

An examination of the SAMR framework in context: Insights from digital technology use in online mathematics tutoring.

Research overview

This study examined teacher practice in online mathematics tutoring using the SAMR framework and the extent to which substitution, augmentation, modification and redefinition was demonstrated in practice. The video analysis revealed that most technology use reflected substitution or augmentation, with teachers demonstrating pedagogical knowledge by selecting tools aligned to students' mathematical needs.

Purpose

This study examines how digital technologies are used in one-to-one online mathematics tutoring, for what pedagogical purposes, and the extent to which the SAMR framework meaningfully captures this practice. The key research question is: What technologies are used, and how are these technologies applied to support mathematics teaching and learning in a 1:1 online tutoring context?

Evolving technologies have seen practices in education transformed, with the introduction of technological tools and the scope of possibilities for communicating through different technological modes (Niess, 2005). In the context of using video conferencing software for 1:1 online mathematics tutoring, a range of opportunities are available for teachers to use technological tools to augment instruction. Despite the use of video conferencing software (e.g. Zoom), there remains a continuum of integrating technology in teaching practice, from no or limited use of technology tools to varying degrees of integrating technology. The utilisation of a technological platform for a specific educational purpose, such as video conferencing software and technological tools for teaching (virtual whiteboards, online games) is an important distinction.

The SAMR framework contains four levels that have been used by educators and researchers to categorise how curriculum is integrated and enacted using digital technologies (Puentedura, 2020). Blundell et al. (2022) conducted a scoping review on how SAMR is applied by researchers and found that most often, teacher actions were categorised as enhancements (redefinition and modification) rather than the

transformation categories. The SAMR model has been criticised in literature due to perceptions of the model design as a taxonomy or hierarchical model, and the lack of acknowledgment of how technology and pedagogy are adapted to different contexts (Blundell et al., 2022; Hamilton et al., 2016). However, the SAMR framework may still provide utility as a lens through which to examine how technology is used in online one-to-one tutoring.

Methods

The Learning+ online mathematics tutoring program was an initiative of the South Australian Department for Education conducted between January 2021 and December 2022. Learning+ aimed to support students in Years 6- 9 at all achievement levels in engaging and succeeding in mathematics learning. All tutors were experienced primary or secondary school teachers. This study draws on detailed video analysis of eight Year 7 student-tutor pairs participating in twice weekly online mathematics tutoring sessions delivered via Microsoft Teams. Videos were coded in NVivo to analyse technology use, interactional patterns (tutor talk, student talk, silence), and pedagogical actions, with observed practices classified using the SAMR framework (Blundell et al., 2022).

Results/Discussion

From a SAMR framework perspective, the examples of technology use were characterised as substitution or augmentation of classroom tools to suit the online tutoring context. The digital tools employed served primarily to replace or improve existing physical resources rather than to transform the learning activity through modification or redefinition (Blundell et al., 2022; Hilton, 2016). For instance, Teacher D substituted screensharing a Word document for distributing printed worksheets, while Teachers A, C/H, F and G substituted a digital whiteboard for a manual whiteboard. Teacher E made no technological substitutions, relying solely on a manual whiteboard and manipulatives. Some teachers augmented their use of tools: Teachers A and D selected digital whiteboards with a save function to support later review, and Teacher C/H augmented multiplication tables practice through an online resource that generated random facts and arrays.

The absence of modification or redefinition is not inherently negative, as Hamilton et al. (2016) argue, technology should enhance learning rather than become its focus, a principle evident when teachers discontinued tools that confused or discouraged students in mathematics learning. However, in practice, and due to broad inconsistencies in the current research and operational definitions of modification and redefinition, the applicability of these SAMR categories to 1:1 mathematics tutoring was limited. In wider research, it is evident that distinguishing between modification and redefinition is difficult, with the terms often used interchangeably. Consequently, there is potential to combine these categories to acknowledge technology's capacity to innovate. Additional contextual factors, including teachers' curriculum intentions and technological capability also influence practice. We propose a revision of SAMR to reduce ambiguity between modification and redefinition, as noted in the current literature and confirmed by the findings of this study, and to incorporate a pedagogical focus that recognises the significance of pedagogical purpose and engagement in technology use. In practice, these interactions are dynamic, multifaceted and complex. Greater attention is needed to exploring how digital tools can more meaningfully enhance students' learning, and together with local innovations, have the potential to support knowledge creation about technology use in broader contexts.