Game-Based Learning in Higher Education

The Good, the Bad and the Ugly

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Abstract. Games are an important tool for stimulating innovation and growth. The benefits of game-based learning are well documented in the literature, however, there are downsides, as with any educational technique. Not to mention the contexts and reasons for failure and success are not always so transparent. One of the core argument around the effectiveness of game-based learning compared to traditional mediums is founded on the principal that games offer a more active and engaging learning experience (compared to students passively listening or watching). Highlighting that learning is not a spectator's sport and game-based techniques epitomizes learning in an applied manner. This paper examines what games-based learning techniques are, how they work, and how they are used in a higher educational setting. We also review a variety of real-world problems and dangers, including recent breakthroughs using advancing technologies like virtual reality, and what this means for learners today and in the foreseeable future.

1 Introduction

1.1 Power of Games

Games (both digital and non-digital) have the ability to control our emotions, focus our attention or even capture our imagination. Computer games are able to harness enormous power and bring us closer together (connect us with people from around the world through communication technologies). Of course, with great power comes great responsibility. Games and learning have always gone hand in hand from the earliest times – as `play' is and still is an important vehicle for learning as well as fun - offering a chance to test the effectiveness of life's strategies away from the looming threat of danger [6]. The fact that games can help us to absorb information, of whatever purpose and value, is clear. This notion has taken hold in today's world with real applications outside entertainment but in a variety of other contexts (training, education, rehabilitation and more). Games are frequently used to convey all sorts of new concepts and to hammer those concepts home through repetition. Placing the learner at the heart of the topic – not as a passive bystander but as an active participant – is the impetus behind game-based learning. Hence, it leaves us wondering, will gaming make this world a better place for learners? Done well, game-based learning can generate powerful, gut-level emotional effects that go beyond simply teaching knowledge-based facts.

1.2 Gamification and Game-Based Learning

Gamification and Game-Based learning both offer exciting possibilities in and around the concept of education. However, they have distinct differences, firstly and most importantly, gamification is about `encouragement' and the tools or technologies that promotes this, while on the other hand game-based learning is first and foremost about the game and its cognitive residue (either from the game content or the academic content). Even though the two are

different – they can complement one another (i.e., they can use one another), since they both lead to the mastery of a topic. Interestingly, neither are expressly designed (nor required) for classroom use—which is why, done well, leads to improved engagement and enjoyment [23]. In summary, gamification is the process of adding game-like mechanics to non-game entities – or another way to think of gamification is "encouragement mechanics". A system of carrots and sticks to promote the desired behavior.

1.2 Contribution

The key contributions of this paper are: (1) Examination of game-based learning techniques both in terms of success, failure and warnings (2) Techniques for analyzing and developing game-based learning solutions to meet the needs of individuals (e.g., integrating game-based principles as a deliberate part of the learning process instead of `add-ons').

2 Games in Higher Education

Trends (Publications/Research – Growing Area Interest)

Prensky [1] suggested that playing "action" computer games has the positive effect of enhancing student's visual selective attention. As Charlier [10] explains the stereo-typical relationship between games and learning `was' perceived as an inefficient time-wasting method that was primarily employed by younger learners (and is changing due to unmistakable advantages). Oblinger [11] reviews next generation of educational engagement emphasizing showing examples of how games are no longer just for fun. As shown in Figure 3, we are able to clearly see the rapid interest in games and education over the past few decades. Worthwhile emphasizing that game-based learning does not have to be about the development of a tool - often attributed to one of the barriers due to the cost implications and available resources. As explained in the literature, taking a more game-informed approach may be best solution [5,28].

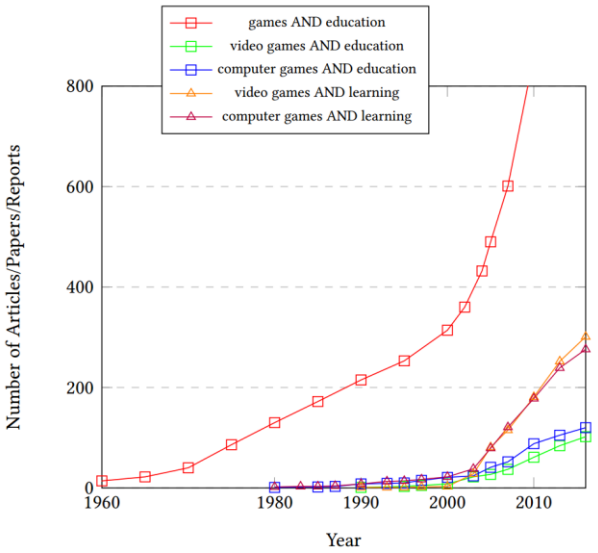

Figure 3. Kenwright [17] presented a coarse guide to the number of articles in the area of games and learning to emphasis the rapid interest and applications of games in education over the past few decades.

Games: A New Secret Weapon for Learning in Higher Education

A report by NMC [3] showed that 68% of people who play games regularly are over 18 years old (i.e., university age). Siang and Rao [9] said learners who are motivated can learn almost everything. An early example of games in higher education was presented by Squire and Jenkins [12] who used the video game Civilization III as a learning medium to describe how the game becomes the impetus for students seeking out more traditional sources of learning material. To win students must deal with political, scientific, military, cultural and economic issues spanning 6,000 years. Not only do students have to learn to be successful with the game, but they must synthesize and integrate information from multiple disciplines. Studies by different researchers (see Figure 1 and Figure 2) have shown consistent advantages of games in learning in different contexts, such as, engagement, memory retention and problem solving abilities.

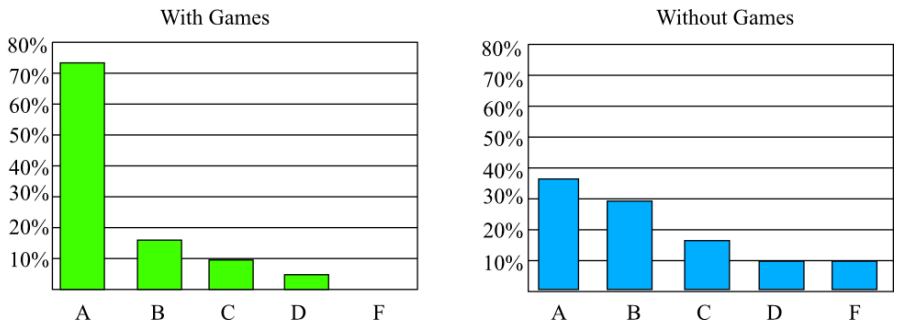

Figure 1. Three studies by Blunt [13] who showed comparatively the advantages of game-based methods in learning (grades).

Are All Game-Based Learning Solutions Created Equal?

Game-development can require significant time and resources, as Blow [4] explains writing a successful solution is ` harder than you think'. Flanagan et al. [5] also reports how many designers struggle to find a balance between their own values, those of users and other stakeholders, and those of the surrounding culture.

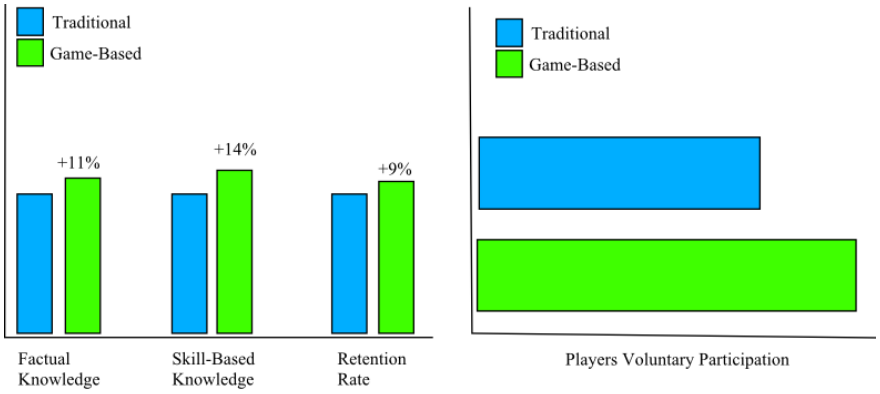

Figure 2. (a) Sitzmann [14] presented the results from 65 studies showing that learners performed better for knowledge and retention rate using game-based techniques. (b) Lee et al. [15] found that learners playing handheld games regularly completed nearly three times the number of problems in 19 days as those using paper worksheets (while voluntarily increasing the level of difficulty as they continued to play).

As may be noted, the mentioned studies, have, to some extent, shared one thing in common; namely, the learning is improved/achieved through motivation and engagement. Two questions that remain are (1) how successful are the solutions compared to one another and (2) how do the solutions compare under different conditions (e.g., subject, technologies, learners and environment). These questions are particularly relevant if we are to develop frameworks or mechanisms that works as expected. As we discuss large body of research investigating aiming to address these problems. However, one noteworthy methodology worth mentioning, that has been employed successfully multiple times for designing learning solutions is the four part structure from Allen [29]: (1) Context – provide a triggering context to where desired

behaviors should be displayed; (2) Challenge – give the learner a challenge that they have to complete; (3) Action – allow the learner to take action to meet the requirements of the challenge (this should be multi-staged and realistic); (4) Feedback – feedback to the learner on how successfully they met the challenge. Whilst the methodology and early stages are obviously time consuming, the coupled structure and organization is highly effective when creating short, focused interactive game-based learning solutions.

What is Changing with Game-Based Learning Today? (Technology, Social Factors, News, Research, …)

Erin's [2] study investigated shifting tends with student usage of such technologies like instant messaging, cell phones, e-readers, social networking, RSS feeds, podcasts and tablets. The survey results showed an increasing use and dependence on educational technologies and a desire for basic library services to be available on a variety of platforms and technologies. As Squire and Henry [12] point out, we need to keep moving forward, however, while technology is a huge factor, it will not be the biggest challenge in the future. We are a long way from having tapped the full pedagogical potentials of existing game hardware and design practices. Technology is not the `only' and `best' solution, as explained in the literature, each approach should be holistic in its learning practices (fit in with the bigger picture). Help address the challenges and/or opportunities in teaching and learning by designing `smart' activities (gameful or not) around students and the learning goals. Needs are the driving factor and not technology. However, recently Merchant [30] investigated the effects of game-based learning in a virtual environments (impact of virtual reality technology-based instruction on learning). The analysis showed numerous advantages and evidence that virtual reality-based instruction had on enhancing the learning outcomes, while shedding light on several virtual reality instructional design principles to improve the probability of success. While a large amount of work has done around designed suitable processes and identify the right "solutions", either digital, analogue or even hybrid techniques, there is still a need for future investigation.

Dangers and Warning Signs

While on the surface game-based learning seems to offer a genuine solution – before lowering our guard there is a very real possibility of danger (take note of the warning signs). US Surgeon General C. Everett Koop proclaimed games among the top health risks facing Americans [8]. All too often, the lure, like a piece of candy, usually intended to draw us in with promises that seem too good. The hope being that learnings will all want to play educational games and learn. Most often this hope is misplaced. When the candy is consumed the learning may moves on, having picked up little information in the process. Pivec [6] explains instructors should consider their students' proficiency with technology so that the technology itself doesn't become a barrier to learning. Hence, instructional designers, managers, and eLearning professionals have found game-based solutions hugely successful `only' when implemented thoughtfully [17,18]. Often overlooked are the dangers and pitfalls, such as, choosing inappropriate content for game-based tool, selecting in appropriate rewards for the target population hindering the learner engagement and impacting the any chance of improved performance.

Benefits of Game-Based Learning:
* Engagement
* Attention Span
* Mental Flexibility
* Competition

* Collaboration
* Urgent Optimism
* Social Fabric
* Blissful Productivity
* Epic Meaning

Limitations/Challenges of Game-Based Learning
* Design Challenges (fully achieve pedagogical objectives – see Figure 4)
* Specialist Skillets (Tools/Create/Develop)
* Time-Consuming Construct
* Difficult to Quickly Change Redesign/Update
* Close observation is necessary to track progress
* Careful planning is required
* Cheating is less clear in game-based learning contexts

Efficiency and authenticity are also issues not really addressed in game-based learning aspects. As we have discussed in this paper, whilst game-based learning is widely recognized and able to help take theoretical concepts into the "real world" scenarios - there the aspect of authenticity, such as, "is this the most efficient way of using a learner's time?" which must be considered **[27]**. Often, the nature of gaming involved simplifications which undermined the real world authenticity. Other times it may be because a large majority of the time was spent reaching an outcome which was entirely foreseeable from the first five minutes. In any case, the time and energy of students might not be utilized as best as they could (squandering time). However, from an instructors' perspective, the successful implementation of game-based learning using very simple scenarios for student engagement and interaction (paper games and group activities) are easy to accomplish. There is a very narrow window within which forecasting is beneficial (too late and you will fail to gain any benefits, yet too early and you get subsequently get not benefits). Different subjects will employ game-based methods in their own way - but certainly a good measure of the effectiveness of game-based (and indeed problem based) learning is the state of tension and passion in the room as people began to embody the challenges and compromises of real-world practice. Of course, we must remember from an inclusion point of view – we know that not all students are equally comfortable in all situations. The passionate arguments often suited dyslexic and ADHD **[25]**; Asperger's syndrome **[24]**; communication difficulties; or mental health issues might excel or fail depending on the context **[26]**. Importantly, no point in turning a teaching and learning experience into a game without considering all aspects.

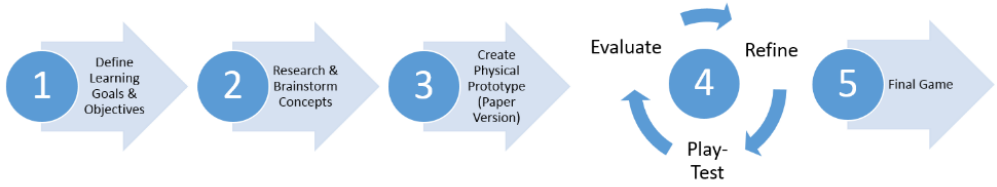

*Figure 4. Common stages for designing a successful game-learning solution (note the procedure is not a `one-shot' solution – and requires multiple iterations, testing and refinements) **[21,22]**.*

Utilizing Games Inside and Outside the Classroom

Lacasa [19] explored the impact of brining commercial games into the classroom to enhance engagement and learning. Ruben [20] explored the influence of classroom instruction through experiential methods, such as, game-based learning to resolve issues (e.g., engagement, learning challenging subjects and knowledge acquisition). Possible areas for students to take games and learning further in the broader sense are:

* Involved in Creation of the Game-Based Learning Solution (see Figure 4)
* Have Students Play Games at Home
* Watch Others Play
* Read Developer Diaries and Walkthroughs
* Reimagine Them
* Design Them
* Actually Make the Games
* Mash Them with Other Media

3 Conclusion

In conclusion, should we care about `game-based learning'? Is it just another `buzz' trend that will fade with time? For one thing, nearly all games, in education and entertainment offer benefits (directly and indirectly). Games certainly have the ability to **edu-tain** students. These benefits might be unnoticed (e.g., teaching patience or problem solving) but they do offer benefits. There are warning signs - as with any approach, one such example mentioned in the media is gaming addiction - however, this as with anything (excessive application or use – such s, constantly reading or exercising) should be monitored. Game-based learning solutions are just one of many tools available to instructors. Of course, as educator the issue is clear, since it is increasingly challenging to keep students engaged while teaching more material to a higher level. Smartly crafted game-based learning solutions offer a distinct advantage which cannot be ignored. In summary, despite the importance of game-enhanced e-learning approaches/artefacts, their processes, design choices, gamification mechanisms still need further development to increase their flexibility, agility and effectiveness.

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