The adoption and the effectiveness of game-based learning depend largely on the acceptance by classroom teachers, as they can be considered the true change agents of the schools. Therefore, we need to understand teachers' perceptions and beliefs that underlie their decision-making processes. The present study focuses on the factors that influence the acceptance of commercial video games as learning tools in the classroom. A model for describing the acceptance and predicting the uptake of commercial games by secondary school teachers is suggested. Based on data gathered from 505 teachers, the model is tested and evaluated. The results are
1. Introduction

Even though the use of video games in education has been studied for a couple of decades (see Wu et al., 2012 for an overview of literature reviews and meta-analyses), it regained a lot of academic attention in the early 2000s (Kebritchi and Hirumi, 2008). Based on the seminal work of – among others – Papert (1980), Lepper and Malone (1987), and Rieber (1996), new media and literacy scholars have linked video gaming to dominant learning theories and cognitive science (Garris, Ahlers & Driskell, 2002; Gee, 2003). Since then, the relation between games and learning has been studied from different perspectives; focusing either on the informal learning that occurs during play (e.g. Steinkuehler, 2005; Williams, 2006) or on the integration of games in formal education. The research on using games for formal learning centers on three different approaches (Van Eck, 2006): (a) using commercial games such as Civilization, The Sims or RollerCoaster Tycoon (Squire, 2004; Sandford, Ulicsak, Facer and Rudd, 2006; Miller & Hegelheimer, 2006; Egenfeldt-Nielsen, 2007), (b) using serious games, games for learning and multi-user virtual environments (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Ketelhut & Schifter, 2011; Kebritchi, Hirumi and Bai, 2008; Ke, 2008), and (c) designing games with the students (Kafai, 1995; Robertson, 2012). As Van Eck (2006) identified the use of commercial games as the most suitable approach in the implementation of digital game-based learning, the present study focuses on the first approach: using commercial video games as learning tools in the classroom.

Indeed, a lot of positive claims have been made about the educational potential of and learning opportunities provided by commercial games, such as increased motivation, raised interest in specific subjects, multiple representations, open-ended approach to information, students in control of their own learning processes, and peer collaboration (for an extensive overview of these claims, see. Egenfeldt-Nielsen, 2007, p. 84). But despite this plethora of theoretical claims, research has been rather slow to provide hard empirical evidence (Hays, 2005; Papastergiou, 2009; Wrzesien & Alcañiz Raya, 2010). A notable exception is the recently published meta-analysis by Connolly et al. (2012). Based on a study of 129 papers, the authors found evidence for all learning and behavioral outcomes, including “knowledge acquisition, perceptual and cognitive, behavioural, affective, motivational, physiological and social outcomes, but with the exception of soft skills” (p. 671). Surprisingly, while they also found more papers addressing commercial games in education than games for learning, they considered it a challenge to identify empirical papers in which explicit use of commercial games was described. If it is indeed true that entertainment video games offer such promising opportunities for learning and teaching, an important question then becomes: Why are commercial games still underutilized in practice?

Research has already partially answered this question, by showing that the adoption (Bakar, Inal, & Cagiltay, 2006; Din & Caleo, 2000) and the effectiveness (Back, 2008; Egenfeldt-Nielsen, 2007) of game-based learning depend largely on the acceptance by classroom teachers, which is in line with findings in the broader field of information technology integration and implementation (Albirini, 2006; Ghaith & Yaghi, 1997; Kao & Tsai, 2009): how teachers perceive and think about the educational use of new technologies appears to be central to its integration (Usluel, Askar, & Bas, 2008). In fact, as the success of any technology integration project in schools is closely linked to teachers’ perceived values, teachers can be considered the true change agents of the schools (Teo, 2008). Consequently, it has been suggested that we need to understand teachers’ perceptions and beliefs that underlie their decision-making processes (Kriek & Stols, 2010).
This paper tries to contribute to the analytical understanding of teachers’ decision-making processes. However, the goal of this paper is not so much to promote the use of commercial video games in education in se, but rather to understand, explain and predict changes in teachers’ behavior in view of adopting these tools (see also Compeau, Higgins, & Huff, 1999). To obtain those goals, a careful research design is set up. Firstly, previously validated scales are used to measure teachers’ acceptance beliefs. Secondly, as there are many inconsistencies within the literature regarding teachers’ acceptance of game-based learning, special attention was paid to the careful collection of data, in order to avoid any type of bias and increase the generalizability of the results. Thirdly, a model-based approach to teachers’ beliefs is presented and evaluated, based on the understanding that “teachers are faced with many variables that interact with each other to either facilitate or discourage the acceptance of technology” (Teo, 2009). Thus, this study contributes to an established body of research that has examined general reasons for playing video games (Ryan, Rigby, & Przybylski, 2006), the play behavior of teachers and teachers-in-training (Jones, Copeland, & Kalinowski, 2007; Kenny & McDaniel, 2011); and teachers’ acceptance of educational computer games (Ketelhut & Schifter, 2011).

2. Literature study

2.1 Teachers’ acceptance of technology

The question of the limited uptake of technology has troubled many researchers from a variety of backgrounds. In fact, there is a whole body of research dedicated to the discrepancy between the advances in hardware and software capabilities and the lack of implementation (Venkatesh & Davis, 2000). Within this research tradition, the measurement of potential adopters’ perceptions of innovations is considered a “classic issue” (Moore and Benbasat, 2001). In education as well, concerns are raised about the “peripheral and minimal” uptake of computers in classrooms and the ineffective use of technology by teachers (Teo, 2009, p. 302).

Cuban (1986) pointed out that many top-down attempts to integrate technology in education have failed to impose a long-term effect on teaching and learning, in part because they ignored the perceptions of teachers. Albrini (2006) concurs, stating that technology implementation plans are focused too much on the technology and its effect on students’ achievement. This is a crucial mistake, because teachers are considered by many as the true change agents of the schools in educational change (e.g. Van Driel, Verloop, Van Werven, & Dekkers, 1997; Fullan, 2001; Usluel, Askar, & Bas, 2008; Teo, 2008).

However, educational research has caught up by studying the applicability of research models that originated in behavioral theory and information system research (Kiraz & Ozdemir, 2006). These models allow examining and predicting the actions of teachers. According to a recent meta-analysis on e-learning acceptance (Sumak, Hericko, & Pusnik, 2011), the most popular theory among these models is the technology acceptance model (TAM, Davis, 1989). This TAM model was developed based on the assumption that the acceptance of any technology can be predicted by (a) the perceived usefulness, and (b) the ease of use. In addition, it hypothesizes a direct relationship between these two user beliefs; according to TAM, people will consider a technology to be more useful when it is easier to operate. This of course shows close resemblances to educational research arguing that teachers will not use technology in the classroom, unless they understand how it will help their current practice by offering either administrative or teaching advantages (Hord et all, 1987; Schifter, 2008).
The problem with TAM-research is that the findings have been rather inconsistent (Legris et al., 2003; Mathieson, Peacock, & Chin, 2001). Two explanations have been recurrent in the literature. Firstly, the effect sizes of the different paths in the model appear to vary depending on the types of users and the type of technology, especially in educational settings (Sumak et al., 2011). Not only inconsistencies were found between students and teachers, but the acceptance process also appears to be different when studying educational technologies instead of more office oriented tools (Sumak et al., 2011, p. 2076). Secondly, a major problem of the traditional technology acceptance model is its inability to account for individual, organizational, and contextual characteristics (Mathieson, 1991; McFarland & Hamilton, 2006).

In the context of game-based learning, Bourgonjon et al. (2010) have tried to overcome these problems when studying students’ acceptance of game-based learning using TAM-hypotheses by including technology-, user-, and context-specific antecedents such as learning opportunities, experience, and gender to the model. By attributing these additional concepts, their video games acceptance model was able to explain 63% of the variance in students’ preference for video games in the classroom. But while the goal of the present paper is similar, we do not aim at a straightforward replication of the student-based study. After all, based on the earlier discussion about inconsistent findings in TAM-research, the relationships between factors and the effect sizes are expected to be quite different for teachers than for students. As there is need for a grounded theoretical teacher-oriented model to describe and explain the adoption of digital game-based learning, it is important to examine the available literature on teachers’ acceptance of games first. This will provide evidence-based insight in the crucial factors affecting game-based learning acceptance.

2.2 Teachers’ acceptance of video games

Over the last ten years, teachers’ perceptions about the use of digital games in the classroom have been studied mainly in two ways. Firstly, in questionnaire research both the willingness of the teachers to try out games and the different factors contributing to the acceptance or refutation of game-based learning have been addressed (Becker and Jacobson, 2005; Schrader, Zheng and Young, 2006; Can and Cagiltay, 2006; Baek, 2008; Pastore and Falvo, 2010). Often, these research studies also elaborate on the gaming history of teachers: How familiar are teachers with games? Does game experience affect their beliefs? Secondly, researchers have confronted teachers with different types of games in quasi-experimental studies, describing what happens to their perceptions and attitudes about games in general and game-based learning in particular (Bakar, Inal and Cagiltay, 2006; Barbour and Evans, 2009; Kenny and McDaniel, 2011; Kennedy-Clark, 2011; Ketelhut and Schifter, 2011). In this section of the article, examples both types of research are examined specifically for identifying important factors that can enrich and contextualize a TAM-based model for studying teachers’ acceptance of commercial games in the classroom.

2.2.1 Cross-Sectional Questionnaire Studies

Becker and Jacobsen (2005) surveyed K-12 teachers about the use of games in the classroom. The general goals of their research were to identify teachers who implement games and to explore whether a correlation exists between teachers’ self-efficacy in dealing with new technologies and the use of games in the classroom. Surprisingly, the authors could not confirm the latter. They did find,
however, that 37.5% of the teachers have had experience with playing games in their spare time (less than 5 hours a week) and that an almost equally large group of teachers (36.7%) were willing to try out a commercial off-the-shelf game in their teaching practice. While these figures might appear quite high, the authors argue that they fall within the range that is to be expected in this age cohort based on previous research. Nevertheless, these results should be regarded with caution, as they do not differentiate between teachers’ intentions to use games as a reward system or as a pedagogical tool (Schrader, Zheng, & Young, 2006), and because the results also show that at the same time 35.7% of the teachers are not willing to use commercial games in the classroom. Another important finding in the study by Becker and Jacobson (2005) is that students and nearby colleagues are enlisted by teachers among the major facilitators for game-based learning together with the teachers themselves and professional development initiatives, while lack of time and technical issues are perceived as the most important barriers toward the use of games in education.

Schrader, Zheng and Young (2006) performed a similar study, surveying a convenience sample of 203 undergraduate students in pre-service and credential programs in three different universities. In respect to gaming experience, the authors found that the majority of the teachers-in-training had played games (76.4%), most of them even playing on a weekly basis. But despite the considerable amount of time spent playing games, only 36% own a contemporary gaming console, and nine out of ten reported not to belong to a gaming community. In addition, the teachers report having very little experience with educational games. Nevertheless, the teachers could see different qualities in each type of games, enlisting first-person shooter characteristics more often than cognitive skills such as problem-solving, clear rules, authenticity, and feedback to describe commercial games and vice versa for educational games. Further, Schrader, Zheng and Young (2006) found evidence that experience with video games affects teachers’ perceptions about games in culture and education.

In a Turkish context, Can and Cagiltay (2006) confronted prospective information technology teachers with positive and negative statements about “computer games with educational features.” Given this conceptualization, which comprises both educational games and commercial games that could potentially have a positive effect on students’ learning or development, it comes as no surprise that the majority of the teachers supported the idea that these games can exhibit cognitive and affective learning opportunities. More than 80% of the prospective teachers even expressed the intention to use games in their future practice, although mostly as additional learning material or as a reward, and less as the primary teaching tool. Can and Cagiltay (2006) also clarify that some of the participants are concerned about classroom management issues and the learning opportunities of the available games.

In his study involving 444 Korean teachers, Baek (2008) identified six more barriers that hinder the uptake of games: inflexibility of the curriculum, negative effects of gaming, students’ unreadiness, the lack of supportive materials, fixed class schedules and limited budgets. Baek (2008) also found that both gender and teaching experience affect the type of limitations teachers consider when they think about using games in the classroom.

In a more recent survey among pre- and in-service teachers by Pastore and Falvo (2010), the relatively wide support for the idea that games can enhance learning and motivate students was confirmed, as the authors found that about 50% of the teachers either have used or intend to use games in their practice. Both groups of teachers described games as fun, motivating and ‘the future’. Indeed, the majority of the teachers were under the impression that the adoption rate of game-based learning will continue to speed up in the next couple of years. This belief was supported more broadly by the in-service teachers than by the pre-service teachers.
2.2.2 Quasi-Experimental Studies

Bakar, Inal and Cagiltay (2006) confronted teachers-in-training with three types of commercial games in the teacher training programme: The Incredible Machine, Age of Empires and Quake. These can be described as a puzzle game, a strategy game, and a first person shooter respectively. Their goal was to explore whether teachers could discover learning opportunities in each of these games. After a brief hands-on introduction, 49 student teachers were asked to write a report on how to use games in the classroom, their preferred type of games for learning, the opportunities and threats, and the difference between single and multiplayer games. The results showed that teachers were very concerned with selecting the right games for the right classroom and curriculum context, even suggesting that inappropriate games might be counter-productive. While there were gender differences concerning the teachers’ preferences, in general the students preferred The Incredible Machine as a teaching tool. Apparently, the clear puzzle elements and lack of violence override the pre-service teachers’ beliefs that multiplayer games offer better learning opportunities than single player games.

In a comparable study performed by Barbour and Evans (2009), pre-service teachers were asked to play a video game in the social science classroom. The students had to keep a video game journal in which they discussed their gaming experiences and answered questions derived from game-based learning literature. Seven themes emerged from the journal data: game preference, educational value, learning and gameplay, the characteristics of both good and bad games, game components, and gender issues. Most importantly, the study showed that pre-service teachers were able to see the merits of commercial games for social studies, but that they also were uncertain whether and how they could use these advantages in their future practice.

Additionally, Kenny and McDaniel (2011) had 58 undergraduate pre-service teachers play the Tiger Woods PGA Tour 07 golf game on either a Nintendo Wii or an Xbox 360. The pretest–posttest quasi-experimental research design allowed them to examine whether easier game mechanics could change the students’ perceptions about games and their use in education. From the pre-test it became clear that only a strong minority played video games on a regular basis, in fact only 17% of the teachers appeared to be “very familiar” with video games. This lack of experience can perhaps explain that most of the pre-service teachers acknowledged that they consider video games too complicated. After the test, however, they reported that the Wii version was more pleasurable, which indicates that ease of use did affect the students’ perceptions of the game. But nevertheless, this did not have an impact on their beliefs about the relevance of games in general.

Kennedy-Clark (2011) studied the current knowledge of and attitudes about the use of multi-user virtual environments (MUVEs) in secondary education inquiry learning among 28 pre-service teachers. Using the theory of planned behavior (Ajzen, 1985) as a guiding framework, Kennedy-Clark (2011) interviewed teachers in order to map their knowledge of virtual worlds, their current behavior and attitudes toward using game-like environments in the classroom. Specifically, his analysis tried to elicit the behavioral beliefs (attitudes toward the outcome of game-based learning), normative beliefs (social norms and pressure to use games) and control beliefs (ease or difficulty to use games). Kennedy-Clark (2011) found that most pre-service teachers only had a basic understanding of what virtual worlds are. Nevertheless, the pre-service teachers held positive behavioral beliefs toward the educational value of virtual worlds. The most cited advantages were the ability to visualize, to
motivate students and to put the learner back at the center of education. And despite the concerns that students can get off track while playing, 71.4% of the pre-service teachers indicated that they intend to use the MUVE in the future.

Ketelhut and Schifter (2011) also analyzed responses to the use of the MUVE River City, but their study focused on in-service teachers in K-12 education. By mapping the teachers’ acceptance of game-based learning against two renowned acceptance theories (Fullan, 2001; Schifter, 2008), the authors examined the explanatory power of both theories. In addition, they were very attentive to different ways in which teachers could be supported throughout the project. Based on a qualitative analysis on their data, they found that Fullan’s (2001) interactive factors for educational change, namely characteristics of the change, local characteristics and external factors, were able to explain the success and failure of the cases, but only to a limited extent. What is lacking from Fullan’s theory are “more subtle issues of efficacy in using technology” (Ketelhut & Schifter, 2011, p. 544), which relates in part to Schifter’s (2008) model of technology integration. The authors conclude that teachers’ feeling of efficacy in using games is at the center of the implementation process, which indicates the need for carefully designed and ongoing teaching, technical and peer support for teachers.

2.2.3 Conclusion

A close reading of these studies presented in this section reveals a number of key issues that affect teachers’ acceptance of games as educational tools. Most importantly, how relevant teachers consider video games to be for their educational practice appears to be a crucial factor for change (Hord et al., 1987; Schifter, 2008; Can & Cagiltay, 2006; Bakar, Inal & Cagiltay, 2006; Barbour & Evans, 2009). Thus, it could be argued that both usefulness and learning opportunities should be accounted for in a model that aims to describe and predict the uptake of commercial games by secondary school teachers. Such a model should also address teachers’ concerns about the complexity to use games in the classroom, although its relation to the other elements remains unclear (Kenny & McDaniel, 2011; Kennedy-Clark, 2011). Another topic that emerged from the literature was the experience of teachers with games in their spare time (Schrader, Zheng & Young, 2006; Barbour & Evans, 2009; Kenny & McDaniel, 2011), which is closely linked to the discussion about whether teachers differ from other people in their age cohorts on the level of innovativeness. In addition, elements in the social environments of the teachers should be considered, as it was shown that students and colleagues could be considered facilitators for game-based learning (Becker & Jacobson, 2005; Pastore & Falvo, 2010; Kennedy-Clark, 2011).

In the next section of this article, a TAM-based model for describing and predicting the uptake of commercial games by secondary school teachers will be suggested based on these findings, and in order to consider the directions of the relations between the factors, also on a further exploration of behavioral theory and information systems research.

3. Hypothetical model

3.1 Technology acceptance model (TAM)

In this research, acceptance of game-based learning is operationalized as teachers’ behavioral intention to use video games. The reason is twofold. Firstly, rather than actual use, behavioral
intention is selected as dependent variable in most previously mentioned studies on teacher acceptance of technology. Secondly, a pre-test showed that game-based learning was still new to most teachers in Flanders (e.g., De Backer, 2009). From a pragmatic perspective, the selection of behavioral intention as the dependent variable is therefore an obvious choice (Hu, Clark, & Ma, 2003).

Less common was the decision to rephrase the concept of “ease of use”. In an exploratory study conducting focus groups with teachers about the use of games in education, it was observed that teachers talk about video games in terms of how difficult it would be to implement them, rather than in terms of ease of use (Eloot, 2010). Similarly, Ketelhut and Schifter (2011) also report that teachers in the River City project are often anxious to break the game or do something wrong. Therefore, in this study we opted to use the construct of complexity (Rogers & Shoemaker, 1971; Thompson, Higgins, & Howell, 1991), rather than ease of use (Davis, 1989) to measure the concerns of the teachers regarding the difficulty of using games in their practice. Venkatesh et al. (2003) have pointed out that there is substantial similarity between both constructs. Whereas ease of use is defined as “the degree to which a person believes that using a particular system would be free from effort” (Davis, 1989, p. 985), complexity can be considered as “the degree to which a system is perceived as relatively difficult to understand and use” (Rogers and Shoemaker, 1971, p. 154) or, in other words, “the opposite of ease of use” (Thompson et al., 1991, p. 129).

An important remark concerning the hypothesis that complexity/ease of use affects teachers’ behavioral intention, is that the meta-analysis of Sumak et al. (2011) could not trace any previously published article in which this hypothesis was studied using professors/teachers as subjects (p. 2072).

Hyp. 1: Usefulness (U) positively affects behavioral intention (BI).
Hyp. 2: Complexity (C) negatively affects behavioral intention (BI).
Hyp. 3: Complexity (C) negatively affects usefulness (U).

3.2 Additional hypotheses

3.2.1 Experience

An interesting concept that potentially affects teachers’ acceptance of game-based learning is experience. In the field of information systems research, Thompson, Higgins, and Howell (1994) have shown that prior experience can potentially influence technology acceptance in three ways: (1) directly, (2) indirectly through attitude and belief components, and (3) by exerting a moderating influence on the relations between antecedent constructs and intention. These relations are found and confirmed in educational research as well, as computer experience appears to be a valuable predictor of computer attitudes (Potosky & Bobko, 2001; Rozell & Gardner, 1999; van Braak, Tondeur, & Valcke, 2004).

Within the field of game-based learning, it is often claimed that teachers’ lack of video game experience is problematic as it supposedly creates a divide between the teachers and their tech-savvy students. In this respect, authors like Prensky (2001), Becker and Jacobson (2005) argue that experience with playing games, increases teachers’ willingness to use games in their classrooms. However, not all game researchers agree that the relationship is necessarily positive (Schrader et al., 2006; Selfe & Hawisher, 2007). Authors have expressed their concerns that teachers’ personal experiences could affect their adoption decision negatively. For instance, teachers could use games
inefficiently (e.g. playing games as a reward), or not at all (e.g. because of the violence in the game play). In other words, the literature is inconclusive. However, Bourgonjon et al. (2011) found that parents – a user group that shares a common goal with teachers – who play video games more often in their spare time, score higher on a video game acceptance scale. In order to provide more clarity about the impact of experience, this variable was included in our research model.

Hyp. 4: Video game experience (Experience) positively affects usefulness (U).
Hyp. 5: Video game experience (Experience) positively affects complexity (C).
Hyp. 6: Video game experience (Experience) positively affects behavioral intention (BI).

3.2.2 Learning opportunities (LO)

The technology acceptance model has its origins in (research in) business and commercial settings where the objectives are different as compared to the goals in education (Hu et al., 2003; Teo, Lee, & Chai, 2008; Wolski & Jackson, 1999). Therefore, it appears that the original TAM variables do not fully reflect educators’ motives (Sánchez-Franco, Martínez-López, & Martín-Velicia, 2009). The concept of usefulness, for example, focuses on job performance, rather than the process of learning. As Schifter (2008) has argued, technologies will only be used when teachers believe that it can help them reach curriculum goals, it is important to address these issues as well. In this respect, Bourgonjon et al. (2010) introduced the construct of perceived learning opportunities (LO), which examines whether users share the belief expressed by experts that video games can indeed be considered operational translations of contemporary educational theories. This construct reflects teachers’ views on a number of advantages and benefits as identified in previous research (Egenfeldt-Nielsen, 2007; Kennedy-Clark, 2011). It can be hypothesized that teachers believe that video games are more useful for education when they perceive video games as tools that offer learning opportunities (see also Bourgonjon et al., 2010).

In addition, it is to be expected that learning opportunities could successfully be predicted based on the amount of experience the teachers have with playing games. This is in line with the assumptions presented earlier (3.2.1 Experience; Howell, 1994), and with the findings of Bourgonjon et al. (2010). However, the latter study examined the beliefs of students, rather than teachers. Nevertheless, it can be hypothesized that experience will indeed affect learning opportunities.

Hyp. 7: Video game experience (Experience) positively affects learning opportunities (LO).
Hyp. 8: Learning opportunities (LO) positively affects usefulness (U).

3.2.3 Personal innovativeness in the domain of information technology (PIIT)

According to Rogers (1995), the rate at which an innovation is adopted depends on the personality traits of the group members. To account for this personality trait in model-based innovation acceptance testing, Agarwal and Prasad (1998) developed and validated the construct of personal innovativeness in the domain of information technology (PIIT). It has been defined as “the willingness of an individual to try out any new information technology” (Agarwal & Prasad, 1998, p. 206) or as “a form of openness to change” (van Raaij & Schepers, 2008, p. 841). Previous research has shown that personal innovativeness in the domain of information technology can be considered an important factor in technology acceptance, not just in general (Lewis, Agarwal, & Sambamurthy,
2003), but also for studying teachers’ acceptance of learning management systems (De Smet, Bourgonjon, De Wever, Schellens, & Valcke, 2011) and parents’ preference for using video games in their children’s classrooms (Bourgonjon et al., 2011). Given the nature of video gaming as an activity constantly pushing the boundaries of computer hardware (Jenkins, 2005), it is to be expected that innovativeness will play an important role in the adoption process by teachers.

Hyp. 9: Personal innovativeness in the domain of IT (PIIT) positively affects video game experience (Experience).
Hyp. 10: Personal innovativeness in the domain of IT (PIIT) positively affects usefulness (U).
Hyp. 11: Personal innovativeness in the domain of IT (PIIT) negatively affects complexity (C).

3.2.4 Subjective norm (SN)

Davis’ technology acceptance model (1989) is based on the theory of reasoned action (TRA, Fishbein & Ajzen, 1975). One of the concepts of TRA that was not incorporated into TAM was social influence. However, because of the empirical support and the inclusion of subjective norm in the TAM2 model, it was later reinstated as a “core construct” (Sun & Zhang, 2006; Venkatesh et al., 2003), especially in the domain of education (Wolski & Jackson, 1999). As teachers exhibit close bonds with their colleagues, it is to be expected that they will turn to their peers for advice and suggestions regarding the usefulness when they are confronted with a new type of technology that could potentially serve as a new teaching tool (Hu et al., 2003; Triandis, 1971; Venkatesh & Davis, 2000).

Specifically in the context of game-based learning, there is evidence that subjective norm – the perceived social pressure to use games or not – is an important factor influencing teachers’ beliefs. Firstly, in the study by Becker and Jacobson (2005), teachers enlisted students and other colleagues among the most helpful facilitators for game-based learning. Secondly, Kennedy-Clark (2011) indirectly questioned subjective norm as perceived by pre-service teachers, however their study was not able to provide clarity on this issue because pre-service teachers do not yet experience the social pressure that exists within a school environment.

Subjective norm can affect behavioral intention either directly through compliance with organizational demands, or indirectly through its effect on beliefs because of internalization (Sun & Zhang, 2006, p. 65). Given the voluntary character of game-based learning, it is therefore to be expected that subjective norm will affect behavioral intention only indirectly through usefulness and learning opportunities.

Hyp. 12: Subjective norm (SN) positively affects usefulness (U).
Hyp. 13: Subjective norm (SN) positively affects learning opportunities (LO).

3.2.5 Critical mass (CRIT)

In adoption research, the concept of “critical mass” refers to the idea that adoption rate of technology is often slow until a certain amount of people have accepted and use the technology. It is the tipping point at which the adoption process accelerates (Mahler & Rogers, 1999; Rogers, 1995). Based on Metcalfe’s law, which states that the value of a network is proportional to the square of the
number of users that are connected (Hsu & Lu, 2004), it is believed that the value of a technology increases with the number of its adopters (Mahler & Rogers, 1999). Consequently, critical mass has been studied in relation to the acceptance of groupware systems (Lou, Luo, & Strong, 2000), online games (Hsu & Lu, 2004), and mobile gaming (Kleijnen, 2004).

Of course, digital game-based learning is not necessarily a networked activity, it could be hypothesized that critical mass affects teachers’ belief structure in another manner. An often-heard argument in the digital game-based learning debate is that adoption in education is almost inevitable as today students (and tomorrow’s teachers) are growing up with video games (e.g. Becker & Jacobsen, 2005). It is believed that this generational divide will lead to educational reform as the new generation of students would demand and deserve teaching strategies that are better adapted to their learning preferences (Oblinger & Oblinger, 2005; Prensky, 2001). Empirical research has shown that it is hard to support this type of generational thinking (Bennett, Maton, & Kervin, 2008) and/or the idea that all students desire video games in their classrooms (Bourgonjon et al., 2010). Therefore there is reason to assume that the popular belief of “critical mass” will affect teachers in their choice to use games in their classrooms.

Hyp. 14: Critical mass (CRIT) positively affects video game experience (Experience).
Hyp. 15: Critical mass (CRIT) positively affects learning opportunities (LO).
Hyp. 16: Critical mass (CRIT) positively affects usefulness (U).
Hyp. 17: Critical mass (CRIT) positively affects behavioral intention (BI).

3.2.6 Research model

Fig. 1. depicts the hypothetical model, comprising the interrelations between factors as discussed in the theoretical background.

<-- INSERT FIGURE 1 HERE -->
Fig. 1. Hypothetical model

4. Method

4.1 Research design and participants

In order to improve the (external) validity of this study, the focus is on teachers-in-practice. Secondary schools were contacted based on their denomination (i.e. community/subsidized public schools, and subsidized private schools), type of education (general, technical, and vocational) and geographical distribution. One contact person in each school – the IT administrator or school director – was visited personally to explain the two-fold purpose of the study (the data collection for this study happened in close collaboration with a project on the acceptance of learning management systems). Anonymity was assured. In turn, the contacts distributed both paper questionnaires and the link to an online version among the teaching staff of the school. The teachers could fill in the questionnaires using the medium of their choice. This way, 505 teachers could be involved \((n_{\text{paper}} = 376; n_{\text{online}} = 129)\). All entries were scanned for irregularities. Average teacher age was 40 (ranging from 22 to 61); 42.7%
of the respondents was male, 57.3% was female. Independent sample t-tests showed no significant differences in answer patterns between both versions of the survey.

3.2 Instruments

The questionnaire consisted of three parts, examining demographic information, teacher related variables and the constructs of the research model. Demographic information included variables such as age and gender (0 female – 1 male). The teacher related variables included teaching experience (years), grade, and subject. The latter two questions appeared to be problematic, as most teachers work in different grades, teaching a variety of subjects. Wherever possible, previously validated scales were used. To measure general experience with games and game learning opportunities, scales developed by Bourgonjon et al. (2010) were included. Subjective norm and personal innovativeness in the domain of information technology were measured with the scales from Azjen and Fishbein (1980; 1975) and Agarwal and Prasad (1998) respectively. Behavioral intention was measured with items from Venkatesh et al. (2003). For usefulness, complexity and critical mass, existing scales (Davis, 1989; Thompson et al., 1991) were adapted. Adaptations helped to reflect video game-based learning, the school context and the teacher profession, based on remarks of teachers participating in focus group research. Secondly, the adaptation helped to ground the items in the teachers’ vocabulary. By using adaptations of previously validated measures, we hope to validate and extend available research to new research contexts (see the suggestion of Venkatesh et al., 2003, p. 468). All scale items were rated on a five-point Likert scale (0 totally disagree – 5 totally agree). The scale focusing on teachers’ beliefs about game-based learning was preceded by a one page explanation about “the use of commercial games in education”. This incorporated two case studies (Civilization, RollerCoaster Tycoon) of games used in a classroom setting.

3.3 Instrument validation

To study the psychometric quality of the – adapted - survey instruments, we adopted a combined exploratory (EFA) and confirmatory factor analysis (CFA) approach.

3.3.1 Exploratory factor analysis

For the exploratory factor analysis, principal axis factoring with oblimin rotation was carried out to reconstruct the suggested eight factor structure. All criteria for factor analysis are met: the sample size is adequate, the Kaiser-Mayer-Olkin (KMO) measure of sphericity exceeds the threshold of .60 (KMO = .907), and the Bartlett’s test of sphericity is significant at p < .001 level. In addition, the five factor structure explains 75.37% of the variance among the items – each item loading high on its own, and low on other factors (see Table 1).

<-- INSERT TABLE 1 - Principal Axis Factoring – Oblimin rotation (N = 505) - HERE -->

3.3.2 Confirmatory factor analysis
Confirmatory factor analysis was performed with the open source package Lavaan for R (Rosseel, 2011) to test the factor structure stability and internal consistency. Firstly, the fit measures for the measurement model were calculated to determine the stability of the factor structure. Error terms were not allowed to correlate. However, as the modification indices suggested a refinement of the model, correlation between the error terms for U4 and U5 was deemed acceptable. It was found that all fit measures meet the requirements for satisfactory fit (Byrne, 2001): \( \chi^2/df = 2.16; \) RMSEA = .049; SRMR = .046; CFI = .95; and TLI = .95. In addition, all items did load significantly on the latent factors (ranging from .49 to .97). The low loadings of two items for critical mass were considered unproblematic given the specific nature of this scale: teachers come into contact with video games through rather distinct peers (family members, colleagues…).

3.3.3 Reliability analysis

After both the EFA and CFA, the internal consistency of the scales was examined, based on a reliability analysis on the entire dataset (\( N = 505 \)). It was found that all scales demonstrate a high level of internal reliability, as all Chronbach’s alpha coefficients exceed the common threshold of .70 (Hair, Anderson, Tatham, & Black, 1998): behavioral intention (alpha > .91), experience (alpha > .84), learning opportunities (alpha > .92), usefulness (alpha > .94), complexity (alpha > .88), personal innovativeness in the domain of information technology (alpha > .90), critical mass (alpha > .70) and subjective norm (alpha > .95).

Based on these findings, it was concluded that the instruments can be considered reliable and valid. The descriptive statistics can be consulted in Table 2.

4. Results

4.1 Correlations

As indicated in Table 3 - depicting the Pearson product-movement correlation coefficients - most research variables are positively related. A notable exception is complexity, which relates negatively to personal innovativeness (\( r = -.385, p < .01 \)), behavioral intention (\( r = -.100, p < .05 \)), critical mass (\( r = -.126, p < .01 \)), experience (\( r = -.243, p < .01 \)) and learning opportunities (\( r = -.110, p < .05 \)). While this negative relation was expected, considering the literature, the interrelations appear to be rather weak.

High interrelations were found among behavioral intention, learning opportunities, and usefulness. Because the preceding factor analysis confirmed that these scales represent distinct constructs, it follows that a high score on usefulness is related to a high score on learning opportunities (\( r = .714, p < .01 \)) and behavioral intention (\( r = .703, p < .01 \)) (and vice versa). The same remark can be made about the relationship between usefulness and social norm (\( r = .539, p < .01 \)). When examining the significance levels of the correlation coefficients, it becomes clear that most of the research hypotheses can be confirmed. However, no relationship is found between complexity and usefulness (\( r = -.084, n.s. \)). In addition, the strength of the interrelation between variables is not always
as expected, as a number of hypotheses are only supported by low to moderate Pearson correlation coefficients (e.g. Hyp. 7, experience and learning opportunities, $r = .209, p < .01$; Hyp. 10, personal innovativeness and usefulness, $r = .144, p < .01$; Hyp. 15, critical norm and learning opportunities, $r = .269, p < .01$; Hyp. 16, critical norm and usefulness, $r = .331, p < .01$).

While these results provide preliminary insight into the relationships between the variables, bivariate correlation measures do not provide sufficient information to make final conclusions about the research hypotheses. Structural equation modeling is a more adequate approach to examine the interconnections between variables as elements of a complex research model.

4.2 Structural Equation Modeling

Structural Equation Modeling was conducted using the open source Lavaan library in R (Rosseel, 2011). Based on the analysis of the goodness-of-fit indices (Table 4), it was concluded that the data fit the hypothesized model reasonably well. The model is presented in Fig. 2, which includes the path coefficients and the percentage of explained variance for the dependent variables.

As expected based on the TAM theory, usefulness affects behavioral intention very strongly (Hyp. 1, $\beta = .66, p < .01$). However, the effect of complexity on both behavioral intention (Hyp. 2, $\beta = .00$, n.s.) as well as usefulness (Hyp. 3, $\beta = .00$, n.s.) appeared to be statistically insignificant. In contrast, learning opportunities appears to predict usefulness very well (Hyp. 8, $\beta = .58, p < .01$).

A remarkable finding is that experience does not affect usefulness (Hyp. 4, $\beta = .04$, n.s.), behavioral intention (Hyp. 6, $\beta = .06$, n.s.) and learning opportunities (Hyp. 7, $\beta = .02$, n.s.), and while it does influence complexity, the relation is rather weak (Hyp. 5, $\beta = -.11, p < .05$).

All hypotheses concerning personal innovativeness could be confirmed. Firstly, it was found that personal innovativeness is a good predictor for experience (Hyp. 9, $\beta = .21, p < .01$). Secondly, it also had a profound negative effect on complexity (Hyp. 11, $\beta = -.42, p < .01$). Thirdly, although the relation between personal innovativeness and usefulness appeared to be rather weak (Hyp. 10, $\beta = .08$), it was found to be statistically significant ($p < .05$).

Stronger effects were found when examining the path coefficients from subjective norm on usefulness (Hyp. 12, $\beta = .30, p < .01$) and on learning opportunities (Hyp. 13, $\beta = .40, p < .01$). Critical mass as well emerges as a crucial variable in the model, as all hypotheses including critical mass were confirmed. Most notably, critical mass’s effect on experience is very strong (Hyp. 14, $\beta = .51, p < .01$), but the other relations – on learning opportunities, usefulness and behavioral intention respectively - were also found to be statistically significant (Hyp. 15, $\beta = .23, p < .01$; Hyp. 16, $\beta = .16, p < .01$, Hyp. 17, $\beta = .16, p < .01$).

The model is able to explain 56.4% of the variance in teachers’ behavioral intention to use commercial video games in the classroom.

<-- INSERT TABLE 4 - Fit indices for the full model based on the $N = 505$ Sample (used $N = 480$) -->

HERE -->
An examination of the path coefficients shows that both experience and complexity’s share in the explanation of behavioral intention is extremely low and statistically insignificant. This was to be expected, given the Pearson product-movement correlation coefficients. For matters of parsimony, the model was therefore adapted by removing all references to experience and complexity. The choice for eliminating both variables from the model is legitimized from an empirical perspective on the one hand, and because of the already ongoing debate about the role of ease of use / complexity in educational settings on the other hand. Goodness-of-fit indices were calculated for the parsimonious model (χ²/df = 2.15; RMSEA = .049; SRMR = .041; CFI = .97; and TLI = .96) and compared to the previous findings. Given the increase to 57.1% of explained variance in behavioral intention, and the slight improvement of the fit indices (Table 5), the parsimonious model could be retained. This model can be consulted in Fig. 3.

The parsimonious model includes two direct predictors for behavioral intention: usefulness (β = .64, p < .01) and critical mass (β = .22, p < .01). In addition, it provides a clear perspective on the different predictors for usefulness and learning opportunities. Firstly, learning opportunities affects usefulness very strongly (β = .58, p < .01). Secondly, subjective norm and critical mass predict usefulness moderately well (β = .29, p < .01 and β = .14, p < .01 respectively). Thirdly, personal innovativeness has a rather weak but significant effect on usefulness (β = .07, p < .05). In turn, learning opportunities is predicted well by both critical mass (β = .26, p < .01) and subjective norm (β = .39, p < .01).

5. Discussion and conclusion

In this section of the article, both the descriptive results as well as the model tests are discussed in relation to earlier research. Similarities and differences are identified, and potential explanations are considered.

5.1 Descriptive statistics

The descriptive statistics show that the teachers in this study hardly have any experience with video games (M = 1.68, SD = .84), which is similar to earlier findings about teachers (Kenny & McDaniel, 2011; Sandford, Ulicsak, Facer, & Rudd, 2006) and adults (cfr. parents, see Bourgonjon et al., 2011). The latter contradicts “anecdotal” beliefs that significantly fewer teachers play video games as compared to adults in general (Becker & Jacobsen, 2005; Shaffer, Squire, & Gee, 2005).

Concerning the merits of video gaming, teachers’ beliefs are rather complex. On the one hand, teachers are not really convinced that video games are very useful for enhancing their job performance...
(M = 2.48, SD = .92). On the other hand, the teachers believe that video games provide opportunities for learning (M = 3.33, SD = .76), in a similar way teachers perceive the merits of ICT in the classroom (Balanskat, Blamire, & Kefala, 2006; Kennedy-Clark, 2011). In other words, while the majority of the teachers under study do not perceive commercial video games as a waste of time as was found in earlier research (Becker, 2001; Virvou et al., 2005), they do not perceive video games as tools that can help them improve their job performance. Moreover, apparently, neither do their significant others, as the mean score for subjective norm is below average (M = 2.25; SD = 0.89).

Also surprising, a relatively low score was found concerning the complexity of using games in the classroom (M = 2.93, SD = .92). A potential explanation is that teachers’ frame of reference is limited to games like Pacman and Tetris, which are not as complex as some of contemporary commercial video games. Another explanation is that teachers were thinking about specific strongly marketed console (games), such as the Nintendo Wii. It has been shown that these types of consoles have the potential for reducing or increasing the perceived complexity of games (Kenny & McDaniel, 2011).

Based on the examination of the descriptive statistics, it also appears that on average teachers do not intend to use video games in the near future (M = 2.73, SD = 1.07). This is comparable to what Sandford et al. (2006) found in the United Kingdom. However, it is much lower than what the preservice teachers reported in the Kennedy-Clark (2011) study. Of course, (the choice of) the type of games in both studies (commercial games versus game-like environments) will have contributed to this difference. In order to explain the variance in behavioral intention, and to clarify the interrelation between variables, model tests are performed in a next step.

5.2 Model testing

The SEM-test results indicate that the model for studying video game acceptance by teachers fits the data rather well. The model was used at an earlier stage to study educational video game acceptance by students (see Bourgonjon et al., 2010). It is not surprising that the study of the model involving teachers, results in differences. In particular, not all hypotheses could be confirmed. While usefulness emerges as the strongest predictors for teachers’ behavioral intention to use video games in the classroom, complexity did not yield a significant effect on behavioral intention. This not only contradicts the traditional TAM (Davis, 1989) hypotheses, but also the widespread idea that complexity is one of the main adoption barriers.

Furthermore, it appears that complexity and also experience with playing commercial video games is not a good predictor for behavioral intention, both directly and indirectly through the other antecedents. This is remarkable, as Becker and Jacobsen (2005) assumed it to be reasonable that an increase of teachers’ willingness to play games would have an effect on the integration in the classroom. It also contradicts the findings of Kenny and McDaniel (2011) and Fortugno and Zimmerman (2005) that familiarity with video games is an important factor in relation to the perceived usefulness for classroom use. The incongruence between this study and the available literature on video game acceptance could potentially be attributed to the current adoption phase of digital game-based learning. The descriptive statistics show that teachers are inexperienced with video gaming. Therefore, it is reasonable to assume that their choices regarding complexity and adoption are more strongly tied to what they themselves and their significant others think about the usefulness of game-based learning.
Indeed, social influences appear to play an important part in the acceptance of game-based learning. Perhaps this can be explained by teachers’ lack of familiarity with this type of educational tool, as this article deals with initial acceptance (Hu, Clark & Ma, 2003). In previous research into the acceptance of online gaming, Hsu and Lu (2007) found that social norms affected behavioral intention directly, whereas critical mass only had an indirect effect through attitude. In this study, the importance of social factors is underscored to an even larger extent, by showing that both subjective norm and critical mass affect as well teachers’ perceived learning opportunities as the variable usefulness. It seems important for future research to focus on these social influences in order to improve our understanding of game-based learning acceptance. Both the insignificance of the effect from complexity and the profoundness of the effect from usefulness on behavioral intention strengthen the idea that implementation strategies in this adoption phase should not as much focus on developing ready to use lessons preparations, but rather on how teachers perceive the merits of video gaming for education and job performance.

In the present study, the theoretical model is able to explain about 57% of the variance in teachers’ behavioral intention of using commercial video games in their classrooms. In future research, additional factors could be studied in order to account for school- and curriculum-related issues (Ong & Lai, 2006). It is likely that teachers will be strongly affected by the relation to the curriculum. However, it could be argued that the potential of video games should be found in transforming school practices, rather than in supporting established – and sometimes ineffective – “patterns of behavior” (Gee, 2011; Schön, 1983). While curriculum-related issues could be important in relation to teacher acceptance, they could perhaps be counter-productive as they support teachers’ “conservative bias” (Papert, 1980).

5.3 Implications for research

The purpose of this study was to understand the perceptions and beliefs that underlie teachers’ initial acceptance of video game-based learning. By specifically focusing on the use of commercial video games as learning tools in the secondary school, this paper depicts a more nuanced picture of teachers’ initial acceptance than previous papers making more general claims about game-based learning. In addition, because of the careful sampling approach, this study presents a rather refined view on the general uptake of video games in education. Based on the descriptive statistics it is apparent that few teachers have used games in their practice. The low adoption rate is in stark contrast with some of the figures raised in other studies. This could point to regional differences. Another potential explanation is that educational games researchers’ perspective is biased, because of their more frequent contact with teachers who are participating in projects involving game-based learning. Either way, this study shows that figures about the use of games in education should be approached with caution.

This paper also contributes to a body of research that examines the use of the technology acceptance model to explain technology adoption in educational settings (Teo, 2011). Most notably, this study found that complexity, which was operationalized as the opposite of ease of use, did not explain behavioral intention very well. This contradicts traditional TAM hypotheses that stress the central role of ease of use in technology acceptance. While it could be the case that the respondents’ answers suffered from socially desirability bias (having to admit that a certain task is complex yields less social approval than stating that something is easy for you), it is remarkable that a recent meta-
study on the use of TAM in education reported a lack of papers that examined the relationship between ease of use and behavioral intention specifically in studies that explored teachers’ and professors’ beliefs toward information technology in education (Sumak, Hericko, & Pusnik, 2011). This could be a symptom of a publication bias. More research is required to explore the exact role of ease of use within an educational context.

By differentiating between usefulness and learning opportunities, this paper further refines our understanding of the concept of usefulness within an educational context. Unlike many employees in a professional setting, most teachers do not strive toward personal effectiveness, but rather take on the role of a facilitator who stimulates students to reach their personal, but also externally determined learning goals. This double concern shared by all teachers is something that deserves further attention in educational research.

In addition, this study underlines the importance of social influences (both subjective norm and critical mass) on initial acceptance of games by secondary school teachers. This is congruent with alternative adoption theories, as well as with earlier findings within related games research (Hsu & Lu, 2004).

5.3 Implications for practice

The results of this study have practical implications for teacher educators because it increases our understanding of how game-based learning (using commercial video games) should be introduced in teacher training programs, especially in early adoption phases. Surprisingly, ease of use is not as influential on teachers’ game acceptance as expected. Therefore, it appears that teachers need information first and foremost, before practical issues should be considered. Other factors that did not affect teachers’ acceptance of games are their personal experiences with video games as well as their predisposition toward information technology. Even though personal innovativeness is directly related to usefulness, its share in the model is rather modest. This implies that blindly promoting games as a new technological panacea or a popular teaching method will probably not be effective as taking on a critical position towards game-based learning. Teacher educators should address in what specific cases and under which particular circumstances video games can increase the quality and effectiveness of the teacher profession. If teacher educators focus on the quality of education, teachers will be more inclined to accept game-based learning as a merit for their practice.

The importance of the social influences in the model also suggests that teachers are sensitive to worked examples and showcases of good practice (Barab, Dodge, & Gee, 2009). This implies that teacher trainers should increase the visibility of successful game-based learning projects such as the use of Civilization and Europa Universalis in history education (Squire, 2004; Egenfeldt-Nielsen, 2007), the use of Neverwinter Nights by the Adventure Author project (Robertson & Howells, 2012), the implementation of adapted Sims games for language learning (Miller and Hegelheimer, 2006), or the case studies described in Sandford, Uliscak, Facer and Rudd (2006).

Last but not least, this study shows that game-based learning is not just a case of teachers who have experience playing video games in their spare time. Instead, it further promotes the idea that game-based learning requires the careful orchestration of different knowledge domains.
6. Limitations and future research

There are limitations to this study. Firstly, a challenge to all user acceptance study is the limited knowledge of the users about the proposed technology under study (Davis, Bagozzi, & Warshaw, 1989). While this study has tried to partially overcome this issue by including vignettes, the question remains whether this study really measured well-formed beliefs or rather propositions toward this new teaching approach that can/will change over time. Indeed, because of the cross-sectional nature of the present study, future research – preferably with a longitudinal approach – is necessary in order to make conclusions about the stability of the beliefs under study (Kenny & McDaniel, 2011; Ma, Andersson, & Streith, 2005).

Secondly, user acceptance research tends to focus on the causes for using a technology. It does not, however, ask how these technologies affect performance (Goodhue, 2007). While this study does provide a preliminary glance at the position of teachers toward the use of commercial games in education, future research seems necessary that examines, discusses and questions the different ways in which video games could potentially affect and reshape teachers’ professions, teachers’ performances, and even education in general (Selwyn, 2007). What is it exactly that teachers think is useful about using this particular technology in their practice (Straub, 2009)? This type of research has to go beyond the focus on explanations of teachers’ low technology acceptance in education (Kriek & Stols, 2010).

Thirdly, this research was conducted among Flemish secondary school teachers. Unlike in primary education where teachers are responsible for an entire year’s curriculum, secondary school teachers are expert teachers focusing on specific subjects. Even though this study does not differentiate between subjects, it is possible that certain groups of subject teachers are more inclined to use games in their practice. For example, as research suggests that games are more suitable for explaining complex relations than factual knowledge (Bogost, 2007), it might be the case that physics teachers are more inclined to use video games in their practice than conservative history teachers who have maintained a focus on teaching the Grand Facts of History (although we should note that there might be a large within-group difference among history teachers as well, as more progressive history teachers favor the reconstruction of history based on an examination of authentic but contradictory sources as the main over a traditional rote learning approach – see Squire, 2004).

Fourthly, there are some limitations that are inherent to TAM-based acceptance studies. Due to the pre-implementation timing of the study, behavioral intention was selected as the dependent variable. This could be a matter of concern. Although previous research has shown that behavioral intention can be considered a good predictor for actual use (Lau & Woods, 2008; Sheppard, Hartwick, & Warshaw, 1988), this type of research is yet to be replicated in educational contexts. We therefore recommend future studies – in later implementation stages – to include observed measures for actual use. Similar remarks can be made about the use of complexity as a construct in this study. Conceptually, complexity is the opposite of ease of use; however, statistically the results of this study contradict the traditional hypotheses of the TAM model comprising ease of use. Within educational contexts, it is advisable that the role of ease of use is examined cautiously. In addition, this paper does not distinguish between different types of use. Even though the teachers were presented vignettes that described examples of good practice, teachers were only asked whether they intend to use games in the future. They were not consulted about the specific ways in which they want to implement games. Qualitative research, using a case study or focus group approach could provide more insight in the specific ways teachers (want to) use games. Indeed, while implementation is an important issue, the
main concern should be quality of education. In this respect, Lei and Zhoa (2007) have argued, “When quality is not ensured, the time spent on technology should be limited” (p. 295).

Sixthly, while this study did not focus on the feasibility and effectiveness of using video games in secondary education, any paper discussing the acceptance of a certain type of technology risks strengthening the subjective norm that video games are an important and academically accepted new educational medium. While we certainly believe that games – much like any major influence in young people’s lives – deserve attention both in education and research, our goal was not to uncritically promote the use of video games in secondary education. On the contrary, we strongly believe that more research is necessary, to show whether and how specific types of games can help us to tackle certain challenges in education. Hopefully, our research can help more experienced teachers, school administrators and researcher in better understanding the initial adoption decisions of teachers in those cases where video game-based learning can offer a fresh perspective or a new and effective methodological approach.

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