Asynchronous Participatory Exams

Internet Innovation for Engaging Students

The Asynchronous Learning Networks Participatory Examination (APE) is a constructivist approach that fully engages students in the entire exam life cycle. Students design and solve exam questions while evaluating their peers' solutions using an anonymous, structured process enabled by Internet technologies. APE achieves higher-level learning by encouraging students to tap into all levels of cognitive skills. Compared to the traditional exam experiences in most classes, most students prefer APE, enjoy its process, and recommend its use. APE liberates both students and instructors by reengineering the examination process and deepening learning throughout.

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Internet technologies enable us to rethink traditional teaching approaches, which opens the floodgates to educational innovation. Why do exams have to be on paper? Why can't we ensure the integrity of online exams? Why can't students collaborate on exams, so they can learn from each other? And why can't students make up the exams and grade them, so they can learn through the entire process? Internet learning technologies let us explore these questions and, inevitably, can liberate students and instructors from traditional roles and restrictions to increase higher-order learning.

We developed the Asynchronous Learning Networks Participatory Examination approach (or APE) utilizing Internet technologies to actively engage students online in the entire exam life cycle, which includes letting them create, answer, grade, and dispute exam questions. Our framework allows instructors to become mentors or facilitators instead of the dominant center of attention, as in a traditional class. This process, in turn, could empower students with deep or higher-order thinking and learning processes.

Based on this theory, we conducted an APE case study with 240 graduate students in an "Information Systems Principles" class for five semesters. Our study results show that APE is an effective and innovative online assessment approach, which could be widely adopted in various online and on-cam-

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pus blended courses. We created and designed APE to facilitate deep learning for distance education, but it could be effective for on-campus classes as well.

Fundamental Theories

Educational assessment strategies are mostly grounded in two well-known learning theories: *objectivism* and *constructivism*. Objectivism advocates instructor-centered pedagogy and generally uses a summative assessment method. This means that instructors control the entire assessment process to measure whether they are transferring knowledge to the students by using quizzes, tests, and examinations designed and marked solely by the instructor. Students are passive exam takers and have little flexibility to actively engage in this assessment process.

Constructivism, on the other hand, promotes student-centered learning with a belief that knowledge is constructed through social cognitive interactions among individual students and learners. We built APE on this theory and used a formative assessment method to ensure that the students take control of their learning via open bidirectional communications between the instructor and students. The instructor is a facilitator, who guides and supports the whole assessment process to help students absorb and integrate new knowledge. This helps students become more actively engaged in constructing new knowledge, which previous research tells us is fundamental to the learning process.

Specifically, the Law of Intensity and the Law of Readiness predict that people learn best when they are ready and motivated by an exciting learning experience.[1] David Johnson and Roger Johnson also state that "learning is conceived of as something a learner does, and not something done to the learner."[2] APE provides an online environment that frees students from the passive experiences of traditional exams because students participating in the APE are primarily responsible for the entire exam process.

Traditional Exams vs. APE

Assessment aims at understanding and improving student learning by explicitly measuring learning progress and achievements and by setting appropriate criteria and standards.[3] Examinations have long been regarded as a vital but unpleasant tool for measuring mastery of education goals. In the traditional objectivist learning environment, instructors play a key role in the assessment process, and students, as exam takers, are mostly passive receivers.

In many cases, asynchronous learning networks (ALNs) have successfully used Internet technologies to transform the traditional classroom into a virtual environment with a promise of learning "anytime and anywhere."[4] M.M. Danchak and M. Huguet have summarized a GUI course evolution over the years involving distance-learning technologies, and they observed that the instructor's role has dramatically changed from "being the Sage on the Stage" to "being the Guide on the Side."[5] Yet this ongoing shift in online learning and some progressive on-campus classrooms (for example, those using inquiry-based methods such as problem-based learning, which enables students to develop problems and investigation strategies[6]) has largely not reached examinations.

In the absence of immediate face-to-face interaction, it's challenging but critical to transform assessment strategies to an online learning setting (see www.outreach.psu.edu). Most current asynchronous learning-management tools (such as WebBoard, WebCT, and BlackBoard) can support online, multiple-choice examinations designed entirely by the instructors. Not surprisingly, the majority of online examination questions are based on well-structured course materials, in which students don't have much flexibility to show their creativity and critical thinking. A few prior studies have attempted to optimize the examination process. For example, M. Dee Medley designed online finals in his computer programming courses that he found to be as good as the traditional written tests that he replaced.[7] Denise Woit and Dave Mason also reported that student learning and retention increased in an online quiz group, compared to students using weekly laboratory assignments.[8]

Table 1 summarizes the key differences between traditional examinations and the APE approach. Compared to traditional exams, APE radically changes the roles of students and instructors. A major APE component is peer assessment, which research has shown to be highly reliable.[9,10] The student learns as an evaluator and as the one being assessed.

APE Process Design

Instructors can use any virtual learning environment (VLE) tools, such as WebCT and Black-

Table 1. Differences between traditional exams and the Asynchronous Learning Networks Participatory Examination (APE) approach.

Exam element	Exam type	Instructors	Students	Outcomes
Creating exam questions	Traditional exam (TE)	Yes	No	TEs don't offer such an opportunity; instructors design all exam questions.
	APE	No	Yes	APE lets students learn by creating exam questions.
Answering exam questions	TE	No	Yes	With APE, students have access to more resources to provide more sophisticated answers. The APE exams' asynchronous nature relieves the time pressure of TEs.
	APE	No	Yes	
Sharing exam components	TE	–	No	TEs usually focus on individual exam takers and sharing answers is considered plagiarism.
	APE	–	Yes	APE encourages online students to share their exam components (including exam questions and answers) and to dispute arguments because each question is different. We used the online tool Turnitin to detect plagiarism.
Grading exam answers	TE	Yes	No	Instructors have the sole responsibility for grading answers in TEs.
	APE	No	Yes	With APE, students play a major role in grading their peers' answers. Instructors act as a judge between student graders and individual exam takers.
Disputing exam grades	TE	Yes (limited)	Yes (limited)	In TEs, grading disputes are limited to interactions between instructors and individual students.
	APE	Yes	Yes	APE provides an open forum for the whole online class to anonymously challenge both exam graders and the instructor. Thus, the APE dispute process provides an additional opportunity to boost higher-order learning.

board, to conduct APE exams. We primarily use the WebBoard VLE platform for this research (www.webboard.com). WebBoard's targeted-threading discussion provides a meaningful contextual environment. (Targeted threading overcomes loss-of-attention problems typically recognized with threading because students work intensely with a thread or group of discussion comments only for an exercise's duration.)

Figure 1 depicts the full APE process for instructors and their students. Briefly, the major steps are as follows:

1. Each student designs two questions, using guidelines and anonymous IDs that the instructor provides. Students post each question in a special WebBoard discussion area. Hiding individual students' identities is an important factor for people who are new to the peer-feedback process.[10]
2. The instructor reviews the questions, editing them as necessary to ensure they are good exam questions with similar difficulty levels, and to avoid giving similar questions to different students.
3. The instructor assigns each student questions to answer. No two students are given the same questions.
4. Students answer their assigned questions.
5. Students grade the answers to the questions they posted and justify their grades following detailed grading guidelines. For example, they allocate 10 points to the quality of background and framing, assign 15 points to the exam answer's synthesis quality, and so on. We call these original authors *level-one graders*. The grading guidelines also serve as a base for further second-level grading, instructor's final grade decisions, and student grade disputes.
6. Another set of students regrade the answers to give a second opinion (*level-two graders*).
7. The instructor posts the actual grade, using the two student grading records as a guideline.
8. Students may dispute their grades by regrading their own answer with detailed justification.
9. The instructor resolves all grade disputes.

(Previous research describes this process in more detail,[11] in addition to how we structured the WebBoard environment.) Further examination details are also available online (see http://web.njit.edu/~bieber/CIS677S02/final-procedures.html for instructions and http://web.njit.edu/~bieber/CIS677S02/final-grading.html for grading guidelines).

Kwangsu Cho and Christian D. Schunn found that knowing their peers would read their assignments motivates students' learning,[12] so we allowed students to read their peers' work on the WebBoard throughout the exam process. Viewing different perspectives on an issue increases depth of understanding. Students adapt their understanding to include these other viewpoints. The students can discover new relationships between concepts and build a collaborative understanding of the problems. Because no questions are exactly the same, reading peers' answers helps students broaden their understanding of course topics and motivates them to read more. Similarly, students learn through reading other questions, grade justifications, and disputes—both as they specifically craft their own and out of general interest and curiosity.

We designed the online participatory exam to engage students and let them feel ownership in the entire exam life cycle. Indeed, they are involved in all aspects of this procedure except administrating the online environment, including developing grading criteria, assigning final grades, and resolving disputes (which they initiate). As fits with the constructivism theory, the instructor mentors the process, which includes ensuring the appropriateness of questions, answering queries, and providing guidance. The grading procedure also lets the instructor focus on particularly tricky answers where level one and two graders don't agree and on disputes when the student being graded doesn't agree. If well structured, the participatory exam could free the instructor from some of the detailed work in developing, administering, and grading exams, judiciously refocusing the instructors' time, which can make them more effective mentors.

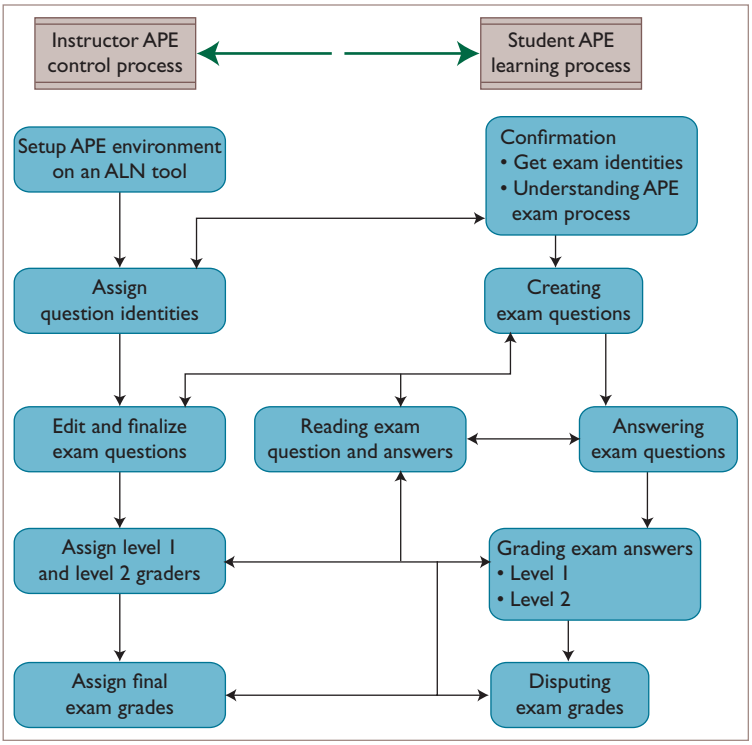

Figure 1. The Asynchronous Learning Networks Participatory Examination (APE) interactive process framework. The one-way arrows indicate a general process flow. Two-way arrows indicate students' back and forth learning-process flow.

Higher-Level Learning

Bloom's taxonomy identifies several levels of cognitive skills:[13] knowledge construction, comprehension, application and analysis, synthesis, and evaluation. APE requires students to actively engage online in all these levels. They must first recall the topics they have learned and grasped to make up the APE questions. While answering exam questions and reading peers' question designs and answers, students apply their knowledge to resolve a problem, through which they can analyze and synthesize their knowledge to achieve higher-order learning objectives.

Furthermore, APE empowers students to grade their peers' exam answers to the questions they authored. If students are dissatisfied with their exam grades, they can also dispute their grades with good arguments. Both grading and disputing involves the evaluation stage of cognitive development, which is the highest level of learning. Therefore, APE radically challenges traditional assessment to achieve higher-order learning and aims to make examinations a more fulfilling and thus enjoyable learning experience.

Evaluating APE Learning Outcomes

From the Fall 1999 to Summer 2002 semesters, we conducted five surveys in a graduate course called "Principles of Information Systems" in a US East Coast technological university. In total, 240 students participated in our field ex-

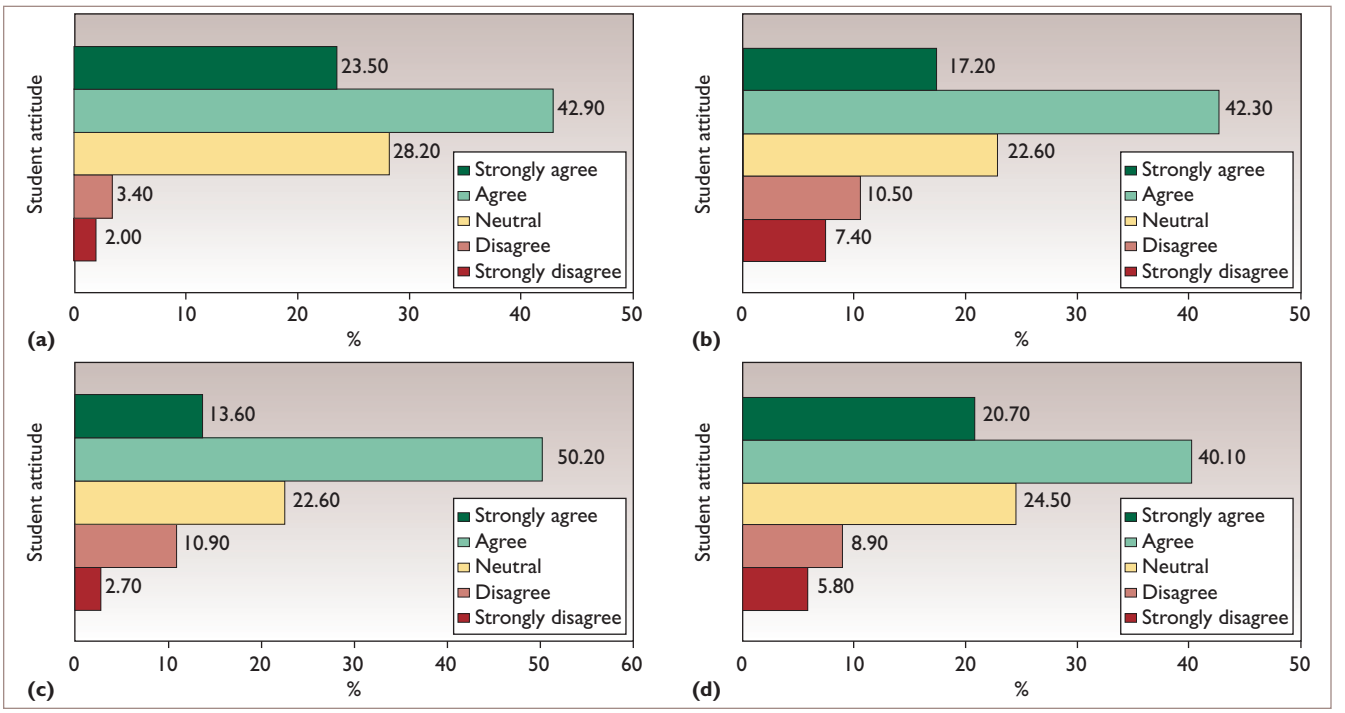

Figure 2. Student perceptions of the Asynchronous Learning Networks Participatory Examination (APE) approach. We collected the students' responses to several statements and questions: (a) "I was motivated to do my best work," (b) "I enjoyed the exam process," (c) "APE successfully enabled me to demonstrate what I learned in class," and (d) "Would you recommend APE for future use?"

periments, reporting positive and promising APE learning outcomes. Our results make a strong case that APE is an innovative and effective online pedagogical approach. Students perceived higher-order learning and reported that they also acquired additional critical skills essential for life-long learning, such as critical thinking, evaluation, and generalization. Students also reported that they learned from making up questions and reading others' work. Approximately 65 percent of students said that they learned from grading others' answers.

Many students also believed that APE was an enjoyable learning experience, and they were motivated to do their best work. Approximately 64 percent of students thought that APE had successfully enabled them to demonstrate their learning outcomes, and they strongly recommended APE for future use (more than 60 percent). Few other exam formats would receive such a positive student response.

Additionally, the majority of the students (more than 70 percent) agreed with the statement "I think the grading criteria given by the professor are explicit enough." Figure 2 gives the students' detailed perceptions.

A previous asynchronous online discussion study showed that perceived enjoyment strongly impacts student learning.[14] In the current study, a correlation analysis also indicates that student's APE learning quality is strongly correlated with their perceived enjoyment — "I enjoyed the examination process" — and with APE grading-process quality and whether students would recommend APE for future use.

Qualitative Evidence

Because of the APE approach's innovative nature, our students expressed interesting and controversial concerns about the new platform. On the one hand, students were worried about being evaluated by their peers because of the competition among students. On the other hand, they enjoyed the flexibility and anonymity APE provided and thought that APE was a better way to assess their learning, as opposed to the memorization and recall necessary for traditional exams. They were excited to act as professors and to learn from their peers.

We've included examples of the student comments on their least- and best-liked APE features. For the least-liked APE features, students rated peer grading the worst of the current APE procedures:

- "In the online exam one of the drawbacks is [that] the grading of the students is not uniform and it varies significantly."
- "I do not agree that each student has the same ability to evaluate the exam result of others ... though the professor already provided a set of detailed grading guideline[s], it is still difficult to make it fair for everyone."
- "Grading should be done by [the] professor."
- "I felt that the students in general were very difficult graders who were not generous in grading."

The best-liked features focused on how much they enjoyed the innovative test-taking process:

- "It was an interesting experience, which allowed me to see both sides of the learning process. One side, the view of [the] student who is trying to pass a test, and the other side is from the perspective of the professor ... in my opinion [this] enhanced my total learning experience."
- "I think this exam was a better way to measure the students' knowledge than in class exam. It was an excellent way to review and integrate all class materials together."
- "[I enjoyed] the opportunity to learn from other students' answers and get an idea of the difficult task of grading papers."
- "The exam was very different from traditional exams and certainly a very good way to learn and test our knowledge."

Jia Shen, collaborating with Michael Bieber and Starr Roxanne Hiltz, conducted a subsequent, large APE study in various undergraduate and graduate information systems classes with five different instructors for multiple semesters.[15] The instructor interviews in that study indicated that it was more work to adapt the APE exams to the existing course structures at the beginning. The instructors who conducted the APE exams for the first time reported that grading was equivalent or more work compared to the traditional exams because they needed to review and grade different exam questions. The experienced APE instructors, however, commented that conducting the APE exams was less work because the grading comments from student graders decreased the overall grading workload. Handling student disputes was minor work because less than five disputes occurred among our 240 APE participants.

Promise of Full Participation

APE enhances student learning in several ways. Students gain ownership over the examination process, and APE enables them to learn more fully from every step in the examination process. Designing problems challenges students to critically assess peers' understanding of a subject and challenges self-understanding. Students must analyze course materials to determine what to ask. Because the APE exam process is asynchronous, students experience less time pressure so they can craft solutions over a longer period, which allows time for critical reflection. Evaluating solutions challenges students to assess how fully a set of materials (the solution) fits their understanding of the topic and problem posed. Reading entries related to other problems lets students learn from the content and challenges them to contrast their approach with that of their peers. The APE's structure can elicit more complex questions and solutions.

APE liberates instructors as well. APE expands their teaching breadth because they can now teach students how to design good questions and evaluate solutions. These benefits make exams an even more effective use of course time. Instructors can spend their time mentoring students and focus on assisting students with specific problems. They also are alerted to their students' thinking from scanning their range of entries.

We envision several extensions to APE and our research on it. We've tested APE primarily for medium-length exam essay questions at the college level, within only a small range of information systems courses. We need to try to replicate our results and perhaps identify different procedures for different types of subject matter and different levels of students.

Our positive results have encouraged us to engage students in the full life cycle of other problems as well, such as homework assignments, labs, and semester projects. At all these levels, students would benefit from the deliberation involved in level-two grading and further learn by collaboratively developing grading criteria for each class of problem.

Shen has experimented with APE where

both undergraduate and graduate students collaboratively developed questions and grades in teams,[15] and this collaboration could be expanded further. In any case, we must experiment to identify better peer-grading procedures that more students would consider fair.

We invite our colleagues at all levels to join us by "going APE" and liberating their classes from traditional, objectivist examinations.

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