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Designing purposeful digital learning

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Abstract
This paper is in response to the manuscript entitled "Designing and integrating purposeful learning in game play: a systematic review" (Ke, Educ Technol Res Dev, 64(2):219–244, 2016) The author discusses five design elements of purposeful digital learning: Knowledge Activation and Acquisition Actions, Integration of Learning Modes, New Learning Spaces, Learning Moments and Learning Supports. The application of this framework, this brief response suggests, extends beyond game–based learning to numerous challenge–based interactive learning designs such as team–based projects, collaborative problem–solving, competitions for innovative ideas, ideation–to–innovation challenges, and individual project–based learning.

Keywords Design framework · Digital learning · Game–based learning

With the increased focus on digital learning, knowing how to build an engaging and effective learning experience that makes maximum use of dynamic interaction data is fundamental for supporting learning at scale. A new framework for the design of purposeful digital learning is emerging, supported by game–based learning principles empowered with dynamic learning analytics, as evidenced by "Designing and integrating purposeful learning in game play: a systematic review" (Ke, 2016). Implications of the article suggests combining ideas from game–based learning, learning sciences, learning analytics and learning design into a new general framework that might be useful for all digital learning. The following paragraphs attempt to present and generalize from five design elements suggested by Ke as a structure for digital learning research and development.

Knowledge activation and acquisition actions

In digital learning there are many sources of information potentially providing massive flows of data into collection and analysis engines. The question is, where in the data flow are the critical actions of learning—activating what is already known and acquiring new knowledge. The quintessential problem that needs to be addressed by a design team is how

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to gather and organize evidence and make inferences about what someone knows and can do by planning, creating and then analyzing how a digital learning experience is providing for these two fundamental activities. As a macro–level lens on design, each task encountered by a learner in a digital learning environment requires a mixture of new and recalled information, because learning requires active construction and integration to make sense of the new in terms that are compatible with the old. Keeping this first principle in mind helps ensure that opportunities to learn remain balanced as well as focused to prompt for and 'mine' this fundamental mechanism of learning.

Integration of learning modes

In digital learning several types of information continuously and simultaneously flow through three primary modes: representation, simulation, and context data. Design teams have access to structure these modes, for example, to control the quality and quantity of 'time on task' and the cognitive, emotional and experiential features of interactive tasks in the environment, and to shape the motivational power of the context. This allows the learner to be more naturally placed in an authentic position to 'enact-as' an apprentice professional through what Ke refers to as 'active embodiment of the focus concepts.' Designed and emergent data can then flow from all modes at once in near–real time among and between the interactions, the learner, and the digital context, supporting the creation by expert teams of new analytic insights from the unique psychometrics of digital learning enhanced by computational methods of data science.

New learning spaces

The process of mapping from the available affordances (e.g. game mechanics and the simulation leverage points) to the goals of the interaction (e.g. in a game, the player figures out what needs to be done to make progress) engages one in an iterative interplay with the learning space, which can in turn, in the mind of the engaged learner, create a schema that guides the learner through successes to rewards. The iterative mental workout cycle according to Ke includes ongoing evaluation, symbolic and semantic interpretation, reward anticipation, planning and performing actions, while quietly, unobtrusive automated observation mechanisms collect data. In addition, the digital environment itself can change in its course of evolution in every iteration. In order for this to work toward the benefit of the learner achieving a desired outcome, the design team has to embed the cognitive, emotional and behavioral objectives into the integrated experience by integrating the motivational pull of a compelling narrative context (e.g. empowering consequential agency, exploration, and expression) that entails and requires manipulating the key affordances of the environment (e.g. the game mechanics and simulation levers) to make progress and gain rewards. This causal loop supposes that the design team has created well–mapped relationships between the real world of knowledge and skills and the digital learning environment that call upon what Bruner called the 'paradigmatic' way of thinking (e.g. creating explanations and predictions) and the 'narrative' way of thinking (e.g. creating meaning through stories). Designing purposeful digital learning requires such an understanding of the processes and content of a digital learning experience.

Learning moments

More contemporary research is needed for further developing the theories and methods for finding and organizing traces of the above concepts as evidence of the moments when prior knowledge is in use and when a schema is under active construction by a learner. Promising evidence, for example, emerges when the learner can talk about such moments in a reflection or metacognitive review. More exciting perhaps is that the digital record may contain traces along a range from tacit experience (e.g. indicated by biosensors, muscle reflexes, and embedded activities) to awareness (e.g. indicated by intentional actions and social communications), strategic thinking (e.g. evidenced by planning artifacts), and reflective use (e.g. verbal expressions showing consciousness and intentional use) of target knowledge. These traces need to be mined for patterns of information that allow pre-post comparisons around the moments when changes occur in the ongoing relationship of the learner to the core mechanics and narrative context of the digital learning experience.

Learning supports

Learners gain from being supported to select relevant information, then organize and think about it by connecting to what one already knows and can do. Fortunately, in digital learning, there are numerous ways and places to embed these kinds of supports for learning. Ke organizes the review of literature into three categories, which can be generalized from game–based learning to all digital learning as embedded in: (1) the rationale and narrative context (e.g. game world); (2) the affordances for manipulation, thinking and expression (e.g. game action, leverage points of a simulation, possibilities for expression) and; (3) the algorithms controlling the flows of information (e.g. game rules, simulation engine, learning process and personalization engine). That embedding of adaptive support can appear in many ways, as a helper agent, an interactive map or graphic, pop–up messages with hints and elaboration ideas, and chatbot companions, for example. The embedding can also appear as changes in the storyline and context as well as in the appearance or disappearance of affordances, making success easier or more difficult, as needed to motivate continued learning.

These five design elements of purposeful digital learning can be applied to numerous challenge–based interactive learning designs such as team–based projects, collaborative problem–solving, competitions for innovative ideas, ideation–to–innovation challenges, individual project–based learning as well as game–based learning. We are fortunate that game developers and researchers like Ke have plowed this ground and provided new vocabulary, mechanisms and reflective context for re-imagining the field of digital learning design.

Reference

Ke, F. (2016). Designing and integrating purposeful learning in game play: A systematic review. *Educational Technology Research and Development, 64*(2), 219–244. https://doi.org/10.1007/s11423-015-9418-1.

David Gibson is Curtin University's UNESCO Chair of Data Science in Higher Education Learning and Teaching. Gibson's research focuses on games and simulations in education, learning analytics, complex systems analysis and the use of technology to personalize learning. He has over 100 publications on these topics. He is the creator of *simSchool*, a classroom flight simulator for preparing educators, and provides vision and sponsorship for Curtin University's *Challenge*, a mobile, game–based team–learning platform.