Journal of Research in Innovative Teaching & Learning

Enhancing self-efficacy in learning: the role of quiz creators and AI study apps

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Received 27 November 2024
Revised 4 February 2025
18 April 2025
Accepted 15 May 2025

Abstract

Purpose – We addressed concerns about using apps like Quizlet and Socratic to complete multiple-choice quizzes and increase active learning, motivation and a deeper understanding of the content using a project called Quiz Creators.

Design/methodology/approach – This experimental design explored using an assignment called quiz creators across three different instructors and two majors, including psychology and teacher education, to examine self-efficacy in a pre- and post-test methodology. Students were either in a control group, where they received traditional teaching methodologies or an experimental group, where they participated in the quiz creator assignment and engaged in a peer review process throughout the semester.

Findings – Overall, using a mixed-factors ANOVA, we found a significant difference over a 16-week timeframe in self-efficacy scores overall ($p = 0.02$) among all groups combined and a significant difference in time in the experimental and control groups in psychology and teacher education ($p = 0.03$).

Originality/value – This is useful for those in the teaching field struggling with students using study guide apps to answer all of their multiple-choice questions on exams and quizzes. This might serve as an alternative option for content and knowledge acquisition.

Keywords Self-efficacy, Active learning, Artificial intelligence

Paper type Research article

With the onset of apps like Quizlet and Socratic, originally meant to serve as study guides or tutorial options for students, these offer quick responses to multiple-choice quizzes and exams, discouraging content knowledge acquisition. Many students go online to find the answers and complete multiple-choice quizzes or exams very quickly, often with high recorded scores. Faculty must explore avenues to engage students in active learning while increasing their

Funding: No funding was provided for this research study.
Conflict of interest statement: The authors note no conflicts of interest.

Journal of Research in Innovative Teaching & Learning
Emerald Publishing Limited
2397-7604
DOI 10.1108/JRIT-11-2024-0283

interest, motivating them to learn, and modifying their expectations of a traditional multiple-choice quiz or exam. Wang *et al.* (2023) stated that retrieval practice is a useful exercise for students to remember content in the future. However, students often do not know how to implement these practices successfully. Research in these areas tends to focus solely on improving declarative memory tasks (Carpenter *et al.*, 2020). In addition, many studies have addressed content-related items and not the self-efficacy behind them. Schunk and DiBenedetto (2020) suggested that there are learning and performance goals. Although individuals may be motivated by grades related to performance, the learning goals allow students to develop new skills for long-term achievement and carry over to their future careers.

Addressing efficacy falls under Albert Bandura's sociomotivational research (Schunk and DiBenedetto, 2020). The idea that people are motivated by their past experiences and ultimately their own capabilities are part of the self-fulfilling prophecy in the learning process. Bandura focused on observational learning methodologies and self-efficacy, which can be directly applied in the classroom environment. The triadic reciprocity model can be used with college students by providing opportunities for them to attain course goals, develop self-efficacy, and engage in peer and self-evaluation through the completion of the quiz creator assignments.

Transitioning from passive to active learning

Historically, higher education has utilized a passive, teacher-centered approach to education. This approach focuses on lecture-based course designs where learning is driven by what the teacher does in front of the class (Freeman *et al.*, 2014). This approach to higher education is considered teacher-centered, as the burden of learning depends upon the teacher's ability to verbally transfer knowledge of course content while students passively listen (Kozantis and Nenciovici, 2023). There is an understanding that students must attend lectures, read the text, and complete a certain number of assignments, quizzes, and exams to indicate that learning has occurred (Webb and Baird, 1968; Fischer and Hanze, 2019); however, the primary burden remains on the educator. This dominant, archaic traditional paradigm has influenced the view that colleges and universities exist to provide learning absorption and that the primary mission of higher education is to deliver knowledge via lecture-based instruction (Barr and Tagg, 1995); To this end, students entering higher education often expect to achieve their degrees by attending a specified number of classes each semester, during which they passively listen to a lecture as the primary vehicle for learning. This expectation is so pervasive that students have an inherent bias toward active learning, which can potentially limit its effectiveness (Deslauriers *et al.*, 2019). This bias led students to rate the quality of instruction in classes where they received passive lectures more highly than in classes that utilized active learning techniques, even though they scored almost half a standard deviation lower than their counterparts in actively taught courses (Deslauriers *et al.*, 2019; Freeman *et al.*, 2014; Kozantis and Nenciovici, 2023). Deslauriers *et al.* (2019) observed a negative correlation between students' *feeling* of learning and their *actual* learning in lecture-based classes. This may be due, in part, to the fact that students believe they have learned more than they actually have when listening to an engaging, fluent lecturer (Carpenter *et al.*, 2013). Freeman *et al.* (2014) found that "students in traditional lecture courses are 1.5 times more likely to fail than students in courses with active learning" (p. 8410). Further, students in active learning classes believed they learned less than those in traditional lectures, but in reality, they learned more (Deslauriers *et al.*, 2019).

Barr and Tagg (1995) maintain that the mission of higher education has shifted from providing instruction to fostering learning, which has facilitated a fundamental paradigm shift regarding best practices in education. Based on research, higher education has shifted from a traditional teacher-based learning approach to a more student-centered, active learning approach (Deslauriers *et al.*, 2019; Freeman *et al.*, 2014; Kozantis and Nenciovici, 2023). As a result, the focus in education has shifted from the teacher to the student (Deslauriers *et al.*, 2019;

Michael, 2006). Michael (2006) defines active learning when students engage in activities through active participation, keeping them mentally and physically engaged in gathering information, thinking critically, and solving problems. Activities may involve long or short intervals during a lecture-based class where students are asked to respond to an in-class poll, participate in small group discussions, role-play, debate a controversial topic, problem solve, generate quiz or exam questions, or reflect on a writing prompt. Active learning often involves collaboration between students in and outside the classroom (The Derek Bok Center for Teaching and Learning, n.d.). A meta-analysis of 104 studies compared the learning outcomes of college students in humanities and social sciences, based on assessment scores, between those taught using active learning methods and those in traditional lecture settings (Kozantis and Nenciovici, 2023). Similarly, Freeman *et al.* (2014) conducted a meta-analysis of 225 studies focusing on STEM disciplines. Both meta-analyses found that students achieved higher examination scores in active learning classes than in traditional lecture-based courses, which supports the idea that active learning can be beneficial across disciplines. Kozantis and Nenciovici (2023) also found that active instruction yielded higher assessment results independent of group size, course level, and type of assessment used to measure learning.

Transitioning from an educational setting controlled and driven by the teacher to a university that has shifted to the active learning approach supported and encouraged by research today can be challenging for students (Hassel and Rideout, 2018). "A mismatch between students' and lecturers' academic expectations may result in communication breakdown or to uncertainties about their respective roles" (Hassel and Rideout, 2018, p. 11). It can also have a direct bearing on academic performance. Students must be introduced to the benefits of active learning and the increased cognitive load that often accompanies it early in their pursuit of higher education. Students must be prepared for and coached through an active approach to learning. Frequent reminders of the value of active learning and research pointing to increased student success will help align instructor and student expectations and increase student learning (Deslauriers *et al.*, 2019).

Encouraging active learning

Active learning is defined by Felder and Brent (2024) as brief individual or group-related tasks completed by all students in the class, combined with instructor-led sessions where student contributions are reviewed and new material is introduced. In the classroom, active learning can take various forms and be utilized in various academic settings. One example of active learning might be placing the students in small groups, providing them with an action to and time to achieve it, and then reconvening as a whole class and discussing student findings. In an English classroom, this may require students to identify the meaning intended in a sonnet. In a science classroom, the students may be attempting to determine the most practical method to measure a pendulum's period without a stopwatch. In either example, the instructor provides some measure of information and instruction to their students before allowing them to explore potential solutions. Borchardt and Bozer (2017) discussed incorporating active learning to enhance critical thinking skills, a key component of any modern classroom when preparing college students for the workforce.

Active learning encourages students to own and activate their learning. Research conducted by Lumpkin *et al.* (2015) identified that college-aged students enjoyed learning through engaging learning activities and also reported positive perceptions of these active learning opportunities. Recent technological advances, especially in artificial intelligence (AI), have provided educators with innumerable new tools to assist in acquiring knowledge and understanding. However, many educators have significant concerns regarding AI utilization, particularly cheating and plagiarism. Dehouche (2021) stated that students may attempt to pass off the work of AI as their own, increasing the rates of plagiarism seen in classrooms. Akintande (2024) identified how AI may drive down student creativity as students utilize AI to complete assignments instead of relying on their abilities and understanding.

These concerns, while valid, also present educators with opportunities to harness the potential of AI to increase active learning in students. Cotton *et al.* (2023) presented educators with ideas on increasing student creativity while utilizing AI, such as developing assessments that require students to demonstrate their communication, problem-solving, and critical-thinking skills. Educators may create assessments that allow students to use AI's power while engaging their creativity; how does what the AI suggests compare to the information students have gathered on their own? Utilizing AI may encourage students to be more active participants in their education, taking what they learn from AI and applying it to their own experiences.

Learning and performance goals

Students are typically driven by some combination of learning and performance goals, which significantly influence their academic engagement and success. Learning goals, also known as mastery goals, focus on gaining new skills and knowledge (Alhadabi and Karpinski, 2020; Luo *et al.*, 2011; Senko, 2019; Schunk and DiBenedetto, 2020; Sides and Cuevas, 2020) and are evidenced to have a positive impact on students' self-efficacy (Alhadabi and Karpinski, 2020; Honicke and Broadbent, 2016). When students focus on learning and personal growth, they are more likely to experience progressive achievements, which contribute to an increasing sense of competence and place value on learning (Elliot and McGregor, 2001; Dweck and Yeager, 2012). Research shows that students who adopt learning goals are more likely to engage in effective learning strategies, persist despite challenges, and be intrinsically motivated (Alhadabi and Karpinski, 2020; Senko, 2019). These students perceive failure as a normal part of the learning process and growth opportunities rather than a depiction of their abilities, which encourages resiliency. This approach can lead to stronger beliefs in their ability to attain higher academic achievement and development because these students are more inclined to view their abilities as pliant and, therefore, invest more in their learning process (Wolters and Hussain, 2015), which reinforces self-efficacy (Honicke and Broadbent, 2016; Dweck and Yeager, 2012).

Conversely, performance goals are centered around demonstrating one's abilities, especially compared to others (Luo *et al.*, 2011; Sides and Cuevas, 2020). Grades are a widely accepted measure of educational success and attainment of academic goals (Alhadabi and Karpinski, 2020; Schunk and DiBenedetto, 2020). These goals typically drive students to compete by trying to outperform their peers or avoid appearing less capable than those around them (Alhadabi and Karpinski, 2020; Luo *et al.*, 2011; Senko, 2019). While such goals can push students to excel and achieve high standards, they can also cause increased anxiety and lead to a fixed mindset, resulting in academic deterioration over time (Elliot and Church, 1997; Alhadabi and Karpinski, 2020; Meece *et al.*, 2006). This means students might become more preoccupied with proving themselves than developing their skills, leading to self-efficacy that is solely dependent on performance. Additionally, high performance does not typically lead to advancements in learning (Soderstrom and Bjork, 2015). As a result, they might engage in superficial learning and avoid difficult tasks for fear of failure, which can hinder their long-term academic growth (Alhadabi and Karpinski, 2020).

An integrated approach that combines learning and performance goals may offer a balanced strategy for academic motivation (Luo *et al.*, 2011; Senko, 2019). Studies suggest that students who are encouraged to pursue both goals stay more motivated and perform better academically (Dull *et al.*, 2015; Sides and Cuevas, 2020). Both goal types positively impact self-efficacy (Luo *et al.*, 2011). For example, assignments that promote mastery while also encouraging high performance standards can help students stay engaged and motivated without the negative effects of focusing only on performance. This balanced approach supports a more effective and resilient learning experience (Dull *et al.*, 2015). Moreover, tasks designed with learning goals have enhanced educational outcomes and motivated student learning (Sides and Cuevas, 2020). By integrating both learning and performance goals into instructional design, educators can create a more dynamic and resilient learning environment

that enhances student motivation and achievement, thereby reinforcing self-efficacy, which ultimately decreases the probability of academic dishonesty (Alhadabi and Karpinski, 2020). Clearly defined learning goals are essential for improving learning outcomes and boosting students' motivation (Senko, 2019). Additionally, studies have shown that students who engage in cognitive and metacognitive learning activities attain higher academic achievement (Heller and Cassady, 2017). One way to empower students in their learning is to employ a student-centered approach where the students are primarily responsible for their progress (Alhadabi and Karpinski, 2020). However, to be effective, these goals must be monitored and adjusted based on the demands of the course and the specific learning context (Xia, 2017).

Bandura's theory of triadic reciprocity

Bandura's (1986) theory of triadic reciprocal causality (TRC) is an integral component of his social cognitive theory. This theory of motivation asserts that personal, behavioral, and environmental factors are interconnected and influence each other in sculpting one's confidence and learning. Personal or cognitive factors include emotions, thoughts, and beliefs about our abilities (self-efficacy). Behavioral factors involve our actions and performance, while environmental factors are external factors that include the social and situational influences around us. The idea is that these three factors influence each other in a bidirectional manner, meaning that our belief in our ability (self-efficacy) can affect, and be affected by, our actions as well as the environment we are in (Bandura, 1999; Woodcock and Tournaki, 2023).

Self-efficacy plays a crucial role in the personal factor because it impacts how people engage in learning. People with high self-efficacy are more likely to press on, put in their most significant effort, and stay persistent even when things get tough (Phan, 2011; Senko, 2019). Evidence suggests that self-efficacy acts as both a determinant and an intermediary of motivation and performance, both positively and negatively (Phan, 2011). Additionally, students with high self-efficacy are more likely to use effective study methods, set ambitious goals, and stay motivated even when they face difficulties. On the contrary, students with low self-efficacy might avoid complex tasks and become less motivated, hurting their learning and performance (Bandura, 1999; Phan, 2011).

The behavioral component of this model demonstrates how our actions, combined with feedback, affect our self-efficacy. Experiencing success can inflate our self-efficacy beliefs, making us more confident in approaching new and challenging tasks (Bandura, 1986; Phan, 2011), while being successful with those new challenges simultaneously boosts self-efficacy. This continuous loop encourages more learning and skill development.

The Environmental aspect of the triadic reciprocal causation model also plays a significant role in shaping self-efficacy and learning outcomes. Supportive learning environments, like those with encouraging teachers and peers who provide constructive feedback and acceptance, can boost self-efficacy (Woodcock and Tournaki, 2023). In contrast, unsupportive or unfavorable environments can deflate self-efficacy and impede progress (Heller and Cassady, 2017). Bandura's (1986) Theory of Triadic Reciprocity calls attention to the importance of having the type of context that builds students' confidence and helps them stay engaged in learning.

This model demonstrates how personal beliefs, behavior, and the environment influence educational success. Phan's (2011) findings further highlight the need for educators to focus on fostering and promoting mastery experiences in classroom learning rather than strictly relying on normative evaluations and social comparisons, as this can help students develop a stronger sense of self-efficacy.

Quiz creator assignment

This study aimed to investigate the impact of a quiz creator intervention on students' self-efficacy scores. The research compared self-efficacy between control groups, which experienced traditional classroom settings, and experimental groups, which engaged with

quiz creator assignments throughout the semester. The analysis revealed significant differences in pre- and post-test self-efficacy scores within the Teacher Education and Psychology groups. While no significant differences were found between the control and experimental groups when considering all classes together, overall self-efficacy scores varied. Notably, self-efficacy scores declined in the control groups but increased in the experimental groups, highlighting the potential benefits of the quiz creator intervention.

Students in our experimental groups were asked to complete quiz creator assignments. This was a two-fold assignment where the student was both the creator of quizzes and a peer reviewer of quizzes. Students were required by their faculty members to create their own 5–10 question multiple choice or a limited number of true/false quiz questions over each chapter. Quiz information had to be visible to at least one other student who took and evaluated their peer's quiz. Peers must find the answer to the quizzes by verifying the textbook page number and accuracy of the question and answer. Peer reviewers were also asked to check the authenticity of the questions created, meaning that peers were asked to report if they found the exact or similar question online through Google, Quizlet, or another entity because this assignment was to develop original questions. Faculty members were asked to check the authenticity of the questions randomly. Reviewers were also asked to rate the quizzes rigorously, i.e. were the questions suitable, the level of difficulty, and simplicity of each question. Quiz creators were implemented to encourage textbook reading and more in-depth focus on the content by creating and reviewing the textbook numerous times. In addition, by pulling in external entities like Quizlet, we asked them to use technology for beneficial purposes. They use the technology, while learning in the process. AI platforms such as study tools are pulled into this process in a manner outside of their typical uses, which we hypothesized would foster engagement and a deeper understanding of the material.

H1. Students in the experimental sections who were required to complete the quiz creator assignments will have a higher self-efficacy score at the end of the 16-week semester.

Methods

Participants

Participants ($N = 31$) were undergraduate students enrolled in upper-level Psychology and Teacher Education courses at a rural university in Texas. Eligibility criteria required participants to be at least 18 years of age and enrolled in one of three instructors' courses. Participants were assigned to either the control or experimental group. The sample was predominantly female ($N = 28$), which is consistent with the student populations in the Psychology and Education programs at the university. While all students were enrolled in 3000-level courses, their academic classification varied: freshmen ($N = 3$), sophomores ($N = 4$), juniors ($N = 15$), and seniors ($N = 9$). Participant ages ranged from 19 to 59 years, with a ($M = 24.5$ years, $SD = 3.5$).

Materials

The Academic Self-Efficacy Scale (ASES) (see Appendix A, p. 29) was utilized to measure participants' beliefs regarding their academic abilities (Gafoor and Ashraf, 2007). The scale includes the following areas: learning processes, reading, comprehension, memory, curricular activities, time management, teacher-student relationships, peer relationships, resource utilization, goal orientation, adjustment, and examinations. The ASES consists of 40 statements, equally divided between 20 positive and 20 negative items, to comprehensively review students' academic self-confidence across the domains. Participants were presented with a series of statements about their learning experiences and asked to indicate their level of agreement on a 5-point Likert scale. The response options ranged from 5 (Exactly true) to 1 (Exactly false), with intermediate options of 4 (Nearly true), 3 (Neutral), and 2 (Nearly false).

The Academic Self-Efficacy Scale was developed to assess the academic self-efficacy of secondary school students, drawing on Bandura's (1977) Self-Efficacy Theory, which is situated within the broader framework of Social Cognitive Theory.

Procedure

Students self-enrolled in their courses according to major, each instructed by three faculty members. If consent was given to agree to participate, these students were asked to take part in a pre and post-test survey designed to measure self-efficacy. Data collection occurred at two-time points: at the start of the semester and again after the semester. The surveys were administered via an online platform, Qualtrics, facilitating efficient distribution and data collection across the student cohorts. Specifically, the pre-test measure of self-efficacy was administered at the beginning of the study, before the quiz creator intervention began in the experimental groups. Following the quiz creator intervention period, the post-test measure of self-efficacy was administered to assess changes in overall self-efficacy scores. In the control groups, we measured self-efficacy in a pre and post-test manner among the participants who engaged a traditional assignment platform.

Results

Research design

A mixed-factor ANOVA was conducted to analyze the data. This analysis aimed to determine the main effects of the control and experimental groups and time in a pre and post-test survey, as well as their interaction, to assess the impact of the intervention on self-efficacy scores. This study employed a mixed-factorial design to evaluate the effects of our quiz creator project on self-efficacy scores. The design included a between-subjects factor and a within-subjects factor. The between-subjects factor consisted of a control group and an experimental group. The control group did not receive the intervention with quiz creators, while the experimental group participated in an intervention designed to enhance self-efficacy. The within-subjects factor assessed the groups at two different time points, at the beginning of the semester in a pre-test survey and after the semester concluded in a post-test survey.

Descriptive analysis

The range of scores for the ASES is between 40–200. With the control group ($N = 13$), which included students who had no quiz creator intervention, our pre-test scores were ($M = 93$, $SD = 4.58$); post-test scores ($M = 83.15$, $SD = 22.52$), and our experimental group who had quiz creator interventions ($N = 18$), pretest scores were ($M = 88.11$, $SD = 11.91$), and post-test scores ($M = 93.66$, $SD = 13.94$) See Table 1 below.

Inferential analysis

A within-subjects analysis evaluated self-efficacy scores across pre-test and post-test measurements. The analysis revealed a significant effect of time, $F(1,29) = 5.77$, $p = 0.02$,

Table 1. Descriptive statistics

Group	Time	M	SD
Control	Pre-test	93	4.58
	Post-test	83.15	22.52
Experimental	Pre-test	88.11	11.91
	Post-test	93.66	13.94

Source(s): Created by authors

$\eta p2 = 0.166$. This result indicates a large effect size and a significant change in both groups' self-efficacy scores from the pre-test to the post-test.

A between-subjects analysis was conducted to evaluate self-efficacy among each participant's control and experimental groups. The analysis indicated no significant main effect on the groups, $F(1,29) = 0.458$, $p = 0.504$, $\eta p2 = 0.016$. This result suggests a small effect size and no meaningful differences between the two groups across time in pre and post-test self-efficacy surveys See Table 2 below.

Class sections

For the purposes of this section, we removed the class with only five students because there were not enough students to compare across all sections. This allowed us to compare the differences between the instructor's pre-and post-test and between Psychology and Teacher Education.

Descriptive analysis (comparing psychology and teacher education)

For the control groups, the psychology ($N = 7$), a pre-test was ($M = 93.28$, $SD = 5.0$), and the post-test was ($M = 79.42$, $SD = 30.90$), where teacher education ($N = 6$) was ($M = 92.67$, $SD = 4.45$) and post-test was ($M = 87.5$, $SD = 5.43$). For the experimental groups, psychology ($N = 8$) pre-test was ($M = 93.87$, $SD = 3.31$) and post-test was ($M = 97.37$, $SD = 10.43$) and for teacher education ($N = 5$) pre-test was ($M = 76$, $SD = 16.62$) and post-test ($M = 88.6$, $SD = 23.89$) See Table 3 below.

Inferential analysis

A within-subjects analysis evaluated self-efficacy scores across pre-test and post-test measurements. The analysis revealed a significant effect of the interaction between time and group (control vs. experimental), $F(1,22) = 5.19$, $p = 0.03$, $\eta p2 = 0.191$. This result indicates a large effect size and a significant change in both groups' self-efficacy scores from the pre-test

Table 2. ANOVA

Analysis type	Source	*df*	*F*	ηp^2	*p*
Within-subjects	Time	1	5.77	0.166	0.02*
Between subjects	Group	1	0.458	0.016	0.504

Note(s): Significance is at the 0.05 level*

Source(s): Created by authors

Table 3. Descriptive statistics

Group	Major	Time	M	SD
Control	Psychology	Pre-test	93.28	5.00
		Post-test	79.42	30.90
	Teacher Education	Pre-test	92.67	4.45
		Post-test	87.50	5.43
Experimental	Psychology	Pre-test	93.87	3.31
		Post-test	97.37	10.43
	Teacher Education	Pre-test	76.00	16.62
		Post-test	88.60	23.89

Source(s): Created by authors

to the post-test. There were no significant differences in pre- and post-overall ($p = 0.85$), pre and post-psychology, and teacher education majors ($p = 0.26$).

Discussion

This study aimed to address differences in the control and experimental self-efficacy scores. The students in the control groups participated in the traditional classroom experience with no quiz creator intervention. The students in the experimental group were exposed to the quiz creators' assignments throughout the semester. Given our results above, there were significant differences in pre and post-test self-efficacy scores in the control and experimental groups when comparing the Teacher Education and Psychology groups. There were no significant differences between the control and experimental groups when comparing all three classes together, but there were differences among overall self-efficacy scores. Interestingly, the control groups declined in self-efficacy scores among all groups overall, while the experimental groups increased overall.

This study had several limitations, including the number of students participating in the pre and post-test research. Among the three different instructors' classes, one class had 15 students complete pre and post, the next had 11 students complete pre and post, and the third class only had five students complete the pre and post-test surveys. We could not use a student's data if they did not complete both surveys. It would be helpful to recruit more students, potentially bring in other measures of self-efficacy, and possibly look at one instructor across numerous sections. Even though we did have two instructors with a control and an experimental group, it might be beneficial to have each instructor use quiz creators in their classrooms for a year to pull data over a more extended period with one faculty member. In addition, it may be helpful to compare differences in upper and lower-level courses.

We saw a significant difference in overall pre and post-test self-efficacy scores over one semester. Self-efficacy scores decreased in the control group and increased in the experimental group in a short period of time. The traditional semester is 4.5 months, and although we cannot tell precisely what contributed to these significant changes, the students in the experimental group showed improvement while enrolled in these junior-level courses. We are also interested in why the control group had almost a 10-point reduction in self-efficacy scores when comparing all groups together. Future studies should consider comparing differences in self-efficacy in various classifications at the freshman, sophomore, junior, and senior levels. There may be differences in the student classifications. It would also be helpful to use different survey methodologies testing self-efficacy.

Future studies should incorporate a larger sample size and consider incorporating qualitative data to gather information about the quiz creator assignment. Anecdotal data from previous courses using quiz creators was positive on instructor evaluations, but these items are minimal and were not part of this study. Overall, instructors' feedback was that they might continue using quiz creators in specific courses and that doing something new was beneficial. In addition, finding ways to incorporate technology, artificial intelligence, and active learning activities is necessary to keep students engaged.

Practical approach

To provide more information on the development of teaching students to create good questions, we wanted to share some ways that we supported them. This feedback section is anecdotal and was requested by a reviewer.

Training participants in the experimental group to design questions

Participants were trained to design effective quiz questions through a structured, criteria-based process. Prior to quiz creation, participants engaged in an in-depth reading of the assigned textbook chapter to ensure familiarity with the material. They were instructed to develop

original questions without the use of external digital tools or online resources, reinforcing the expectation of academic integrity and originality. To guide the design process, participants were introduced to four key evaluation criteria that they would also use later during peer review: *Rigor, Authenticity, Accuracy,* and *Thoroughness*. These were outlined in a rubric used to evaluate both question design and peer feedback. Rigor emphasized the importance of creating challenging questions with well-crafted distractors and required participants to consider how much effort would be needed to locate answers within the chapter. Authenticity focused on ensuring all questions were self-authored and free from plagiarism. Accuracy required that each correct answer be clearly supported by the text and be the most appropriate choice among the options. Finally, Thoroughness encouraged students to cover the chapter comprehensively, addressing its main themes and learning objectives. This multi-layered approach not only supported the development of high-quality quiz content but also provided a framework for meaningful peer feedback and evaluation.

Challenges

At the start of the project, several challenges emerged that impacted the overall process. Some participants struggled to meet all of the established criteria for quiz design, resulting in questions that lacked rigor, accuracy, or coverage of key chapter content. Additionally, a number of participants failed to submit their quizzes by the designated deadline, which prevented them from being assigned a peer for review. Others did not provide peer feedback promptly, disrupting the intended flow of the assignment and limiting the effectiveness of the peer review process. These issues highlighted early on, the need for clearer expectations, stronger time management, and increased accountability throughout the project. We were able to more clearly define the expectations for participants moving forward.

Improvement over the semester

As the semester progressed, participants demonstrated noticeable improvement in their quiz question design. This growth was largely due to the clarification of expectations and participants recognizing the direct impact of their performance in peer feedback, which was reflected in their grade. With a better understanding of the assignment criteria and increased motivation, students began submitting their work more consistently and on time. Additionally, they started to engage more thoughtfully with peer feedback, using it to refine their questions for greater clarity, rigor, and alignment with the chapter content. This iterative process led to a higher overall quality of quiz submissions and a more effective peer review experience.

Examples

As participants became more familiar with the criteria and incorporated peer feedback into their revisions, they began receiving more positive comments on the quality of their quiz questions. This recognition boosted their confidence and affirmed their ability to design questions that were rigorous, accurate, and aligned with the chapter content. Over time, many expressed greater self-efficacy in their ability to create thoughtful, well-constructed assessments.

In the Psychology course, the instructor stated that students began to create questions that had depth and application-based questions rather than simply multiple choice questions with an obvious correct answer. In class, students were talking about each other's questions and addressing those who created questions that did not make sense, were too easy, or too difficult, and this increased accountability over the semester.

Students as creators and faculty takeaways

Participants engaged thoughtfully with their peers' quizzes by completing them and providing detailed feedback based on the assignment's four key criteria: rigor, authenticity, accuracy, and thoroughness. They evaluated how challenging the quiz was, whether the distractors were

well-designed, and how much effort was required to locate answers in the text. Participants also assessed the originality of the questions, often conducting brief searches to confirm that content was not copied from online sources. They reviewed the accuracy of each question, ensuring that the correct answers were clearly supported by the textbook and were the best possible choices. Finally, they considered how comprehensively the quiz covered the chapter's main topics. This structured peer review process helped reinforce content understanding and supported the development of stronger question design skills.

The faculty were able to see a change in student engagement in a short period of time. In class discussions increased and we are able to pull some of these questions into our final exams. Specifically, in the Psychology course, the faculty member will use these questions in other classes and will continue using the quiz creator assignment, especially in the face-to-face courses.

Conclusion

Traditional lecture-based courses and those with solely multiple-choice-based items may not be meeting students where they are now, so incorporating innovative technologies or activities seems to be the wave of the future, and these tools are here to stay. In addition, we suggest looking at content knowledge acquisition over time for students using quiz creators. It would be interesting to compare the differences in retention among a traditional classroom versus those who use quiz creators as an integral part of their learning experience.

Our takeaway from this project is that utilizing technology such as AI study apps in a constructive manner might be a way to enhance learning overall. Because the experimental group showed increases in self-efficacy scores across the board, perhaps activities where a student engages in peer reviews, active learning opportunities, peer learning, and adaptive teaching methodologies may meet students where they are and foster a deeper understanding of the materials. In addition, this may improve confidence in education. Those who were in the control groups decreased over time, which *could* mean that students overestimated their abilities at the beginning of the semester, so further investigation of these methodologies is critical to assess these practices.

IRB approval

IRB approval was obtained on January 8th, 2024 to conduct this research.

Data availability statement

The data supporting this study's findings are available from the corresponding author upon reasonable request. All items from this study included in this paper are available to use by readers for research purposes.

Supplementary material

The supplementary material for this article can be found online.

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