The Role of Instructional Technology in Personalized Learning

Carlee Russell

Department of Education, University of Wyoming

ITECH 5010-40: Instructional Technology

Dr. William Cain

March 21, 2021

Abstract

Personalized learning is not a new educational theory, but it has exponentially increased in popularity in more recent years. This study will discuss the definitions of personalized learning and examine how instructional technology has been applied recently to personalized learning, and how it can be improved in the near future. Special consideration is given to Artificial Intelligence's applications in personalized learning. Current practices, future trends, and case studies were used, with an emphasis on the most recent data, not older than 4 years, except in one case study. Personalized learning is a growing movement in education with new technologies developing rapidly and being implemented in diverse ways across many learning environments.

The Role of Instructional Technology in Personalized Learning

As early as the 1800s, schools allowed students to move at their own pace and demonstrate mastery before moving on to a new subject or grade. In that sense, personalized learning is not a new idea. However, with the rapid developments in technology over the past three decades, there has been a rise in interest in personalized learning and the instructional technology that makes it possible and potentially scalable.

There are models of personalized learning in place at every level of education, though the level of personalization and the degree of implementation varies widely. Exciting technological developments, including Artificial Intelligence, are already being integrated into existing models with promising future applications. Though there is disagreement on matters as small as the definition of personalized learning and as big as the level at which implementation must occur for a program to be considered personalized, there is consistent enthusiasm and promise for the future of personalized learning.

Identifying and Defining Key Components

Before any of the reviewed authors begin discussions or present research, they acknowledge three things: a lack of standard definitions, a lack of standard implementation, and the constantly evolving nature of the field. In order to use a term such as *personalized learning*, there is a need to discuss the fluidity of the definition and the spectrum of implementation that can all fall under the term.

Personalized Learning

Elizabeth Brott Beese (2019), Professor of Learning Design and Technology at Purdue University, proposes a broad definition of personalized learning as “any planning or decision-making process which runs for one student at a time, and uses information from or about individual students, in order to output educational plans and decisions for them” (p. 253). More commonly, the US Department of Education’s definition is used and expanded upon: “Instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional

approaches, and instructional content (and its sequencing) all may vary based on learner needs... learning activities are meaningful and relevant...driven by interests, and often self-initiated" (*Competency-Based Learning,* n.d.). To this definition, Alamri et al. (2021) contribute the benefits of removing constraints of traditional approaches, including the ability for students to self pace and to work any time in any location (p. 65); however, others do not agree personalized learning must remove the constraints of time and location. Larry Cuban (2018), Professor Emeritus of Education at Stanford University, posits personalized learning as a continuum of this definition, with one end consisting of common objectives and content but customized pacing and delivery, and the other end having student-driven content, instruction, and methodology with a big picture goal of developing mature, engaged, mindful adults in place of standards based outcomes.

A clear, concise, widely accepted definition may be unattainable; however, a varied understanding of how educators and experts define personalized learning for themselves gives a clear picture of what is important, desired, and necessary right now. The changing nature of the field indicates the need to proactively keep up-to-date on the needs and innovations surrounding personalized learning.

Learner-Centered (or Student-Centered) Education

Personalized learning requires teachers to switch from traditional learning approaches to learner-centered approaches, which focus on customizing the learning environment, instructional methods, and learning content in such a way that takes into account individual learners with unique and diverse characteristics and interests (Lee et al., 2018, p. 1271). Cuban (2018) observes that student-centered learning has the goal of nurturing the whole student beyond academics to growth in areas such as social and psychological maturity. Learner-Centered Personalized Learning, then is the ultimate goal for many educators and designers. This becomes important when addressing the barriers to personalized learning since the current technology is largely seen as insufficient to create such an

environment, with a notable exception. Without accessible technology to cultivate such a learning system, this desired situation remains unreachable.

Current and Proposed Frameworks for Technology for Personalized Learning

Adaptive Personalized eLearning Service (APeLS) is a personalized eLearning service based on an adaptive engine that is being used for higher education courses (Conlan, 2004, p. 291.) A four year study of this multi-model, metadata-driven approach revealed that while students did receive the course map they expected after taking a pretest, knowing the option was available, they sought more control over their course. They were able to retake their pretest and figure out the system until they achieved the content map they desired. (Conlan, 2004, p. 291.) So while the adaptive model is successful in terms of personalizing a course, increased performance, and student satisfaction, it lacks in integrity and authenticity, as well as fostering the desired growth in individuals. While the data on APeLS is older, the problem of students beating the system still exists.

Lee et al. (2018) envision a system that, unlike most learning management systems, operates at individual levels not course levels, specifically in four areas: "recordkeeping, planning, instruction, and assessment" (p. 1273). Student data (recordkeeping) provides the characteristics necessary to prepare a personalized learning plan for individual students (planning). Students work through the plan (instruction) and the outcomes of the projects on that plan (assessment) become more data to add to the recordkeeping and further personalize their learning. The cycle repeats, always learning and adapting, ideally leading to success in the learning objectives (Lee et al., 2018, p. 1274). This framework is the basis for many models with variations on implementation and methodology.

Another proposed framework is classifying the learning objects by learning style and offering them to students individually, according to their assessed needs, abilities, and desires (Abdelhamid & Alhawiti, 2017, p. 16). Departing from traditional learning approaches, this design among others places the emphasis on the characteristics of the students instead of on the technical data of the content such

as title, context, and type, delivering content in such a way that a students' outcome is theoretically maximized as they learn within their preferred style. Each piece of content is given tags to identify its learning style and other characteristics, and those tags are matched with the learner's characteristics to personalize their course map. According to Abdelhamid and Alhawiti (2017), the technologies to accomplish this exist but haven't been used together to create this level of personalization (p. 16).

The Critical Function of Instructional Technology in Achieving Learning Objectives

Truly personalized learning, especially for entire classes, is not attainable without technology. However, teachers as a whole do not want to lose the feel and connection of a classroom and they cannot compromise standards in achieving learning objectives. Instructional technology, rightly assessed and implemented, can be the solution to personalized learning within the classroom and online. Two clear roles for technology in achieving those objectives are continual feedback and ongoing assessment of students' characteristics.

The role of instructional technology in gathering and offering feedback is widely discussed, as instructors and evaluators see the need for ongoing feedback in both directions, just as there would be in a traditional classroom, which then is used to assess and redirect students at any given point in a course. With modern technology, students' learning objectives and their mastery can be continually assessed formatively and summatively, monitored, and recorded (Lee et al., 2018, p 1274). Real time assessment and adjustment is a key component of personalized learning and offers students the feel of a live instructor's feedback and the ongoing adjustment of their learning to better fit their needs, which mimics a teacher's prerogative to repeat or bypass a lesson.

In addition to assessing students' progress and mastery, another key component of personalized learning is assessing the students' characteristics, including learning styles, needs, abilities, and preferences, and adapting their learning accordingly. Most of the proposed frameworks depend on this piece. Alamri et all explore current technology that has this capability, particularly algorithm-based

adaptive learning platforms (well known examples include PLATO, Edmentum, and ALEKS). They identify the limitations to these existing programs to be in their content base, the inconsistency of allowing or disallowing instructor-created content, and their imperfect algorithm for customization (Alamri et al., 2021, p. 69). However, for many the imperfect algorithm is not enough, and that for truly personalized learning, "there must be an intelligent process that can match the characteristics of available learning components against those of the individual learners" (Abdelhamid & Alhawiti, 2017, p. 16) in a continually adaptive way, and the components must be self-contained and reusable for the process to be feasible. Four specific technologies are needed to create this process: learning objects, ontology, semantic web, and content management. Unlike other authors, Abdelhamid & Alhawiti believe current technologies, including Ontology and the Semantic Web, are sufficient to create this level of personalized learning (2017, p.16). Ontology "defines a common vocabulary for researchers to share information in a specific domain, and includes machine-interpretable definitions of basic concepts and their relationships in that domain" (Abdelhamid & Alhawiti, 2017, p. 17) helping form the structure for personalized learning that is based on learning style. And the Semantic Web, enabled by the Ontology, can sort the available learning components and deliver relevant, reasonable ones to the learner. However, the Semantic Web may be set aside in favor of Artificial Intelligence (AI).

Artificial Intelligence in Personalized Learning

Artificial Intelligence in personalized learning could replace both the instructor and the algorithm based systems currently running. AI is simply computer systems that can perform tasks that would normally require human intelligence. Lee explains that in place of a limited algorithm, "AI allows the system to intelligently determine the next learning task for the student. Also, AI can automatically identify learners in need and even provide just-in-time support and appropriate guidance by evaluating the learner's past progress and current status" (Lee et al., 2018, p. 1289). Such technology does exist,

specifically in the areas of intelligent tutoring and intelligent learning environments (Goel & Joyner, 2017, p.49).

Goel and Joyner incorporated AI into a graduate level computer course in two areas: intelligent tutoring and authentic engagement. After 2,000 students took their course, they compared the data with students taking the same course in a traditional classroom setting. They found that AI did re-create some of the features of the classroom, including establishing a rhythm for the class. AI also solves the issue of ongoing evaluation and support. Without AI, many courses run automated grading after an assignment has been submitted, but fail to support students during the learning process. AI can offer formative feedback based on automatically generated evaluations during the student's learning, and provide tools to improve their learning experience (Goel & Joyner, 2017, p.58). The conclusion of Goel and Joyner's research is that the students who took the online course with integrated AI outperformed the in-class, non-AI students.

The consensus among authors is that AI is the future of personalized learning. Some, such as Goel and Joyner, are prepared to abandon other methods, while others see an integration of AI into current practices, but for truly personalized learning that is sustainable and scalable, AI is the most likely solution.

Conclusions

Personalized Learning is changing at an increasingly rapid pace. Studies and data that are only 3 years old already are out of date and the majority of research published does not include the progress attained during the pandemic. Current systems have capabilities that allow for personalized learning in some ways, but there is not yet fully customized, fully automated, fully personalized learning. Not every author considered that to be the goal, however. The current technology and its usages fills the immediate need of customized content maps, taking learner characteristics into consideration, and allowing self-pacing and mastery when they are desired. However, the future of personalized learning

through Artificial Intelligence is rapidly evolving and in some ways has already arrived, and those in the space are excited at the possibilities.

Future Research Questions

- Is it time to shift the focus to only Artificial Intelligence, or do other technologies have a future role in personalized learning?
- What are the potential drawbacks of automated systems of learning? 10 years from now, what will the research show is more harmful than helpful?
- What is needed for smooth, stable transitions to technology driven personalized learning, for both teachers and students?
- How can technologies be reused across learning environments?
- What AI models are already here but not addressed in published research? Goel and Joyner (2017) suggested virtual teaching assistants who can participate in discussion forums (p 58). Does this exist?

References

Abdelhamid, Y., & Alhawiti, Mohammed M. (2017). A personalized e-Learning framework. J*ournal of Education and e-Learning Research*, 4(1), 15-21. https://doi.org/10.20448/journal.509.2017.41.15.21

Aeiad, E., & Meziane, F. (2019). An adaptable and personalised e-learning system applied to computer science Programmes design. *Education and Informational Technologies*, 24**,** 1485–1509. https://doi.org/10.1007/s10639-018-9836-x

Alamri, H.A., Watson, S. & Watson, W. (2021). Learning technology models that support personalization within blended learning environments in higher education. *TechTrends,* 65**,** 62–78. https://doi.org/10.1007/s11528-020-00530-3

Beese, E. B. (2019). A process perspective on research and design issues in educational personalization. *Theory and Research in Education*, *17*(3), 253–279. https://doi.org/10.1177/1477878519893963

Conlan O., Wade V.P. (2004) Evaluation of APeLS – an adaptive e-learning service based on the multi-model, metadata-driven approach. *Lecture Notes in Computer Science*, 3137, 291-295. https://doi.org/10.1007/978-3-540-27780-4_35

Cuban, L. (2018). *Second Draft: A Continuum of Personalized Learning*. Larry Cuban on School Reform and Classroom Practice. https://larrycuban.wordpress.com/2018/09/27/second-draft-a-continuum-of-personalized-learning

Dockterman, D. (2018). Insights from 200+ years of personalized learning. *npj Science Learn,* 3**,** 15. https://doi.org/10.1038/s41539-018-0033-x

Goel, A. K., & Joyner, D. A. (2017). Using AI to teach AI: lessons from an online AI class. *AI Magazine*, *38*(2), 48-59. https://doi.org/10.1609/aimag.v38i2.2732

Lee, D., Huh, Y., Lin, CY., & Reigeluth, Charles M. (2018). Technology functions for personalized learning in learner-centered schools. *Education Tech Research Dev*, 66**,** 1269–1302. https://doi.org/10.1007/s11423-018-9615-9

Martin, F., Chen, Y., Moore, R.L., & Westine, Carl D. (2020). Systematic review of adaptive learning research designs, context, strategies, and technologies from 2009 to 2018. *Education Tech Research Dev,* 68, 1903–1929. https://doi.org/10.1007/s11423-020-09793-2

U.S. Department of Education (USDOE). (2019). *Competency-based learning or personalized learning*. http://www.ed.gov/oii-news/competency-based-learning-or-personalized-learning

Walkington, Candace & Bernacki, Matthew L. (2020). Appraising research on personalized learning: Definitions, theoretical alignment, advancements, and future directions. *Journal of Research on Technology in Education*, 52(3), 235-252. https://doi.org/10.1080/15391523.2020.1747757

Walkington, Candace & Bernacki, Matthew L. (2020). Personalization of instruction: design dimensions and implications for cognition. *The Journal of Experimental Education*, 86(1), 50-68. https://doi.org/10.1080/00220973.2017.1380590