



Taking critical thinking, creativity and grit online

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Abstract

Technology has the potential to facilitate the development of higher-order thinking skills in learning. There has been a rush towards online learning by education systems during COVID-19; this can therefore be seen as an opportunity to develop students' higher-order thinking skills. In this short report we show how critical thinking and creativity can be developed in an online context, as well as highlighting the importance of grit. We also suggest the importance of heuristic evaluation in the design of online systems to support twenty-first century learning.

Keywords Critical thinking · Creativity · Grit · Online learning · Higher-order thinking skills · Heuristic evaluation

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Introduction

This paper is in response to the article “Designing for 21st century learning online: a heuristic method to enable educator learning support roles” (Nacu et al. 2018). In this paper, the authors outline a framework for heuristic evaluation when designing online experiences to support twenty-first century learning.

Twenty-first century skills can be key to success in a modern knowledge society. Among these skills, critical thinking is important not only at work, where problem solving is essential, but also in any social setting where adequate decision making is required (Dwyer and Walsh 2020). Additionally, creativity helps ensure that the outcomes of critical thinking can be both culturally ingenious as well as treasured (Yeh et al. 2019b). This is achieved by embracing cognitive abilities in order to create new combinations of ideas (Davis 1969).

Technology has been shown to facilitate the development of higher-order thinking skills in learning (Engerman et al. 2018). However, in general, schools have failed to take advantage of this by incorporating adequate use of technology into their practices (Olszewski and Crompton 2020). Therefore, the rush towards online learning by education systems during COVID-19 can also be seen as an opportunity to develop students’ higher-order thinking skills. One potential drawback with online learning is the distance it creates between peers, thus hindering student engagement and the development of higher-order thinking skills (Dwyer and Walsh 2020). We show how this barrier can be overcome when developing critical thinking and creativity in an online context.

Critical thinking

Critical thinking includes the ability to identify the main elements and assumptions of an argument and the relationships between them, as well as drawing conclusions based on the information that is available, evaluating evidence, and self-correcting, among others. It is seen as a self-regulated process that comes from developing skills such as interpretation, analysis, evaluation and explanation; going beyond technical skills. It can therefore be considered a metacognitive process (Saxton et al. 2012; Facione 1990).

By taking learning online, both self-study and teacher-led sessions can be enhanced through a problem-based learning strategy. In the first stage, students build on a question or topic posed by the teacher, e.g. a mathematical problem or an essay writing assignment. In the second stage, students peer-review their classmates’ responses or essays using a rubric provided by the teacher. Students break down their classmates’ responses and see how they relate to the objective of the activity. They then compare this analysis with the rubric in order to provide feedback. In a third stage, the students develop a new response based on their initial response, the experience of giving feedback, and the feedback they received. This process develops self-evaluation as the students compare their own response with their classmates’ and discover any gaps in their knowledge. It can also develop metacognition as they integrate various sources of knowledge (initial response, feedback received and the experience of giving feedback) when developing a new response. In the final stage, the teacher discusses the different responses with the class. The teacher then compares the students’ work with the expected response and provides a general summary, transferring the responses to different domains.

While Stages 1 through 3 are asynchronous and computer-aided, stage 4 can be synchronous and supported by the use of a web-based video conferencing tool. Active student

participation and teacher mediation are both key since interactive and instant feedback has been shown to improve critical thinking (Chang et al. 2020).

In addition to the problem-based strategy presented here, other active learning strategies can also be used to develop critical thinking, e.g. structured questioning, role playing, and cooperative learning (Cruz and Dominguez 2020). How these might be implemented online is still open to discussion, though heuristic evaluations may be a good alternative given the possibilities presented by online learning as a resource provider, learning broker and learning promoter (Nacu et al. 2018).

Creativity

Creativity is an essential element of the problem-solving process. Creative people often find ways of addressing a problem that others cannot see, while also having the ability to overcome barriers where others may otherwise give up (Kaufman 2016). There are different techniques for developing creativity. In-depth learning is facilitated when students represent concepts based on their own personal perceptions (Liu et al. 2018). In this sense, analogy can be a powerful tool for boosting creativity. Analogical transfer includes the idea of making analogies by analyzing objects, ideas or concepts across domains, i.e. information is transferred from the known (the original domain) to the unknown (the new domain) by searching for similarities (Shen and Lai 2014).

We propose an analogical transfer strategy. In the first stage, the teacher identifies a concept with examples from different domains. This might include showing a video that not only introduces the concept but also provides a context that is both familiar and relatable for the students. In the second stage, students reflect on situations from their own lives where they can apply the concept that is being studied. Here, the use of open-ended questions allows the students' creativity to be explored in greater depth, while adapting to their different backgrounds and levels of prior knowledge. In the third stage, which is mediated by the teacher, the students discuss their responses from stage 2. The teacher should focus on original responses from different domains, or responses where it is not clear whether the solution is correct.

Stages 1 and 2 can be conducted asynchronously and scaffolded using technology through the inclusion of multimedia and student guides. However, stage 3 should be synchronous and supported by the use of a web-based video conferencing tool. In this way, technology facilitates the development of creativity by facilitating the discovery process, the collection of ideas, and the integration of knowledge (Yang et al. 2018). Mediation in stage 3 is therefore key (Giacumo and Savenye 2020). Effective teacher-student dialogue can improve the teacher-student relationship and enhance the creative process. Heuristic evaluation can therefore help us understand this relationship by looking at these interactions on the online platform (Nacu et al. 2018).

Grit

As with any learning process, critical thinking and creativity require students to be both present and focused, which in turn requires grit (Yeh et al. 2019a). In other words, the way in which students approach their schooling is just as important as what and how we teach them (Tissenbaum 2020). Grit should therefore not only be considered an essential element

of academic achievement but also as a mental process that activates and/or directs people's behavior and actions (Datu et al. 2018, Lan and Moscardino 2019). This is particularly relevant in a COVID-19 context, where the pandemic is affecting the wellbeing and mental health of many students, families & communities (OECD 2020).

In order to achieve effective student engagement, the objective must be attainable, interesting and accessible (i.e. in their zone of proximal development). The means used to complete the task must be attractive and feel more like a reward than an assignment. Finally, the teacher should work on the students' persistence, not just in order to complete the task but as an essential quality for everyday life (Barnes 2019).

Teacher grit may also be key. As Haderer (2020) suggests "Why do some teachers stay when others run from the challenges?" In this sense, reflection has been shown to be relevant for teacher efficacy and grit (Haderer 2020). Heuristic evaluation methods may therefore allow the educator to understand the learning system as a whole (Nacu et al. 2018).

Ending remarks

As indicated in (Nacu et al. 2018) we are "faced with the need to create youth-centered spaces that also provide adult facilitation of learning". Heuristic evaluation can therefore help connect online platforms with students, teachers and twenty-first century skills needs.

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Compliance with ethical standards

The different research projects underlying this report received approval from the University's ethics committee. The participation was voluntary and the students signed an informed consent form.

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