

What evidence is there that digital games can contribute to increasing students' motivation to learn?

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1. Introduction

This paper reports on both theoretical and empirical evidence pertaining to why and how video games can motivate students to learn in traditional or non-traditional settings. The first section describes the background and rationale of the paper. It explains key concepts linked to motivation, engagement and flow, and illustrates how some features in video games can promote intrinsic motivation, a motivation that is believed to encourage and sustain learning. In the second part of the paper, empirical evidence of the motivational aspects of video games is presented, with reference to recent scientific studies conducted essentially between 2005 and 2011. The evidence collected demonstrates that games are employed to successfully increase motivation on the part of the learners, in a wide range of settings, for different topics (e.g., science, literature, or engineering), and to address the needs and specificities of different types of learners (e.g., gender, age, or special needs). The literature review shows that games can teach both academic and non-academic skills, and motivate students to collaborate, share information, and increase their attainments. The results presented in the review emphasize that, while games are motivating, some additional mechanisms need to be implemented to ensure that they will systematically manage to engage, teach and change students' behaviors. These include game design (e.g., personalized strategies, adapted challenge or a good balance between educational and entertaining features), and teaching strategies (e.g., briefing, debriefing, and teachers' support).

2. Theoretical basis for motivation in video games

2.1. Motivation and learning

Motivation is one of the key elements to learning (Keller & Kopp, 1987; Astleitner & Leutner, 2000) as it stimulates students' interests, supports individual and collaborative learning (Dillenbourg et al., 2009), and may in some cases be a predictor of students' success (Pajares & Graham, 1999). Because video games support intrinsic motivation, a motivation that is believed to have an important lasting effect on learners (Habgood et al., 2005), they have been considered and used for educational purpose. It is agreed that learning is both an emotional and cognitive process (Malone, 1982; Piaget, 1951) and that, when players are engaged in activities that are intrinsically motivating, they are more prone to demonstrate deep learning, and use this knowledge in other settings (e.g., outside school).

2.2. Playing and motivation

Well-designed video games can be ideal learning environments, as they inherently incorporate sound educational theories and concepts, and require players to learn and develop skills to succeed. Video games captivate the attention of players who experience emotions that may impact positively on the learning process (Baker et al., 2010). Players often experience a state of flow (Csikszentmihalyi, 1990) where they are immersed, engaged, and willing to achieve the goals and aims of the activity, regardless of the challenges

ahead, and it was demonstrated that a state of flow can have a positive impact on learning (Webster et al. 1993; Kiili, 2005).

Games are engaging, fun, and they intrinsically motivate players to learn more about the game rules, its mechanics, and sometimes to learn and gather information when the game is over. Malone (1982) suggested that video games may promote engagement and intrinsic motivation, and possibly motivate to learn. Bowmann (1982), Provenzo (1991) and (Rieber 1996) also observed that game mechanisms, such as feedback cycle and intrinsic motivation, may benefit learning activities and therefore ought to be integrated into instructional settings.

3. Empirical Evidence

3.1. Video games motivate to learn in traditional settings

Video games (i.e., commercial, educational or bespoke) have been used in a great variety of contexts, including primary education, secondary education, third-level education, and the industry. Scientific evidence has demonstrated that they can successfully increase motivation to learn academic or non-academic topics such as mathematics (Lee et al., 2004; Kebritchi et al., 2010), science (Toprac, 2011; Squire et al., 2004; Barab et al., 2009), languages (Hailey et al., 2011; Rankin et al., 2006; Howell & Veale, 2009), history (Squire & Barab, 2004) software engineering (Navarro & Hoek, 2007; Shaw & Dermoudy, 2005; Papastergiou, 2009), to train medical students (Roubidoux et al., 2002), or to raise students' awareness on sensitive topics such as the environment (Klopfer & Squire, 2008), or healthy eating (Serrano, 2004). In these studies, researchers have gathered scientific evidence that video games can motivate students to learn academic skills while they are at school or at home (Toprac, 2011), and sometimes encourage them to complete more exercises than in traditional settings (Lee et al., 2004). It also appears that learning benefits are increased when students have had a prior exposure to the topic, and when the game allowed them to put their knowledge into practice. Results from these studies also indicate that, in many cases, video games are perceived as an enjoyable and entertaining experience by students, and that teachers also acknowledge this positive effect. Games seem to improve students' perseverance and confidence, and some of them have welcomed the opportunity to use Game-Based Learning on a regular basis (Shaw & Dermoudy, 2005). Although the video games genres employed in these experiments can vary from Real Time Strategy games (RTS) to First-Person Shooters (FPS), MMORPG (Massive Multiple Online Role Playing Games), which are based on collaboration between players to solve quests and puzzles, seem to particularly support intrinsic motivation (Dickey, 2007).

In addition to learning by playing, researchers have also reported on studies where students have been involved in the design and development of video games. In several cases, research shows a high degree of engagement and willingness to know more about the topic taught. It was found that learning by creating video games encourages students to become experts in the topic taught because they need to (1) collaborate, (2) investigate, (3) and synthesize information to be included in the game. Along with declarative and procedural knowledge, participants may learn meta-cognitive skills that should help them at school and for their future career. For example, Kelleher et al. (2007) found that students using Alice, a game development environments targeted at students with no or little knowledge of programming, were more motivated to program; they spent 42% more time programming, and expressed more interest in using Alice in the future than the students who used a version without story-telling features. Another interesting example was provided by Beavis & O'Mara (2010) who explain that game play is increasingly part of "what it means to be literate in the 21st century". They explain how students who created a video games using Game Maker, a free game engine, used (and consequently improved) their multi-literacy skills (e.g., graphics, audio, etc.). According to Beavis & O'Mara (2010), this experience emulated a working environment where students could collaborate, develop their knowledge-finding skills, and engage with communities in order to find solutions to some of the problems they may encounter.

3.2. Video games to teach non-academic skills

Although video games may not always be strictly based on the curriculum, it is agreed that they may change

students' attitude and behaviour towards a topic, and motivate them to learn more. In some cases, games may also motivate participants to become experts in a specific topic through *meta-gaming*, a process through which players gain an in-depth knowledge of the game and its mechanics. Video games can be employed to raise awareness by providing an environment in which players can develop a better understanding of the mechanics (e.g., causes and effects) of real-life phenomena; some games and related experiments cover contemporary events such as the recent Haitian earthquakes, the Palestine conflict (Buch & Egenfeldt-Nielsen, 2006), the spread of infectious diseases (Neulight et al., 2007), or the genocides in Darfur¹. Studies conducted with such games have shown that players had an increased interest in the topic, and showed more empathy for the characters. For example, Buch & Egenfeldt-Nielsen (2006) have illustrated how *Global Conflicts Palestine*², a commercial educational video game on the Palestine conflict, has motivated students, helped them to appreciate the conflict from different perspectives, and supported a deeper understanding of the conflict. It is interesting to note that some game genres, such as MMORPGs, leverage learning resources and support knowledge and skills that are not always acknowledged in formal education, such as peer-to-peer support and online discussions forums (Williamson & Facer, 2004).

3.3. Accounting for individual differences

Empirical evidence has shown that video games were particularly effective to engage students with low self-efficacy (e.g., those who don't believe they can perform some tasks successfully), special needs, attention deficit such as AD/HD (Attention Deficit/Hyper-Activity Disorder), autism, or Asperger syndrome (Amon & Campbell, 2008; Carr & Blanchfield, 2009; Saridaki & Mourlas 2011). Games can be employed to motivate patients to perform rehabilitation exercises (Betker et al., 2007), or inform (and consequently reassure) them about their condition (Kato et al., 2008). Some researchers also found that motivations may vary across players based on their individual differences such as gender, age, personality, and sociocultural background; as a result, personalized or customized mechanisms ought to be included in video games for successful motivational outcomes. This was the case for Marty & Carron (2011) and Virvou et al. (2005), who combined a tutoring system that adapted to users' knowledge and behaviour with a Game-Based Learning environment. These experiments showed that adaptive mechanisms in GBL can significantly increase students' motivation to learn. In a similar study, Deen & Shouten (2011) have developed a game-based system that adapts to users' preferences or "internal regulations", and they found that students felt less forced to learn English after they played an educational video game that satisfied their need for autonomy and relatedness.

3.4. Factors that improve motivation to learn in video games

As noted by Wilson et al. (2009), very few studies have managed to identify which factors affect learning outcomes in video games, and to which extent. However, several scholars such as Wishart (1990), Oxland (2004), or Staalduin (2011) have managed to identify some of the factors that may influence involvement and learning in video games. These aspects include control, challenge, complexity, achievable and clear goals, hidden secrets, adaptation, debriefing, conflict, fantasy, mystery, and safety. The narrative aspect of video games also plays an important role in increasing students' involvement, as demonstrated by Waraich (2004). Evidence has also shown that the use of multimodal interaction and multi-sensory cues may successfully engage learners, enable them to adapt the interaction to their own style, and help them to understand phenomena by providing new perspectives and quantitative representations (Salzman et al., 1996).

3.5. Improving attainment through motivation

As mentioned in the previous sections, although scientific evidence proves that video games do motivate to learn, it should be emphasized that motivation to learn is not always sufficient to increase both knowledge and academic results. The literature shows that several features should be considered for this purpose. Effective GBL approaches should include briefing, debriefing, game objectives linked to the curriculum, progression in the game linked to the students' proficiency in the topic taught, and an effective feedback

1 <http://www.darfurisdying.com>

2 <http://www.globalconflicts.eu>

process that identifies areas of misconceptions and provides remedial actions accordingly.

Because self-efficacy and confidence play an important role in attainments (and may be increased by playing video games), it is essential that students, after playing the video game, feel more knowledgeable or more able to grasp concepts that they perceived as complicated or too abstract beforehand.

4. Summary

Video games seem to unanimously motivate participants to collaborate and exchange information, thus promoting a social-learning perspective. This approach seems to be particularly effective in the context of inquiry-based learning, where participants are encouraged to elaborate, test and revise hypotheses, based on their finding in the game. The game in this case acts as a platform where exploration, observation, and deductions are key to successful learning.

Games constitute a truly motivating and engaging medium that can effectively be used to motivate students for a wide range of topics. Contributing factors to motivational outcomes are both linked to (1) the design of the game, (2) the medium employed to deploy the game, and (3) the environmental scaffoldings (e.g., teachers' help). In most cases, successful games include clear goals, rules, multi-sensory cues, narratives, and a good balance between the educational and entertaining features. Increased motivation is often experienced when teachers are actively involved in the introduction and use of the game, and evidence shows that video games are particularly effective for scientific inquiry.

5. Method for answering the question

Searches were conducted using a combination of academic search engines, academic journals, and books. Publication containing evidence were peer-reviewed, and published between 2005 and 2011 in English. Whilst the ebsco database was initially employed for the search, it did not seem to include some recent scientific publications pivotal in the understanding of motivation and learning in digital games. As a result the research was extended to additional academic sources including peer-reviewed journals and books on game-based learning.

While the focus of the literature review was on academic publication between 2005 and 2011, it was in some cases necessary to include earlier work, especially to provide a theoretical perspective on learning and motivation in video games.

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