Intelligent Immersive Virtual Training Environments to Foster Teachers' Dual Roles of Self-Regulated Learners and Teachers

Megan Wiedbusch[1], Cameron Miller[2], Anthony Fransella[2], Andrew Gomoll[2], and Roger Azevedo[1]
1. Department of Learning Sciences and Educational Research, University of Central Florida, Orlando, FL
2. Virbela, San Diego, CA

Current AIEd systems have not focused on training teachers as both self-regulating learners (SRL) capable of *learning* about self-regulation and external agents capable of *instilling* self-regulation in their students (self-regulated teaching; SRT) in a reciprocally beneficial dual-role relationship (Kramarski, 2018). Most research and instructional tools (e.g., learning analytics, data mining-based dashboards, etc.) provided to teachers during instruction lack accurate information about timely, actionable, and relevant SRL processes (i.e., students' and teachers' cognitive, affective, metacognitive, and motivational [CAMM] processes; Azevedo et al., 2019). New research has begun to propose the development of such teacher dashboards (Noroozi et al., 2019; Wiedbusch et al., 2021), but has not explored how to facilitate effective training with such complex and nuanced data. Furthermore, they do not help teachers learn about self-regulation or how to become effective SRLs themselves. As such, during this demonstration we will introduce a potential future direction of how an SRL-focused teacher training virtual simulation environment, Virbela, can be leveraged to not only train pre-service and current teachers, but also to serve as a research sandbox to further explore the dual role of SRL and SRT in teachers.

Imagine you have a group of pre-service teachers who want to practice and train their newly acquired instructional skills before jumping into the classroom. They feel confident in the subject material but are less certain how to assess and assist students who are learning about complex topics such as microbiology. We envision the teachers observing simulated students as they learn about microbiology and scientific reasoning in a virtual classroom housed entirely within the Virbela platform. One student might be researching important information online about how viruses spread to complete worksheets. Another student might be playing Crystal Island, a serious game in which the student takes on the role of a CDC agent studying a mysterious disease. But how can the teacher access information about student engagement, states of confusion and frustration, effectiveness of cognitive strategies, and the students' metacognitive monitoring and regulation to help and challenge the student? Because learning is occurring through a virtual platform with simulated students, large quantities of context-rich time-series multimodal multichannel data about the students' CAMM processes (i.e., learning behaviors, emotional states, goals, monitoring skills, etc.) can be collected and directly fed back to the pre-service teachers for evaluation and possible intervention. Moreover, teacher performance data is also collected and evaluated to pinpoint shortcomings in teacher knowledge and skills about SRL or the difficulties these teachers might have in evaluating and measuring complex self-regulatory skills of their students (e.g., inability to detect covert metacognitive monitoring that is not verbalized). For example, while watching a student play Crystal Island, a teacher may correctly identify when a student finds relevant information about viruses but miss the fact that the student has grown frustrated with reading and has switched goals to randomly test potential sources of the disease instead of using effective scientific reasoning processes to find a solution (Zimmerman & Klahr, 2018).

During an After-Action Review, our proposed system may recommend training around student goal setting and the role of goals in metacognitive monitoring. The teacher can then exit the virtual training classroom and enter their own SRL-focused learning center to receive expert assistance from learning scientists (and eventually pedagogical AI agents who model emotion regulation strategies to their students), ask questions about what successful CAMM processes can look like, and talk about what to do when they do not see them. For example, they might review a snapshot of the simulated student they were just watching and have the switching of goals highlighted. The scientist or agent can then engage with the teacher about whether (or not) this behavioral switch is important, when and how they should intervene, and practice some of the discussed strategies. Perhaps the teacher might suggest they were aware of the switch but did not feel it was pertinent to intervene. This could allow the scientist and teacher to review theoretical models of goal setting, bringing up visuals (see Winne & Hadwin, 2008) within the Virbela space to directly consult in their discussion. They could also run multiple scenarios to see how choosing to intervene (or not intervening) could impact the students' learning. Other manipulations could also be applied within these scenarios to offer more nuanced instructional information. For example, if we increase the amount of prior knowledge this simulated student has, how would that impact the effectiveness of intervention about goal setting? What if we decrease the amount of emotional regulation strategies the student has available? With this new information about goal setting and how to do it, the teacher can return to the training classroom to practice identifying goal-based behaviors and enact new instructional techniques.

This new model of research would not only provide information about student learning. All the while teachers are being trained and fed data about the student in Virbela, researchers are having teacher data provided to them about their own multimodal multichannel CAMM processes. We can imagine this real time data being fed to learning scientists to use both to facilitate what type of SRT intervention is needed as well as understand the theoretical implications for models of SRT (based on figures and tables in Kramarski, 2018). This data could also be aligned and synchronized with the learner data to help examine collaboration and shared metacognition and emotion regulation. Virbela is an inherently social platform, and consequently can facilitate preservice teachers to gather in a virtual space together to collaborate and co-regulate their learning, much like team-based teaching. Simulated virtual students can demonstrate various levels of CAMM process efficiency and common learning deficits for teachers to identify and correct, all while their own data is collected to evaluate their role as self-regulated learners. Because Virbela is uniquely positioned as a virtual simulation, teachers can practice new instructional techniques and explore various context, student learning dynamics, and SRL and SRT strategies without increased risk to students. Furthermore, it allows for learning scientists a platform with which complex system-level dynamics of student learning can be tested and studied. That is, this platform will allow researchers to directly apply various theoretical models of SRL to a variety of learning contexts to understand their underlying parameters and conditions under which they hold true. In this way, Virbela acts as a sandbox for fostering self-regulation in students and teachers as well as a testbed for learning scientists and computer scientists in the AIEd community to test and research learning through simulation-based intelligent immersive virtual environments.

References

Azevedo, R., Mudrick, N. V., Taub, M., & Bradbury, A. E. (2019). Self-regulation in computer-assisted learning systems. In J. Dunlosky & K. A. Rawson (Eds.), *The Cambridge handbook of cognition and education* (p. 587–618). Cambridge University Press. https://doi.org/10.1017/9781108235631.024

Kramarski, B. (2018). Teachers as agents in promoting students' SRL and performance: Applications for teachers' dual-role training program. In D. H. Schunk & J. A. Greene (Eds.), *Educational psychology handbook series. Handbook of self-regulation of learning and performance* (p. 223–239). Routledge/Taylor & Francis Group.

Noroozi, O., Alikhani, I., Järvelä, S., Kirschner, P. A., Juuso, I., & Seppänen, T. (2019). Multimodal data to design visual learning analytics for understanding regulation of learning. *Computers in Human Behavior, 100,* 298-304.

Wiedbusch, M. D., Kite, V., Yang, X., Park, S., Chi, M., Taub, M., & Azevedo, R. (2021). A Theoretical and Evidence-based Conceptual Design of MetaDash: An Intelligent Teacher Dashboard to Support Teachers Decision Making and Students Self-Regulated Learning. *Frontiers in Education,* 6. Frontiers.

Winne, P. H., & Hadwin, A. F. (2008). The weave of motivation and self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (p. 297–314). Lawrence Erlbaum Associates Publishers.

Zimmerman, C. & Klahr, D. (2018). Development of scientific thinking. In J. Wixted (Series Ed.), *The Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience*, S. Ghetti (Ed.), Vol. III. Developmental & Social Psychology.