same country, on average, graded each other 3.6% higher than students from other countries. For the second scenario, out-of-the-box scripts were given to students to use as feedback. Although researchers could not conclude, they postulated that this type of feedback could improve the quality of peer feedback. Lastly, data analysis and iteration were used to improve peer-review assessments. Researchers found that by studying the discussion forms, they could pinpoint where students had questions about rubric word choices, and where these questions lead to a higher variance between peer and staff grades. When these sections of the rubric were rewritten to be more readable, they found a higher correlation between peer and staff grades.

With all of the improvements to the online learning experience, researchers still found a few drawbacks to the peer-review assessment system. [2] The most obvious was that students and staff had different skill levels and did not always agree on assessments. The second was that peer-reviews needed to occur on a particular schedule so that peer groups could interact. This constraint led to less flexibility for students with differing work schedules and family responsibilities. The last issue, one which would probably bother me the most, was that peer assessments are often subjective; which could lead to a great student receiving a poor score. Ultimately though, the peer-review structure has many benefits. "When peer assessment provides the primary evaluative function, the staff role shifts to emphasize coaching… [12] when teachers coach but do not grade, students focus more on conceptual understanding." [2, 13]

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