
Science Education And Video Games

Do video games have a proven positive effect in education? Of the two papers being compared here, one would answer 'absolutely', while the other believes benefit needs further research to be proven beyond specific subject matter. This paper will highlight key ideas from both papers, addressing similarities and differences. The key focus will be on the overlapping example of science curriculum and the findings from both.

Barab, Gresalfi & Ingram-Goble (2010) Transformational Play: Using Games to Position Person, Content, and Context discusses specifically the use of Quest Atlantis for which the authors were lead designers. It may be noted here that as lead designers, there is potential for confirmation bias in their findings as they have a vested interest in the success of the studies.

The paper discusses the benefits of transformative play, indicating playing doesn't automatically mean transformative play, rather playing for educational benefit requires three factors to be balanced and met:

- Person with Intentionality
- Content with Legitimacy
- Context with Consequentiality (Barab et al, 2010)

They elaborate further stating "Players take on role of protagonist who must employ conceptual understandings to make choices that have the potential to transform a problem based fictional context and ultimately the players understanding of the content as well as of herself as someone who has used academic content to address a socially significant problem." (Barab, Gresalfi & Ingram-Goble, 2010,p 526). The idea that cognition and context are intrinsically linked is not new and can be seen in many studies across learning science research such as Squire and Klopfer (2007).

One of the major benefits of gameplay is that students have the ability to fail in a safe environment, and can reflect on their decisions and consequences of their actions within the game world. Barab et al (2010) highlight the importance of context and the shift from rote acquisition of concepts to providing experiences with personal and contextual significance, which in turn can provide even novice learners the opportunity for transformational experiences. This provides the opportunity for deeper engagement, and new learning opportunities. Barab et al (2010) do suggest however that gameplay benefits from an active element, such as is available through platforms such as the Xbox Kinect, which was not a component of their two case studies.

Both case studies of this paper showed that students who conducted learning through use of Quest Atlantis showed marked improvement over their counterparts learning the same subject matter in a more traditional manner. For the purpose of this paper, the focus will be on case study one, 'Taiga Fishkill'. In this study, students were asked to investigate causes of a decline in the fish population, including observations within fish tanks and then moving to larger more complex park scenarios. Students showed higher post test results and in a delayed post test eight weeks later they also scored significantly higher indicating that students who had

completed the activity within Quest Atlantis showed less forgetting and deeper understanding as well as good results in transfer, interpretation, analysis and definition of core concepts.

Paper two (Young, et al, (2012) Our Princes is in Another Castle: A Review of Trends in Serious Gaming) highlight theories such as Vygotsky's concept of games being essential for children's development. However, the bulk of the paper is a literature review focusing on the connection between video games and classroom achievement. Young et al (2012) hypothesised a positive effect on engagement motivation, sustained motivation in subject area and content mastery. However, their findings were less optimistic. The paper breaks the literature into five subject areas; maths, language, physical education, science and history. They determine that while good results were achieved in language learning and physical education, the literature was inconclusive with regard to application in other areas. Young et al (2012) did not disregard the potential of video games having application in education, however, they indicates there were a number of factors to be considered in game selection or design and emphasised there is still a way to go before we can conclusively say that video games have a irrefutable place in the education landscape.

In selecting video games, Young et al (2012) highlight that they need to:

- Be designed and researched with careful attention to contemporary learning theories
- Take into account customisation of task difficulty to learners capabilities, metacognitive reflection, rich situation interaction between learner game and classroom
- Similar to paper one, Young et al (2012) indicated that body movement incorporation (i.e Xbox kinnect) may be worth including in any video games used for education.

For the purpose of comparing 'apples to apples' as much as possible, this paper discusses findings regarding science curriculum. Interestingly a paper by Barab et al (2009) was included in the literature review also discussing use of Quest Atlantis. However, the 2010 paper was seemingly not included in the review. There is no indication if it appeared in their original search. Regardless, Young et al (2012) do highlight Barab et al's earlier paper as one of the studies showing a positive correlation between learning and video games. Their overall findings regarding video game usage in teaching scientific curriculum can be summarised as:

- Literature shows only tepid exploration of science topics, most of which were viewed in isolation, not allowing for spiral curriculum, and reducing the effectiveness of teaching the complex interactions between scientific concepts.
- Games tend to be constrained with regard to what students do, see and interact with due to the nature of their programming, this in turn limits student driven experimentation and exploration and their ability to naturally engage with early stages of problem-solving.
- While Quest Atlantis and WhyVille did show promise regarding incorporation of socially driven achievement and investigation, research was ultimately deemed too scant to confirm.
- Scientific learning requires investigation and exploration anchored in systematic learning objectives and essential questioning. Furthermore, there needs to be a link bridging the virtual world to the real world to cement learning of key principles and concepts in science education.

When we compare this to Barab et al (2010) we reach an interesting divergence in the findings. While both identify that Quest Atlantis does show promise for improving learner outcomes and

supports the important social element of scientific learning, Barab et al (2010) seem to suggest that despite focussing on only one topic area and being constrained to set scenarios, Quest Atlantis and the Taiga Fishkill scenarios provide students sufficient freedom to explore, identify and define problems, investigate and interaction with virtual players so learners not only understand the concepts but can transfer this understanding, find personal meaning within the context and retain the learning for longer periods than their real world counterparts. The findings from Young et al (2012) indicate (while this specific case study was not referenced), it is unlikely that the game play alone was sufficient and that real world bridging as well as linking to other areas of the scientific curriculum is needed to achieve maximum learning potential. While Barab et al (2010) does not directly refute the idea that these elements are required, it doesn't address them either.

On the basis of comparison of the findings within both papers, it appears that there is definite potential for video game use in achieving academic goals and contrary to what some literature may suggest, there are examples within subject matter within STEM courses being able to effectively utilise programs such as Quest Atlantis to teach learners and enable exploration, problem solving, socialisation, investigation, questioning and can create a space for learning science practices such as problem based learning (Barrows, 1986) and productive failure (Kapur, 2006) to be utilised. Students can fail and see the consequences of their decisions, how elements interact differently under different circumstances, explore their hypotheses and engage in a way that allows personal meaning making and combining content in context. This may not always be possible in traditional classroom environments, where real world constraints such as safety, ethics, time, budget, environmental factors, real-world viability of scenarios and so on may impede the ability of teachers in demonstrating concepts and contexts.

It is clear that more research needed which supports conclusive and consistent understanding of key concepts with regard to video game use in education. Barab et al (2010) while showing a positive link in game use and academic outcomes does have potential (though unconfirmed) bias due to the authors role in development of the platform. Young et al (2012) is not without limitations; however, with only 39 papers being reviewed out of a potential 363 meeting the original search criteria. Its is possible that the self-imposed constraints removed the review of a wider pool of literature and in doing so not only potentially missed some key findings from the research community but reduced the data available to reach potentially conclusive results. That said, whether conclusive or otherwise, the potential benefits of employing games in enhancing learning science strategies such as problem-based learning are exciting and worth pursuing further evaluation of.

References

1. Barab, S, Gresalfi, M & Ingram-Goble, A (2010). Transformational Play: Using games to position person, content and context. *Educational Researcher*, 39(27), 525-536
2. Barrows, H, 1986, The Taxonomy of Problem Based Learning Methods, *Medical Education*, 20, 481- 486
3. Kapur, M, (2006), Productive Failure, *Cognition and Instruction*, 26(3), 379-424
4. Squire, K, & Klopfer, E (2007) Augmented Reality Simulations in Handheld Computers, *Journal of the Learning Sciences*, 16(3) 371-413
5. Young, M., Slota, S., Cutter, A., Jalette, G., Mullin, G., La, B., Yukhymenko, M. (2012) Our Princes is in Another Castle: A Review of Trends in Serious Gaming, *Review of*

edubirdie.com