GUEST EDITORIAL PREFACE

Special Issue on Epistemological Games

Jenny Saucerman, University of Wisconsin-Madison, Madison, WI, USA

Golnaz Arastoopour, University of Wisconsin-Madison, Madison, WI, USA

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INTRODUCTION

Use of digital learning environments has increased over the last decade, leading to a proliferation of designs for simulation- and game-based learning (McClarty, Orr, Frey, Dolan, Vassileva, & McVay, 2012). Researchers, parents, and educators alike are asking: what makes a game educational? An article in a recent volume of *Psychological Science* in the Public Interest discusses the differences between games that are only entertaining versus games that are educational in response to the recent increase in *edutainment* apps and games. The authors argue that educational games should be, among other aspects, meaningfully connected to our daily lives, which is supported by recent studies in the learning sciences (Hirsh-Pasek, Zosh, Golinkoff, Gray, Robb, & Kaufman, 2015).

Games that meaningfully connect with our daily lives create environments where young people can explore virtual worlds and solve simulated real-world problems. Learning to solve complex problems whose solutions require more than basic facts and skills is a critical component of equipping young people to participate in the societies and cultures of the digital age (Shaffer, 2007; Autor, Levy, & Murnane, 2003; Levy & Murnane, 2004). By interacting with realistic virtual environments—and with one another in such environments—young people can learn the skills that we value in the 21st century, such as innovation, critical thinking, and communication (Gee & Shaffer, 2010; Gee, 2003).

One important characteristic of such virtual environments is the extent to which they model the epistemological norms of real-world practices. Shaffer (2007), for example, describes epistemological games as learning environments that are designed to help players develop ways of seeing and solving problems that matter in society. His work builds on decades of research in the learning sciences, which shows that effective learning is *social and situated* (Bandura, 1986; Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Vygotsky, 1978). Learning is

social and situated when people interact with other members of a community or interact with cultural tools that the community has developed and when it occurs in an authentic context in which actions have meaningful consequences. Such social and situated learning communities have been described as *communities of practice*—groups of people who share ways of working, thinking, and acting in the world (Wenger, 1998; Lave and Wenger, 1991).Thus, the power of epistemological games lies in their ability to simulate the social contexts and meaningful activities of communities of practice.

Shaffer (2006) describes the learning that occurs in epistemological games in terms of developing an *epistemic frame*—a network of skills, knowledge, identities, values, and epistemologies that are interconnected in specific ways. Epistemic frame theory suggests that professionals rely on domain-specific skills and knowledge to make and justify their decisions and actions. They identify as members of the group and share a set of values to identify important issues and problems in the field. Developing an epistemic frame means making meaningful connections among the elements that are characteristic of a particular community of practice. For example, an engineering intern might make a design decision to increase the safety of a product for the wellbeing of a client. She might make this decision based on the results of a data analysis. In this case, the intern justifies her design decision by valuing the safety of her client and executing the skill of conducting and interpreting a data analysis. She knows which values to consider and what information to gather in order to make a design decision the way a professional engineer would.

Of course, young people are not able to think exactly in the ways that scientists, artists, and other professionals think, nor do they exhibit the epistemic frames that professionals do. Epistemological games provide a way for young people to begin to learn epistemological practices in a domain without possessing the knowledge and skills necessary to engage in authentic problem solving. Many game designers create virtual environments with the intent of helping young people develop this professional way of thinking, but other designers may create virtual environments in which young people can develop these epistemologies serendipitously.

When games are purposefully designed to be epistemological, they are frequently modeled after the culture of a particular community of practice. In order to create an accurate model of a culture, researchers may conduct an ethnographic study of the community that examines the ways in which doing, learning, and thinking are linked (Shaffer, 2005; Bagley & Shaffer, 2010; Hatfield & Shaffer, 2010; Nash & Shaffer, 2013). Researchers can then identify well-formed activities, reflective practices, and pedagogical techniques within ill-structured professional domains that inform the design of an epistemological game (Arastoopour & Shaffer, 2015). For example, Bagley & Shaffer (2010) described the ways in which professional urban planners engage in reflective thinking with their students after executing an action within the domain. After some initial resistance, their students start demonstrating similar reflective thoughts that inform their own urban planning designs. Because these reflective discussions affected the ways in which students thought about their urban planning designs, they were incorporated into a simulation of the urban planning domain.

However, video game scholars have also identified epistemological practices in games that were not explicitly designed to simulate the problem solving practices of a particular community. For example, Steinkuehler and Duncan (2008) argue that massively multiplayer online games such as *World of Warcraft* can be unintentionally designed learning environments in which players demonstrate "scientific argumentation, model-based reasoning, and theory-evidence coordination" (p. 531). Players record their observations of enemies in a spreadsheet format, develop explanatory and predictory mathematical models, and compare those models to other competing mathematical models. In this case, the learning that occurs within the game is social and situated because the results of players' experiments have significant implications for their strategies and

game play. Thus, decades of research on epistemological games have shown that game design, whether purposefully or unintentionally, significantly affects players' epistemological practices by providing the opportunity for young people to engage in simulated, real-world problem solving in which they can learn valued 21st century skills and ways of thinking.

Epistemic frame theory is one useful way to situate discussions about epistemological games because it lays out an integrated framework for thinking about theory, design of interventions, and assessment of epistemological games. But it is only one of several productive conversations in the field about what epistemological gaming does, can, and should mean. Therefore, the purpose of this special issue is to initiate a discussion on topics central to the development, implementation, and analysis of epistemological games. The issue will look at epistemological games in the broad sense of games and digital environments that develop young people's complex, real-world problem-solving skills in a social and situated context. In this issue, we present papers that describe (a) current empirical research on the design and use of such epistemological games; (b) theoretical perspectives on how and why epistemological games introduce players to communities of practice and authentic problem solving; and (c) provide critical perspectives on implicit and explicit values in epistemological games.

ARTICLES IN THIS ISSUE

Hatfield focuses on a particular epistemological game that is based on the practice of journalism. The game is designed as a virtual internship in which students engage in professional activities. Drawing on Shaffer's epistemic frame theory, Hatfield shows that young people can develop the journalist's ways of complex, professional thinking by engaging in simulated, real-world practice and reflective discussion with mentors. He demonstrates the development of participants' professional thinking by measuring their discourse patterns over time and by comparing these patterns to (a) situations in which participants did not have access to reflective discussions and epistemological experiences and (b) actual (non-simulated) professional practica. Hatfield suggests that theoretically-derived analysis tools, such as *epistemic network analysis*, are productive because they not only provide a method for measuring valued learning outcomes, but they also provide a method for validating the authenticity of simulated professional practica.

Marshall, Erickson, and Sivam extend epistemological games into the domain of science education. The authors contrast *school science* and *authentic science*, arguing that the way science is taught in schools does not accurately reflect the epistemological dimensions of how science is practiced in real-world scientific communities. In other words, school science lacks instruction on the "the purposes of research, theory-data coordination, theory-ladenness of methods, response to anomalous data, nature of reasoning, and social construction of knowledge". To address this problem, Marshall, Erickson, and Sivam developed a simulation for preservice teachers that attempts to engage the teachers in the epistemological practices that are routinely omitted from science curricula. They compare the preservice teachers' behaviors within the simulation to the criteria of *authentic inquiry* as defined by Chinn and Malhotra (2002). They conclude that such a simulation can indeed engage players in a number of the epistemological dimensions of real-world scientific communities.

Martinez-Garza examines epistemological practices outside of the context of professional simulations. In his article, "'For !!SCIENCE!!': Examining Epistemic Practices of the Community of Players of *Dwarf Fortress*", Martinez-Garza describes the ways in which members of the *Dwarf Fortress* incorporate practices from real-world scientific communities into their systematic studies of the *Dwarf Fortress* world. *Dwarf Fortress* is a resource management game

in which players, mostly unsuccessfully, attempt to build a thriving ecosystem of dwarves living within a fortress (Weiner, 2011). The game is known for the complexity of its simulation, using, for example, dwarves' personality types, climate, and economic patterns to model ecosystems. Martinez-Garza argues that this environment's simulation models real-world scientific phenomena realistically enough to encourage its players to form hypotheses about *Dwarf Fortress*'s world that are similar to the hypotheses we form about our own world. Because *Dwarf Fortress*'s mechanics are hidden from the users, the members of the community share the results of their experiments in ways that align with the practices of real-world scientific communities.

Finally, Metchley provides a critical examination of the current state of epistemological games. He acknowledges the effectiveness of epistemic frame theory as a framework for understanding how learning develops in epistemic games and of epistemic network analysis as a tool for measuring learning development. However, Metchley argues that epistemic frame theory may not explicitly account for how epistemology can be both enacted (inference from an individual's or group's behavior) and professed (explicitly stated or indicated) and what the relationship between the two epistemologies may be. He suggests that conflating the two can lead to ill-formed choices on what constitutes evidence of students' epistemological development and learning within an epistemic game. For example, a researcher may have evidence that a student's discourse is aligned with the discourse of a community, but this may not necessarily be valid as evidence that the student is *thinking* like a practitioner in the community. Examining the context and the social interactions in which this discourse takes place may provide more insight into the development of students' ways of thinking. He argues for a more precise interpretation of epistemology and revisits how we account for practitioners' epistemic beliefs as well as the evidence we use to account for learners' epistemic thinking. This examination may ultimately provide a richer understanding of how we can design and assess learning in epistemological games.

Together, the papers in this issue present some current directions for research on epistemological games and demonstrate the rich potential that cross-disciplinary engagements around the topic of epistemological games may hold. We hope that this set of papers stimulates further discussion of epistemological games.

Jenny Saucerman
Golnaz Arastoopour
Guest Editors
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