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Editorial

Technology enhanced distance learning should not forget how learning happens

Since regular classrooms and lecture halls are temporarily empty due to the Covid-19-/Corona-pandemic, the almost exclusive privilege of teachers to meet with their learners and to devote time to them by providing them with detailed explanations, monitoring their progress, and giving them feedback is under major pressure. Nearly a century ago Sidney Pressey made a case for a simple apparatus that could perform these instructional principles - a teaching machine that was able to test, score, and indeed, teach – to substitute and assist teachers (1926). Today, universities, promptly followed by secondary and primary schools, are in a fast-track process to adapt their conventional education to design technology-enhanced distance learning (TEDL) - *modern teaching machines* - in order to reach the approximately 1.5 billion students who are not allowed to physically attend their classes (UNESCO, 2020).

Technology is in this respect both a risk and a chance for delivering distance education. Educators are being bombarded with advice and good practices on how to design TEDL which inevitably incorporates the risk that developers focus so closely on what the innovative technology does that they lose sight of two other major components of quality instruction. First, the subject-matter content that this technology was there to deliver and second, the instructional principles with which this content can be effectively delivered. As Richard Clark (1983) so eloquently wrote, instructional technology is "similar to grocery trucks in that they delivered food to stores and so made food available more or less efficiently but were not responsible for people's nutrition." For this reason we, as guest editors of this virtual special issue, draw upon three important evidence-informed instructional principles from effective face-to-face education, namely using worked examples, providing practice and feedback, and stimulating metacognition to turn risk into chance.

Indeed, since Pressey, a tremendous amount of useful information about learning and designing effective instruction accordingly has been acquired (See e.g., Merrill, 2002; Van Merriënboer; Kirschner, & Kester, 2003). The contributions in this virtual special issue present state-of-the art technologies that incorporate these well-established instructional principles. The principles also have the additional advantage of efficiency; that is their implementation is not excessively time-consuming, and can be easily implemented by educators across all levels in distance education but also in the transition from distance learning to more blended education, which is an undeniable convenience and necessity in post-pandemic times. We selected 18 research papers from previous issues of *Computers in Human Behavior* in the time period ranging from 2011 to 2020 that have studied these three principles, stretching from primary to tertiary education (Table 1).

1. Providing clear guidance using worked examples and optimal use of multimedia principles. Sharing worked-out examples with learners before they start practicing on their own is a sensible way to guide students through the vast library of to be learned material (Atkins, Derry, Renkl, & Wortham, 2000). Online videos that are customized to the particular features of multimedia principles are particularly advantageous for a flipped classroom (Mayer, 2001).
2. Providing ample chances for practice and feedback. Students need practice followed by feedback when they are putting knowledge to use. In order to move forward in an online learning environment students (Hattie & Timperley, 2007) should know which next steps to follow and educators should know how these steps are optimally facilitated.
3. Assisting students on their pathway to successful individual learning by implementing metacognitive scaffolds into the instructional technology. Research has shown that learners often have faulty ideas on how they learn which leads to ineffective forms of self-regulated learning (see e.g., Bjork, Dunlosky, & Kornell, 2013). Therefore, the development towards TEDL must go hand in hand with incorporating cues that stimulate self-regulated learning.

Table 1
Selected articles for the special issue.

Providing clear guidance using worked examples and optimal use of multimedia principles.
Instructing in generalized knowledge structures to develop flexible problem solving skills (Kalyuga & Hanham, 2011).
Impacts of a flipped classroom with a smart learning diagnosis system on students' learning performance, perception, and problem solving ability in a software engineering course (Lin, 2019).
Effects of segmentation and pacing on procedural learning by video (Biard, Cojean, & Jamet, 2018)
Developments and trends in learning with instructional video (de Koning, Hoogerheide & Boucheix, 2018)
The efficiency of worked examples compared to erroneous examples, tutored problem solving, and problem solving in computer-based learning environments (McLaren, van Gog, Ganoe, Karabinos, & Yaron, 2016)
Comparing the effects of worked examples and modeling examples on learning (Hoogerheide, Loyens & Van Gog, 2014).
Emotional design in multimedia learning: Differentiation on relevant design features and their effects on emotions and learning (Heidig, Müller, & Reichelt, 2015).

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Table 1 (*continued*)

Providing ample chances for practice and feedback
Effects of digital video-based feedback environments on pre-service teachers' feedback competence (Prilop, Weber, & Kleinknecht, 2020).
Providing feedback on computer-based algebra homework in middle-school classrooms (Fyfe, 2016).
An evaluative study of a mobile application for middle school students struggling with English vocabulary learning (Hao, Lee, Chen, & Sim, 2019).
Assessment of the influence of adaptive E-learning on learning effectiveness of primary school pupils (Hubalovsky, Hubalovska, & Musilek, 2019).
Improving instructions in educational computer games: Exploring the relations between goal specificity, flow experience and learning outcomes (Erhel & Jamet, 2019).
Assisting students on their pathway to successful individual learning
Impacts of cues on learning: Using eye-tracking technologies to examine the functions and designs of added cues in short instructional videos (Wang, Lin, Han, & Spector, 2020).
Effects of Self-Regulated Learning Prompts in a Flipped History Classroom (van Alten, Phielix, Janssen, & Kester, 2020).
Relations between students' perceived levels of self-regulation and their corresponding learning behavior and outcomes in a virtual experiment environment (Verstege, Pijeira-Díaz, Noroozi, Biemans, & Diederen, 2019).
Helping students help themselves: Generative learning strategies improve middle school students' self-regulation in a cognitive tutor (Pilegard & Fiorella, 2016).
Images in computer-supported learning: Increasing their benefits for metacomprehension through judgments of learning (Vössing, Stamov-Roßnagel, & Heinitz, 2016).
Cue-based facilitation of self-regulated learning: A discussion of multidisciplinary innovations and technologies (van Merrienboer & de Bruin, 2019)

The effective use of technology could provide substantial benefits to our sudden transition to TEDL by adding flexibility and widened access to high-quality learning materials. With this special issue we hope to address an urgent issue by highlighting some instructional principles that are paramount for delivering effective and efficient instruction, no matter how old or modern our teaching machines are. Perhaps it is now worth pausing to state the obvious.

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