Educational Assessment in the Time of Artificial Intelligence:
Assessing Creative and Critical Thought

Colleen Halupa, East Texas Baptist University, United States

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Abstract
The release of artificial intelligence (AI) text generator programs, such as ChatGPT, have changed the landscape of higher education, particularly regarding assessment. Traditional assessment used to measure higher levels of learning often include research papers, case studies, analyses, and other written works. These types of assessments can often be easily completed on generative AI programs. AI detection programs have been unable to keep up with the advances in AI; this has resulted in many universities turning off the AI detection feature on plagiarism detection programs due to unreliability. This leaves faculty unsure if students are: a) completing their work without AI assistance, and b) actually learning. The purpose of this paper is to address the theories of emerging pedagogies and associated assessment techniques that are more AI-resistant, and require more critical and creative thought.

Keywords: Artificial Intelligence, Disruption in Higher Education, Emerging Pedagogies, Assessment Techniques

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Introduction

Disruption has been caused in higher education by the release of generative AI programs, particularly in regards to student assessment. ChatGPT was released to the public in December, 2022. It was created with Generative Pre-trained Transformer language which can be can be indistinguishable from human writing (Lund & Wang, 2023). These programs can write essays, create outlines, and solve mathematical problems. The creation of these AI programs has required higher education faculty to consider alternate forms of assessment that cannot easily be completed on an AI program. Although plagiarism detection programs such as TurnItin exist, they are by no means perfect. Walters (2023) in a study of 16 AI text detector programs found Turnitin was the most accurate; however, Annie Chechitelli, the Chief Product Office of Turnitin reported that higher false positive rates were found in documents with less than a 20% AI match (2023). Some interference has been reported when students use programs such as Grammarly, but this is likely because students do not know the difference between Grammarly and GrammarlyGo which is a generative AI program.

Higher education institutions have struggled significantly with policies and procedures regarding AI and plagiarism AI detectors. Because cheating is so difficult to prove due to problems with the detectors, some colleges have turned them off. In September 2023, Quach reported Vanderbilt, Michigan State, Northwestern and the University of Texas at Austin had opted to turn off their AI detectors. Chechitelli (2023) noted that Turnitin had a 1% false positive rate, but at large universities such as Vanderbilt where 75,000 papers are ran through Turnitin a year, this would result in 750 false positive plagiarism cases. For Vanderbilt, that risk was too high (Quach, 2023).

AI programs are not going to go away. Instead, they are likely to continue to get better. There are currently almost 100 AI programs available and the number continues to increase. Because the technology is increasing so rapidly, it is difficult for companies such as Turnitin to keep up. This leads to philosophical questions for faculty. Will anything ever be original anymore? But, was anything ever original to begin with since for centuries humans have been basing their work on the work of others that came before them? However, to deal with this disruption, faculty are going to have to assess differently if they want to know if students can apply the content being taught.

Critical Thinking, Volition, and Creativity

Critical Thinking

In 1941, Glaser in a seminal study of critical thinking (CT) noted it had three components: the ability to be thoughtful about problems within the realm of one's own experiences, the ability to understand logics and reasoning, and the ability to apply the first two. Definitions of critical thinking vary, but according to the Foundation for Critical Thinking (2023), CT is the "intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing and evaluated information gathered from, or generated by, observation, experience, reflection, reasoning or communication" (p.1). It is interesting to note that the terms used marry exactly with the last four domains of Bloom's taxonomy in education. In order for critical thinking to occur, students must be assessed beyond the knowledge and comprehension level of Bloom's. In these lower taxonomy levels, prior to AI, it was easier to cheat. AI has now impacted cheating in the higher levels of Bloom's taxonomy as well since it can be used to generate all sorts of creative and research text.

In the Delphi Report on Critical Thinking which was published in 1990, cognitive skills for critical thinking were identified and included: interpretation, analysis, evaluation, inference, explanation and self-regulation. Interpretation included the ability to decode significance and clarify meaning. Analysis included examining all aspects of an idea, identifying pros and cons, and then analyzing them. Evaluation included assessing arguments and points of view. Explanation included identifying results, arguing for or against something, and justifying procedures and points of view. Self-regulation is self-examination and correction of incorrect assumptions and behaviors (Facione, 1990). This is related to volition which will be discussed later. In order for students to attain these abstract skills, they have to practice them. That is impossible with teacher-centered methods such as lecture and multiple-choice testing. In addition, assessments that are crafted with these concepts in mind are likely less susceptible to student use of AI to complete the task.

There is significant dissention on whether CT can be taught. Socrates and Plate believed it could be taught through dialectic thinking. John Dewey (1910) believed it could be taught, but not through passively listening to a teacher lecture; he theorized it could only be done through experiential learning. Consequently, educational theorists such as Piaget and Montessori thought critical thinking could not be taught because people learn through experience. Kolb (1984) agreed with Dewey regarding experiential learning, but he did not believe CT could be taught. Sharples et al. (2017) noted students have to have knowledge first, but cannot critically think without exposure which is experiential. Willingham (2020) noted the reason it is so difficult to define CT and develop competencies and skills that reflect it is because it is different in every discipline, and there are no proven ways to teach it directly. The best known method at this time is simulations and problem-based learning which will be discussed later (Dekker, 2020; Thorndahl & Stenhoft; Willingham, 2020).

Every generation seems to lament that the upcoming generations have lost the ability to critically think. However, CT is in some respect innate, or man would have died out generations ago. Technology has significantly impacted critical thought. Previous to all information being available at everyone's fingertips, a person who had a lot of knowledge about a variety of things could have been perceived as a critical thinker. This is confusing intelligence and aptitude with critical thinking which is different.

Does the availability of technology and information increase the potential for critical and also creative thought? It very well may, but AI could potentially have a negative impact on critical thought, or in the future, the perceptions of CT may in fact change. The definitions of CT has changed somewhat as information became more widely available in the last two decades with the movement to information literacy. As time goes on and AI goes into wider use, this may significantly impact how critical and creative thinkers are viewed in the future.

Volition

Frith (2013) noted volition is internally generated behavior; it implies a sense of urgency or prioritization of certain tasks (agency), such as getting an education. There is regret when a wrong action is taken, because agency includes a strong sense of responsibility. Deimann and Bastiaens (2010) said volition is the ability to maintain a course of action when obstacles arise. In today's world, it is the ability to stay focused and avoid distractions caused by technology and modern life. This is very difficult for many students since many are externally motivated (praise/grades) rather than internally motivated. However, Wrzesniewski et al. (2014), in a study of West Point Cadets that included 14 years of data and over 10,000 cadets, found

intrinsic motivation was the key to success and reaching goals. This was the case across all races, religions, gender, socioeconomic background and prior testing scores.

Volition and motivation are related, but different because a student can be motivated, but never accomplish a task. Motivation is willingness, while volition is action and not just intent. Skills needed for volition include selective attention, the ability to process and discern incoming information, emotional control, and motivational control. Students must keep an eye on the ultimate goal and foregoing instant gratification that will cause regret. In addition, a student must enact environmental control and avoid distractions and have parsimonious information processing which is knowing when to stop and when to go forward to support the current goals (Kuhl, 1985). Kuhl noted selective attention protects volition by inhibiting processing of information about competing factors and distractions. This is also maturity and the willingness of a student not to be able to have and do everything she wants now (delayed gratification) so she can meet the goal and have it in the future. Mischel from 1974 through 2014 in the Marshmallow Test experiments found that children who were willing to delay gratification had more positive cognitive abilities and success later on in life. This can be correlated to the ability to stay focused, which is a form of self-control, which is critical in volition.

Creativity

Zeng et al. (2011) noted many perceive creativity as a skill that is only present in those who favor the arts, but creative thinking is critical in fields like healthcare, business and others. Gafour and Gafour (2020) noted creative abilities are one of the most sought after skills in the 21st century workplace. Zeng et al. found most people tend to rate themselves as above average in regards to creativity; males overall, feel they are more creative than females. Yet, this is not what employers are reporting.

Creativity is very difficult to measure, but in relation to problem solving, which is a critical skill for employers, it can be facilitated. This can be done by presenting problem spaces that are not well defined (Zeng et al., 2011). Walton (2003) agreed with this, and said creativity can be encouraged by offering less structure. This leads to problem-finding, which is seeking opportunities to find different solutions to meet goals, and problem formulating which is framing a problem in a concrete way to come up with solutions. Analyzing a problem has a critical impact on the creativity of the final solution (Zeng et al., 2011).

Creativity is very difficult to define in education since it is so individualized. In addition, creations of any kind are usually built from other's creations (Tanngaard, 2012). Tanngaard notes in reality, creativity is both common and collective.

Tanngaard wrote "materials, tools, things, institutions, normative practices and "ways of doing" already in the world are taken as starting points for new creations" (p. 21). Creativity is often thought of as a higher order thinking process, which in keeping with Bloom's taxonomy, would require students to reach the evaluation and create levels in activities and assessment. Students may often feel they aren't creative, but Tanngaard notes people are constantly engaged in transformation and change. She notes humans rarely produce knowledge that is detached from themselves or others, which is also true in education.

In education, teachers concentrate on students getting the right answer. This is convergent thinking. Instead, teachers need to concentrate on encouraging students to come up with different possible solutions which is more divergent thinking if the goal is to encourage creative

thought. In 2004 Scott et al. performed a metanalysis on 70 creativity studies and found creativity could be enhanced by teaching students to link ideas which seemed to be unrelated to develop associative thinking. This leads to assessments that requires students to find multiple solutions rather than just the right solution.

However, students cannot become creative problem solvers without the required materials which Tanngaard notes are crucial for creative thought. Teachers have to provide that material in order for students to develop creative problem solving. This is done through proper design of activities and assessment in the classroom.

Assessment in Higher Education

Traditionally in higher education, psychometric model assessments were used. These included multiple-choice tests that do not usually assess higher levels of learning (Appiah, 2018; Brown & Adulnabi, 2017; Filsecker & Kerres, 2012; Lesage et al., 2013, Schroeder, 2021). Those that do are difficult to write and validate. Psychometric model assessments were easily graded; however, they have always been subject to cheating or question (Shroeder, 2021). When online learning became prevalent in the late 1990's, it became even easier to cheat on multiple choice tests that were given online. Traditionally in some fields to assess higher levels of learning, student research papers were also used. Now with AI programs, students can ask an AI program to generate a research paper at literally the drop of a hat. This means the traditional assessments that were used in the past may no longer be as effective in the future.

In 2000, Ison and Russell identified two levels of change that are driven by learning and called them first and second order change. Traditional assessment lends itself to first order learning where a student may learn something for a test, but then he or she "dumps" the knowledge and it is forgotten. It never has a true impact on the student's life or behavior. Second order change impacts the way a student thinks and acts. It is these second order assessments that are less susceptible to student's using AI rather than doing their own work. These second order assessments are tied to emerging rather than traditional pedagogies.

In the last two decades, there has also been a significant movement from teacher-centered to student-centered learning in higher education. Traditional pedagogies were based primarily on behaviorism and cognitivism and leant themselves to traditional assessment such as psychometric testing. However, student-centered pedagogies require assessment that is more complex and less likely to be generated by an AI program.

Transformative Learning (TL)

In transformative learning, assessment is based in self-reflection, as well as critical thinking. Assessment in TL often requires the student to relay personal experiences to show how changes in meaning schemes and thought have transpired. Students are required to identify and evaluate the process of their learning to demonstrate critical thinking (Mezirow, (1978, 1985, 1990, 1991, 1997, 1998, 2000a, 2000b, 2003, 2006). In addition, the self-reflective practices used in TL spur more creative thought. This creative thought requires students to address the process of learning and how their thinking was transformed.

Romano (2018) suggested several assessment types that can be used in the transformative learning framework. These include self-evaluation methods where students take a self-assessment and then evaluate their potential strengths and weaknesses and how these may relate

to future performance. Other assessment techniques include the creation of journals and case studies on a topic. Metaphor analysis is another example that is often used in the social science. Since a metaphor can mean different things to different people in different contexts, it is an assessment where it may be difficult to use AI. Art-based techniques including creative writing, music composition, improvisation, photography and collages where images represent contexts of learning are an another example. Critical discussion where students evaluate pros and cons of an issue and debate these issues is a commonly used assessment took in transformative learning (Western Governors University, 2020).

All of these examples are from the humanities which by their very nature are more open to creative assessment. Esterhazy and Fiksen (2019) discussed a portfolio approach in the sciences (ecology) which required students to evaluate aspects of physical chemistry and science and reflect on how this challenged their assumptions of the work. More research needs to be done to provide higher education faculty concrete examples of TL assessment in order for these techniques to be more widely used.

Assessment in TL often an ill-defined problem where actions must be evaluated. However, students are not used to these types of assessments because they have not been exposed to them. At this point, generative AI programs still sound somewhat "machine-like" and are not as adept as sounding like humans who are engaged in self-reflective thought. Therefore, these types of assessments may be a deterrent in student use of AI.

Heutagogy

A second emerging pedagogy where the assessment style is less amenable to the use of AI programs is the concept of heutagogy as posited by Hase and Kenyon in 2002. The goal of heutagogy is to create learners who can function at higher levels of thinking on their own. Assessment that uses heutalogical principles are complex. Students must clearly evaluate several potential scenarios to come up with the best outcome. This includes identification of variables and causative relationships. In this type of assessment, the teacher supplies the material and students decide how to solve the problem. But when faculty are stretched thin in higher education, these types of assessment can be very difficult and time consuming to write. In addition, they are very time consuming to grade which is why faculty who are teaching overload or have a large number of students in a class tend to use traditional assessment.

Assessment in heutagogy is not "an attempt at some finite measurement of learning…or how well we have learned something" (Booth., 2014, p. 64). Booth (2014) outlines two assessment approaches that are effective in heutagogy. The first is reflection and critical reflection which is a hallmark of transformative learning. The second is assessment where students must seek guidance and feedback from others. This includes group work, as well as formative assessment. Lynch et al. (2021) recommends having students create computer content for other audiences, including websites. This is also a type of problem-based assessment which will be discussed later. Such assessments can enhance technology capabilities, as well as incorporate problem solving and formative feedback.

Stoten (2020) noted in business education, heutagogical assessment allows students to experience real world problems that do not always have a distinct solution. He notes this is a type of experiential learning where more emphasis is placed on evaluating possible solutions. He notes, however, that assessment in heutagogy is problematic. This is because the education

of students is still measured by traditional pedagogical and psychometric measures by credentialing and licensure agencies, as well as accreditation bodies.

Richardson et al. (2017) discussed a heutagogical case study approach that was used in Australia in masters' program in business. Case studies can be an effective assessment technique in many fields. However, assessment has to be carefully crafted so the student has to demonstrate the process of decision-making, rather than just giving a potential correct answer which can be obtained through the use of AI programs.

Psychometric assessments identify a specific knowledge level and assess all students using the same measure. Transformative and heutagogical assessments are very personalized and the learning process is different for everyone. This can make it very difficult for the educator to assess adequate performance. Mohammed et al. (2019), in using a heutogogical basis for structural steel design in civil engineering, recommended that assessment be conducted throughout to ensure that students are meeting minimum levels.

Because of the difficulties in incorporating both transformative and heutagogical assessment and the time faculty must spend creating and grading these types of assessments, it is recommended that faculty start slow and perhaps incorporate one of these types of assessments in a class. Using these techniques can allow a faculty member to know if a student is truly learning and is capable of critical and creative thought.

Problem-Based Learning (PBL) and Experiential Learning (EL)

There are no hard and fast rules for creating assessments that are AI-resistant, but perhaps one of the most AI-resistant types of assessment is problem-based learning. In addition, problem-based learning can provide assessments that reflect the lack of structure and a wide problem space required for creativity as noted by Zeng et al. (2011) and Walton (2003). PBL teaches student multiplicity which is the ability to look at problems differently (Dekker, 2020). The answers to real-life questions cannot easily, at this point be found in AI programs when there are many possible answers and the problem is complex. However, the major problem with PBL assessments is they are very discipline specific, they are not commonly found in many textbooks, they are difficult to create, and very time consuming to grade. These are the reasons overtaxed faculty may not utilize them as readily as they should.

 However, as recommended previously, a good starting point is to include at least one problem-based learning activity and assessment in each course that is high value for students (worth a significant enough part of their grade that they will do it). In higher education, this should be introduced at the freshman level so students can adjust to this different type of thinking and learning. Then, as students progress through a program of study, additional problem-based assessments can be incorporated, this can increase student CT and volition since these types of assessments cannot be put off until the last minute. It also increases creativity (Ersoy & Baser, 2014; Yu, 2014), as well as motivation (Blumenfield, 1991; Ulger, 2018; Yu, 2024).

In addition to PBL, experiential learning is also an effective tool to increase critical thinking and deter concerns of cheating and use of AI. Ayab et al (2011) found experiential education in engineering increased student creativity and problem solving abilities. This has also occurred in business education (Gemmell & Kolb, 2020) as well as other disciplines. However, experiential learning opportunities such as practicums and internships are not available in every program of study. Simulations can be used in some disciplines. Assessment that is more

experiential in nature can be crafted for use in the classroom, but many faculty find this difficult.

Overall, assessing students using PBL or EL is more meaningful and more applicable to skills students will need in the future workplace, and in life. It also makes students more responsible for their own learning.

Conclusion

Assessing differently in higher education using emerging pedagogies and strategies to promote problem solving and critical thinking can help increase student creativity, critical thinking, and problem solving which are crucial 21st century job skills. Assessing in such a manner helps prevent cheating and the use of AI in the classroom. These types of assessments should be incorporated when students enter college, and the numbers of these types of assessments should increase in upper level classes. It is important to acknowledge, however, that these types of assessments are very time consuming for faculty to create and grade.

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