EDITORIAL PREFACE

The Use of HFACS in Game and Simulation Development, Implementation and Assessment

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THE INTERDISCIPLINARY NATURE OF IJGCMS

The International Journal of Games and Computer-Mediated Simulations (IJGCMS), at its core, has always had an international and interdisciplinary focus. The interdisciplinary focus reflects the broader nature of the field itself. For instance, psychology might attempt to study the degree to which game and simulation play increases or decreases tendencies towards violence. Education could study the degree to which game play or game development impacts cognition, affect, or socio-emotional characteristics. Computer science might assess the physical aspects of game hardware in an attempt to further explore human computer interaction.

One of the benefits of having an interdisciplinary approach is the degree to which authors can borrow from other disciplines to solve existing problems or to shed light on new advances in their own field. This is something we as an editorial board continue to push as we encourage authors to build on the work of others. In this editorial, we explore how a concept from aviation and aeronautics might impact scholars in games and simulations.

HFACS

J. Reason researched the concept of human error. In a 1990 publication, he stated that often the person who was the active participant of an accident failed because of latent failures in the system. He proposed that layers of defenses each had holes in them, and if those holes lined up, an accident would occur. He did not specifically define the holes.

Shappell and Wiegmann (2003) drew upon this work and created a classification for assessing human error in aviation accidents. The taxonomy, called the Human Factors Analysis and Classification System (HFACS), attempted to define the holes in the system; at addressed where both the active participant and latent system failures exist. This system has been proven quite successful at post accident and incident analysis in aviation and many other fields, including mining and medicine, to help understand why the incident occurred.

What has not been done, to our knowledge, is to take this taxonomy to proactively assess an instance of a game or simulation development, implementation, or evaluation. As this taxonomy is primarily designed to look for
human error and latent failures, its application to a pre-analysis of implanting new technology or other human hardware or software issues would provide a complete structural analysis. By using this analysis to look for the holes in the system before any accident occurred, effective interventions could be created and put in place to potentially improve implementation and to reduce negative outcomes.

The key to the success of this system is the in-depth analysis of potential gaps at four levels (Shappell, Detwiler, City, & Boquet, 2006; Wiegmann & Shappell, 2001, 2003)  

1. Organizational
   a. Resource Management
   b. Organizational Climate
   c. Organizational Policy
2. Supervision
   a. Inadequate Supervision
   b. Planned Inappropriate Operations
   c. Failed to Correct Problem
   d. Supervisory Violations
3. Pre-conditions for Unsafe Acts
   a. Environmental Factors
      i. Physical Environment
      ii. Technological Environment
   b. Condition of Operators
      i. Adverse Mental State
      ii. Adverse Physiological State
      iii. Physical/Mental Limitations
   c. Personnel Factors
      i. Crew Resource Management
      ii. Personal Readiness
4. Unsafe acts
   a. Errors
      i. Decision Errors
      ii. Skill-based Errors
      iii. Perceptual Errors
   b. Violations
      i. Routine
      ii. Exceptional

At a cursory glance, it is easy to see why this framework is useful for understanding accidents. It may be less clear how this framework might impact game and/or simulation development and implementation. Consider, however, the case for building a game for K-12 use. Designers and developers would benefit from looking at this framework for successful development and implementation.

At the organizational level, what are the kinds of policies in place for game and/or simulation use in schools? Will schools have the budget to be able to implement this into their existing curriculum? Will they have the time to devote to this in the face of standardized tests and state-based curricular standards?

At the supervisory level, what will be required of teachers in order to successfully implement this game or simulation? Do they know how to operate the game/or simulation? What will happen if something fails? How will they get help in correcting the failures? Are there things about the students, the curriculum, or the context that the instructors know will bias the implementation? What is the buy-in for the teacher? Why will they commit to this plan of action vs. doing business as usual?

The pre-conditions are often most ignored when it comes to implementation in schools. Does the school have the technological infrastructure to run the game or simulation? Are there physical or mental limitations in the audience that would prevent successful implementation? This could include physical or mental characteristics (e.g., not being able to type or to be online), or it could include readiness (e.g., certain students not being at a given reading level).

Finally, there are factors within the actual interaction of the student that could cause failures. Sometimes these are accidental, without a willful violation of the games’ rules. For
instance, they might not have the skill (mental or physical) to do what the game and/or simulation requires. In other cases, these violations are willful acts. For instance, students find a way to use the game or simulation in a way that wasn’t intended.

An examination at each of these levels could be used in two ways. For design, these factors could act as a checklist to reduce failed implementation. For implementation, these factors could serve as a review as to the implementation’s success of failure.

CONCLUSION

The purpose of this thought exercise is not to suggest that HFACS should be the standard by which all game and simulation design and development is measured. It is clear that HFACS is very useful in examining safety and reasons accidents occur. And, it may too far of a stretch for some designers and educators to implement such a set of theories or processes in place as they consider technology implementation. Having said that, it should be clear that there are at least some aspects of HFACS that would be useful for those interested in games and simulations to consider.

The point of this thought exercise was to suggest that fields often claim to have exemplary interdisciplinary collaboration. In this case, due to the number of various fields interested in gaming and simulation, we have a natural affinity towards inter-field thinking. However, we do not necessarily see that in actual research, publication or practice.

This editorial is a call for researchers in games and simulations to continue to think about the ways in which the work in other fields could impact our own thinking. We believe that HFACS does have potential for explaining outcomes (where accidents are seen as failed implementations), and we will continue to explore that area. We encourage others to find successful programs, frameworks, and procedures and tie them back to strengthen the research and theory that supports our field.

Finally, it is worth noting that we spend a lot of time talking about the success of games and simulations. There are those researchers who have studied errors and that seems to continue to be an emerging area of empirical and theoretical work. We encourage this continued area of focus as learning does not only come through success.

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In this issue, there are four exemplary research articles. The first article from Beck examined teachers’ expectations of student performance based on gender and ethnicity of the student. His work builds on prior research that demonstrates that both gender and ethnicity do impact teachers’ expectations. Beck furthered this work by replicating the study using avatars. His results provide evidence that there are potential biases and prejudices towards avatars in terms of educational expectations from teachers.

The second article, written by Steinkuehler, Alagoz, King, and Martin, examines two out-of-school programs. Using “I-Dig Science” and “Casual Learning Lab”, the team used ethnographic methods to explore learning outcomes, locus of intentionality, and design heuristics. The authors conclude with a set of “petit generalizations” that they argue are relevant to a broader range of contexts.

Hartshorne, VanFossen, and Friedman penned the third article, which is an exploration of roles, civic participation, and leadership within MMORPGs. Using a survey method, the authors explored both civic participation and civic engagement of student players of World of Warcraft. The results of their study suggest that student players in such an MMORPG report being more civically engaged than their peers. The authors’ suggest using such games as a method of developing effective citizenry.

The final article in this issue is an article by Ma, Williams, and Prejean that explores design components in a game-based learn-
ing environment. This paper is an analysis of decision-making related to the development of *Conquest of Coastlands*. The authors suggest that this analysis will help designers understand the relationship between various design components.

In addition to the four research articles, there is a book review authored by Deale, Key, Regina, and Pastore. The authors examined the book *Women and Gaming: The Sims and 21st Century Learning*, written by Gee and Hayes (2010). The book is a call for educational reform through games. More specifically, the book investigates female gamers as examples of successful educational reform. The authors of this review find some merit in the book content, but also make an argument for more research to substantiate some of the claims provided.

**REFERENCES**


**ENDNOTE**

1 For an in-depth discussion of these factors and the definitions of each term, please read the work of Shappell & Wiegmann and visit http://hfacs.com/).