MEASURING STUDENTS' TIME PERSPECTIVE AND TIME ON TASK IN GBL ACTIVITIES

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ABSTRACT

Computer-based learning in general and Game Based Learning (GBL) in particular are becoming widely used in lifelong learning institutions and business schools. However, instructional and research design of these environments is still in a process of adaptation, due to the novelty of the GBL methodology and the initial stage of research studies in the field. One of the key factors in understanding these learning contexts is the time factor, defined both as an objective dimension (Time-on-Task; ToT) and as a subjective, psychological variable (Time Perspective; TP). The purpose of this paper is to discuss how to measure these two temporal variables in computer-based learning activities. In particular, we will raise the question of which techniques and methodologies are being used to measure these temporal variables in computer-based learning and GBL, and we will further discuss these methodologies in order to propose an suitable methodology that could be useful for researchers. For this purpose, an exhaustive literature review on time measurement in the learning sciences was conducted. The outcomes of the study aim to draw a usable methodology for measuring both TP and ToT in computer-based educational contexts. Results of this study could be of interest for researchers and practitioners in the field of computer-based learning when designing and implementing time measures in the learning process.

KEYWORDS

Time Perspective, Time-on-Task, Computer-based Learning, Game Based Learning, Serious Games.

INTRODUCTION AND RATIONALE

Continuing professional development and lifelong learning are vital to both individual and organizational success (Wall & Ahmed, 2008). Games for education, also known as Serious Games (SG) have long been used for management training in order to safely practice skills and competences that could play a central role in learners' improvement (Mawdesley et al., 2010). There is a broad corpus of research on factors involved in students' learning performance for computer-based learning approaches; in particular, digital Game Based Learning (GBL) activities have been studied the last years with initiatives such as the network of excellence in Serious Games (GaLA project, 2010). Nevertheless, studies focusing on the temporal aspects of SG are still lacking. Time has been highlighted as important in these scenarios (Barberà, Gros & Kirschner, 2012). In particular, we can distinguish two different approaches; the psychological time of learners, in particular, Time Perspective (TP; Zimbardo & Boyd, 1999), which is related to learning performance and investment in learning; and the objective measure of learning time, also defined as Time-on-Task (ToT; Romero, 2010), defined as the time students spend on a learning activity. That can vary depending on the learning task measured.

An original contribution of this exhaustive literature review is to contribute to filling the blank existing in the field of Game Based Learning (GBL) and time, thus helping achieve an understanding of the role of TP and ToT in computer-based learning environments, in particular, in SG activities. In this paper, we focus on the existing ways of measuring these two temporal variables in order to build a solid methodological base for further studies, such as exploring how students' TP and ToT could relate to learning performance when adult learners play SGs in the context of b-learning courses.

BACKGROUND RESEARCH

In computer-based learning, time plays an important role during the learning process. From the literature review by Barberà, Gros & Kirschner (2012), we can say that, though the time factor in ICT-based learning methodologies is important, in particular for the teaching and learning processes, it has mostly been neglected by researchers. As the authors claim: "The time factor (…) management and conscious adaptation is decisive for the well-functioning of online learning". (p. 17). Time can be tackled using different approaches; however, in learning, time invested in learning and Time Perspective (TP) can be considered as key variables (Adelabu, 2007); TP, in particular, is a student attribute that, if correctly measured, can be very useful in explaining dropping out. With the results of our study, institutions could help students by giving them some guidance on the average scheduled time devoted to learning activities. More, if studied as the time devoted to a learning activity or task, we can define Time-on-Task (ToT; Romero, 2010) as another variable involved in students' learning performance in computer-based learning.

We will therefore focus this review on these two temporal aspects: from a more psychological perspective, the temporal orientation or Time Perspective (TP; Zimbardo, & Boyd, 1999), defined as the way individuals and cultures divide their experience into three different temporal categories: past, present and future. In the next section, TP is introduced as one of the main factors in the human relationship with time from a psychological perspective according to Zimbardo & Boyd (1999). ToT is then introduced as an objective measure of time in a learning task, defined as time-on-task (Romero, 2010). Finally, we will study these
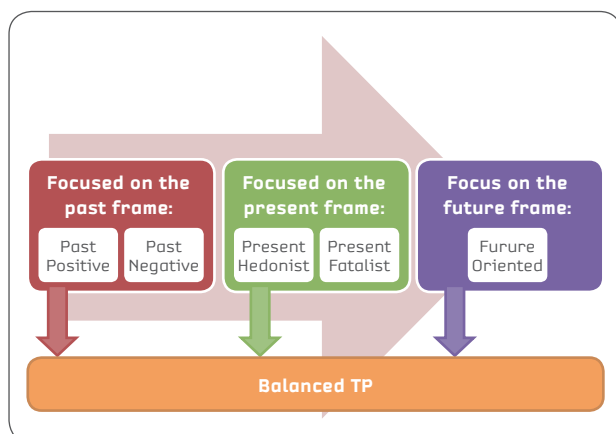
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temporal variables in the particular field of computer-based GBL.

TIME PERSPECTIVE

TP is a psychological construct that has been related to learning performance, motivation and self-regulation processes. It is composed of five factors as seen in figure (1):

As education has historically been defined as a future-oriented process (Leonardi, 2007; Schmidt & Werner, 2007) researchers have focused on the concept of Future Time Perspective (FTP) as a factor of students' psychological time. FTP in general, and Time Perspective (TP) in particular, have been approached in lecture based, face-to-face learning environments, where TP is understood as important in relation to learning performance and investment in study. The lack of a theoretical base on TP has hampered somehow the use of a uniform measuring process and instrument for studying students' TP (Thiébaut, 1998). In this presentation, we will discuss the Zimbardo Time Perspective Inventory (ZTPI; Zimbardo & Boyd, 1999) as a reliable and valid instrument for measuring TP, together with other proposed, qualitative methods.
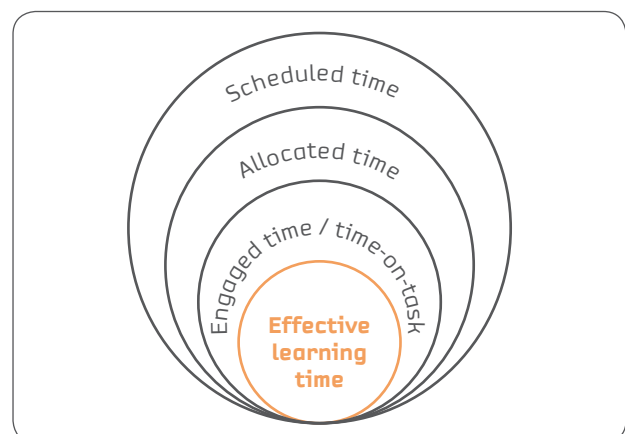
TIME-ON-TASK (TOT)

Concerning ToT, we focus on the Allocated Learning Time (ALT) model (Harnischfeger & Wiley, 1985; Fischer et al. 1980), this model is a theoretical framework historically used in face-to-face contexts, and adapted for computer-based contexts (Romero, 2012).

Scheduled time is defined as the time an educational institution schedules for learning activities. Allocated time, constrained by teachers in class, differs from the real engaged time (also called ToT), as students may not be working on academic matters all the time, they socialize, are distracted and so on. Following Caldwell, Huitt & Graeber (1982), the amount of time spent on learning is a factor determining students' achievement. This engaged time or ToT can be defined as the amount of time students devote to a learning task within the bounds of allocated time (Fischer, 1979, ALT model). Within this time, they have a certain amount of effective learning time, which is hard to see in learning situations where learners are not directly observed by the teacher. For this reason, most of the research developed in relation to academic times and learning has been focused on the relationship between ToT and learning performance (Romero & Usart, 2012).

Figure 1. Factors of the Time Perspective (Zimbardo & Boyd, 1999)

Figure 2. The ALT model for e-learning contexts (from Romero, 2010)

COMPUTER-BASED LEARNING AND SERIOUS GAMES

Continuing professional development and lifelong learning are vital to both individual and organizational success (Wall & Ahmed, 2008). Previously studies assumed that face-to-face learning contexts are future-oriented; as Leonardi (2007) affirms, educational processes are oriented towards future learning goals and delayed gratification. This is particularly the case in adult education, where students are supposed to be more mature and to have a better understanding of the links between studying and their own success in the future (McInerney, 2004). Romano & colleagues (2005) admit that the growth in distance education increases the need to study students' learning strategies in distance and computer-learning environments, including time management and self-regulation. Games for education, also called Serious Games (SG), have also long been used for management training in order to safely practice skills and competences that play a central role in student workers' improvement (Mawdesley et al. 2010).

Furthermore, it is reasonable to focus on time, both, objective (ToT) and psychological (TP), when trying to understand student's achievement in these educational settings. When focusing on GBL methodologies, as games focus on instant rewards, these activities are supposed to help present-oriented individuals improve their learning behaviours (Zimbardo & Boyd, 1999) because it has been observed that present-focused individuals engage and can perform better in instant feedback situations such as games and social activities. Present-hedonist individuals are supposed to have less time management skills and to be easily distracted by external factors (Wassarman, 2002). In SGs, it is also expected that differences will be observed between playing times (ToT): under time pressure, future

oriented students are supposed to manage time better in order to achieve their short-term goals (winning the game) and long-term goals (success in the course) while present and past-oriented individuals just play for fun and instant rewards. There is also the possibility that present-hedonists just "click". In this case, lower time played would lead to low performance outcomes.

GOALS

As has been seen, there is a gap in the study of time in relation to learning performance and time on task (ToT) for formal education, in particular, for those participating in computer-based and GBL learning tasks.

The broader aim of this study is to examine TP and ToT measurement processes in computer-based learning environments. These contexts are widely used (Kirriemuir & McFarlane, 2004), especially for adult education and training (Usart, Romero & Almirall, 2011). In particular, our objective is to define a reliable procedure for measuring students' TP (defined as a subjective, psychological construct) and ToT (defined as the objective time spent on the learning activity) in the context of formal, computer-learning programs for adult management students where SGs are implemented.

RESEARCH QUESTIONS

Two research questions will guide our study, in particular, our literature review:

❯ How has students' TP been measured in previous studies for distance and computer-based learning environments?

❯ How has ToT been defined and measured in previous research, in particular, in learning (SG) activities and computer-based courses?

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PROCEDURE

Our search for relevant literature on the measurement of students' TP and ToT was carried out with a selective literature review, based on a three-step model: first, a search was carried out on two different research engines; Summon (the UOC engine that is focused in online education and psychology; and also Science Direct, where most of the journals on education and time perspective are listed; the keywords for the search were "time on task and learning" and "time perspective and learning". Secondly, all the references cited in the articles found in the first step were searched in order to spot different articles not retrieved in the first step; and therefore try to maximise the location of published references for this field. Thirdly, journals in the references selected in the final list on TP or ToT were identified as the main journals publishing on TP and ToT in the context of education. All these journals were searched, directly from their homepages. This last step was conducted in order to complete the number of references and to make sure that no articles were left out of the literature review. A total number of 46 articles were retrieved in the first step for ToT and learning, and 12 more were added from the second step. Finally, 21 references were selected for ToT based on the following criteria: an article was chosen if it gave both an explicit definition and a measurement process for ToT. For the

TP variable, the process was equivalent, and 51 out of 194 papers were finally listed (38 of them were specifically focused on FTP). All the references were focused on the fields of learning or education.

RESULTS

TP MEASURES

Research on TP has historically been focused on face-to-face environments; in particular, 38 articles out of 51 focus on the future factor of TP (FTP). There are different instruments for measuring students' TP; not only self reported tests or questionnaires (Peetsma, 2000; Shell & Husman, 2001), but also task-reported measures such Teahan (1958). Nevertheless, since the Zimbardo & Boyd's (1999) TP foundational work on TP, more authors admit that, as a psychological construct, a self-reported test such as the ZTPI is a valid and reliable way of measuring this variable (Adelabu, 2007; Horstmanshof & Zimitat, 2007; de Bilde, Vansteenkiste & Lens, 2011). Closer in time, some researchers are studying how to adapt the ZTPI to formal learning scenarios. Along these lines, Janeiro (2012) presented the Time Perspective Inventory (IPT) as a new instrument for assessing the time perspective in school context, with 32 items organized in four scales, three related with the temporal zones (future,

Table 1. TP literature research results

Learning environment	Number of studies	Instruments
Face to face	2	• Task-reported measures (Teahan, 1958)
	46	• Self-reported tests: ZTPI, FTPQ, FTPS, IPT (Zimbardo & Boyd, 1999; Peetsma, 2000; Shell & Husman, 2001; Janeiro 2012)
Online learning	2	• Self-reported tests: ZTPI (Zimbardo & Boyd, 1999)
Game Based Learning	1	• Self-reported tests: ZTPI (Zimbardo & Boyd, 1999)

present and past), and one with an anxious or negative perception of the future. In parallel, the researcher measured positive relationships between future time orientation and school achievement in grade 12 students.

Despite the scientific production since 1942 on the study of TP and learning, little research has focused on computer-based learning or GBL tasks. Only one study distributed questionnaires online (Horstmanshof & Zimitat, 2007), and as a theoretical approach, Schmidt & Werner (2007) pointed to the importance of FTP in online learning environments. However, the study does not conduct any measurements of this variable. For GBL tasks, up to the authors' knowledge, three studies measure TP in games or social learning activities, all of them base their research on Zimbardo & Boyd's (1999) TP definition. Brown & Jones (2004) showed how present-oriented individuals have greater engagement in social activities. The authors used a self-reported questionnaire, the Temporal Orientation Scale (TOS) to measure TP. Results for African-American high school students indicate that past and present-oriented students tended to engage in social activities more than academic activities. In the same vein, Wassarman's (2002) thesis on TP and gambling behaviour points to present-oriented adults engaging more in gambling activities than past and future-oriented individuals. He used the ZTPI. Finally, Romero & Usart (2012) measured TP in a GBL activity. A total of 24 adult students in a master's course formed the sample (9 women and 15 men, age M = 31.90, SD = 4.09). A classification game, MetaVals, was implemented in an introductory finance course. The research scenario was set by an online pre-test of financial literacy, together with face-to-face SG activity, (where students played a web-based SG to classify assets and liabilities) and an online post-test. Students were rated, according to the ZTPI, as future or present-oriented. Results show that an active learning approach such SG involves competition and

social interaction and demands students think about the future, but also focuses on instant rewards.

From this review, there are still different aspects of the role of student TPs in SG that need to be approached. One of the factors to be studied is the social aspect of collaborative GBL tasks. TP studies have focused only on individual learning activities; and little is known about how differently oriented individuals behave when cooperating or competing with other students. As SGs feature increasingly in current learning trends in adult formal education, research on TP should now study how to implement TP measurement in SG tasks.

TOT MEASURES

This variable has been studied in formal educational contexts since the beginning of the 20th century; and reappeared in the late 1950s. Carroll's (1963) model of school learning attended to instructional time variables. Studies in the sixties and seventies (Lahaderne, 1968; Hinrichsen, 1972) found positive correlations between time-on-task and achievement. However, research on ToT had its peak in the 1980s and nineties, with the definition of finally, a theoretical framework: the ALT model (Fisher, 1979). In this widely used approach, ToT can be understood as part of a superordinate concept: instructional time, which includes scheduled time, allocated time, engaged time (or ToT) and effective time (as seen in the ALT model in figure 2). Most of the references reviewed base their work on Fisher (1979) definition of academic engaged time or ToT: "the time which a student spends engaged in academically relevant material which is of a moderate level of difficulty" (p. 52). Following Caldwell, Huitt & Graeber (1982), there is an engagement rate to measure ToT, defined as the percentage of the class actively working, or engaged, in a learning task, and they related to achievement.

Table 2. ToT literature research results

Learning Environment	ToT Definition	ToT Measure
Face to face	ToT is the time a student spends engaged in academically relevant material of a moderate difficulty level. (Fisher, 1979). A conjunctive concept, not as simple as time engaged in learning, measured while people are working on a task or thereafter (Berliner, 1990).	• Number of self-determined trials children spend in learning an alternate, equivalent form of an experimental task. (Gettinger, 1985) • The integration of instantaneous workload for the time interval spent on the task (Berliner, 1990).
Online learning	Engaged time or ToT can be defined as the amount of time students devote to a learning task within the bounds of allocated time (ALT model).	• Time students spend in a computer-based task (Metcalfe, 2002) • Time logs of students engaged in individual or collaborative activities (Levinsen, 2006; Romero, 2010) • Time spent online by learners (Wellman & Marcinkiewicz, 2004)
Game Based Learning	ToT is the manner time is used in learning (Stallings, 1980).	• Time working with puzzles and games, both individually and in small groups (Stallings, 1980). • Time students' are engaged (logged) in the gameplay (Gee, 2003; Lewis, 2007).

Gettinger (1985) measured the time spent in learning (ToT) in 4th and 5th grade students, as the number of self-determined trials children spent in learning an alternate, equivalent form of an experimental task. Furthermore, Berliner (1990) highlights that ToT is a conjunctive concept, not as simple as time engaged in learning. He defines it in terms of learner's achievements, and measures it while people are working on a task or thereafter. Berliner admits that measurement issues for instructional time could be vastly complex, and advises that even if measured adequately, instructional time variables are not particularly powerful. He gives even a mathematical definition; the integration of instantaneous workload for the time interval that was spent on the task (i.e., the area below the instantaneous load curve), where average load represents the mean intensity of load during the performance of a task. From our review, we can therefore accept that ToT is a behavioural and quantifiable instructional time measure, aimed for

monitoring the time-on-the-right-tasks (Berliner, 1990), the percentage of time students are engaged in tasks or materials that are related to the outcome measures used is a means to bring important concerns about curriculum and curriculum assessment into the teaching time model. Finally, when measuring ToT in face-to-face activities, the inclusion of self-reporting measures students' cognition, assessing moment-to-moment attention during lessons, may provide stronger relationships when relating ToT to learning variables (Peterson, Swing, Braverman & Buss, 1982).

From the extensive search carried out in the Summon and Science Direct databases, we can observe that not so many authors have studied ToT in computer-based contexts or GBL tasks. As a start, Metcalfe (2002) measured in a computer-based task (word counting and Spanish-English learning) that students with a fixed ToT for the computer tend to spend more time on medium difficulty items. In the other two studies found focused on online learning,

this variable followed the ToT definition given by the ALT model, and is measured as time logs of students' engaged in individual or collaborative activities (Levinsen, 2006; Romero, 2010). Observing a group of 120 college students in an online pharmacy program, Wellman & Marcinkiewicz (2004) found that time spent online by learners (ToT) was weakly correlated with learning.

Finally, as seen in table 2, four studies have been identified as focused on GBL and ToT; Stallings (1980) defined ToT as the way time is used in learning, and relates it to achievement in maths and language tasks. In particular, he contrasted time working with textbooks to time with puzzles and games among primary school pupils. He highlights that SG tasks were related to non-verbal skills, problem solving and lower student absence rates, and time spent in small groups was also positively related to achievement when compared to one-to-one classes. From the Romero & Usart (2012) research on GBL and ToT, two studies explicitly defined and measured ToT in SGs: Gee (2003) and Lewis (2007). These authors measured ToT as the time students' were engaged in the gameplay (logged in). In particular, Lewis (2007, p.918) observed that "time-on-task" is one of the great general truisms of educational interventions: the longer one spends learning, generally, the more one learns. However, he claims that the influence of time-on-task is subject to the relevance of the learning objectives addressed by a game. He considered a student's ToT in relation to an increase in learning performance. Games could facilitate an increase in ToT because of their engagement and improve some learning performances, but increasing ToT would not necessarily efficiently increase learning performance. Furthermore, Gee (2003) also argued that a well-designed SG could increase the students' ToT by creating an environment that encouraged practice, although this time does not directly relate to a better learning performance.

CONCLUSIONS AND IMPLICATIONS

Measuring time in computer-based learning and SG tasks is an aspect that has been under-studied. From a subjective, psychological standpoint, we can affirm that self-reporting of TP from the ZTPI can be considered as a standard methodology in face-to-face environments and therefore be transposed to computer-learning and GBL. Moreover, as these new educational environments are no longer solely focused on the future (Zimbardo & Boyd, 1999; Schmidt & Werner, 2007), but also include present centred activities and rewards (Wassarman, 2002), TP with all its factors is the variable to study. On the other hand, a triangulation of students' TP results with an objective measure of actions of students is needed and could lead to more precise and reliable results in this field.

From our literature research, we have to admit that TP has been widely studied in face-to-face, instructional contexts, and little work has focused on the study of these temporal variables in computer-based learning or in SG tasks. Firstly, as Zimbardo & Boyd (1999) highlighted, there is an existing number of instruments and measures for TP. There is therefore a need for a reliable technique that can measure TP factors. ZTPI has been translated into different languages (Díaz-Morales, 2006) and can easily be administered online with tools such *Limesurvey* or *Moodle* (Romero & Usart, 2012). This instrument, combined with other measures such as students' time management and persistence, could give greater validity to the measurement of FTP. The fact that self-reported questionnaires are widely used in the field of learning, could therefore be limiting the validity of the measures on FTP.
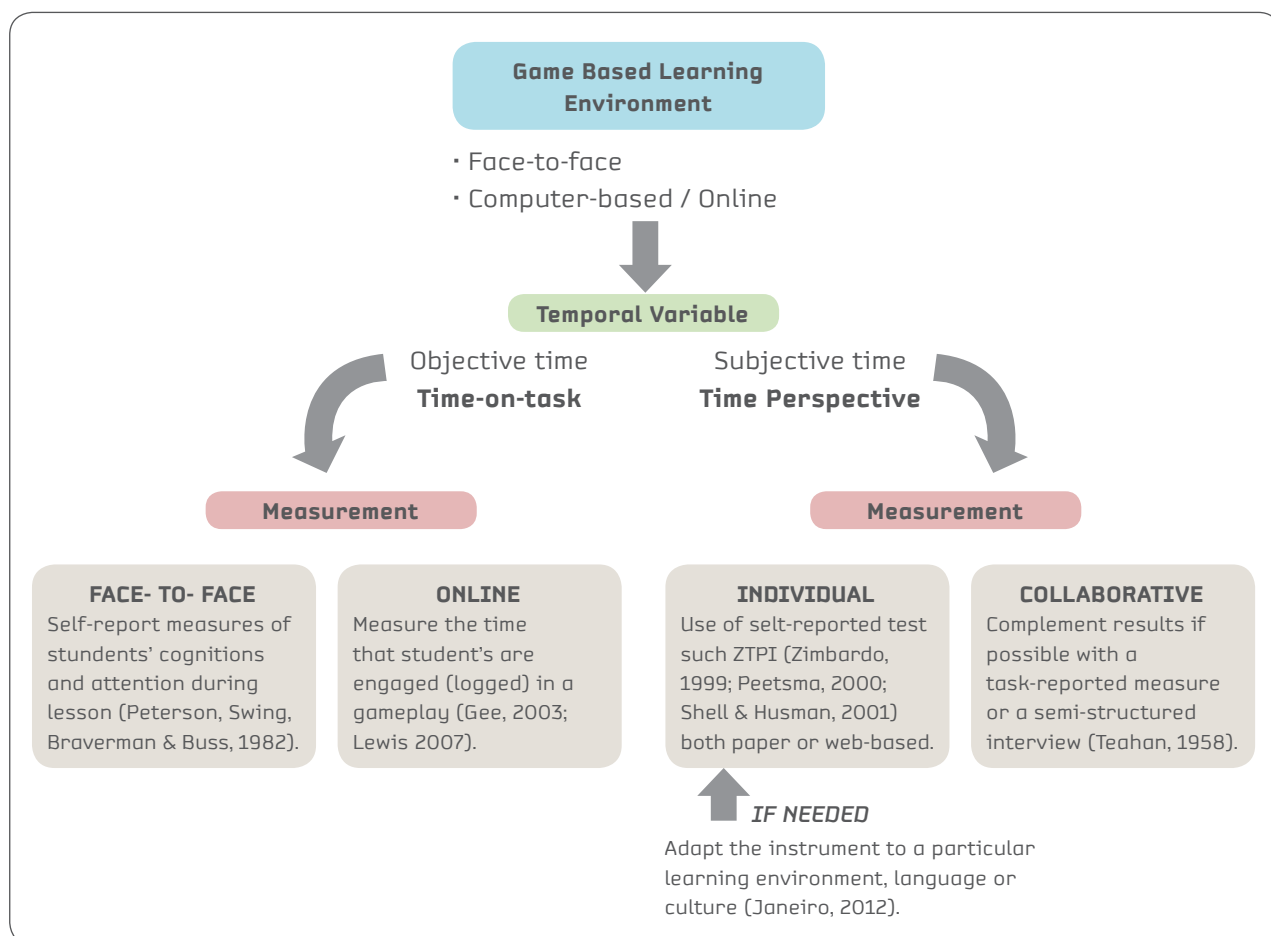
According to the small number of references retrieved, ToT has also been under-studied

in the field of computer-based environments and GBL. It is important to mention that the existing measures of ToT from different perspectives could have a great impact on results, especially when related to achievement. Following Caldwell Huitt & Graeber (1982), small changes in each measure of time could lead to large differences in its effects. We should therefore focus on one definition and how we measure this variable when beginning a study. In computer-based environments, ToT is defined in the context of the ALT model (Romero, 2010), and is measured as the time students spend on a learning task. With the spreading of these learning methodologies, students' time logs are easier to monitor and study; particularly in specifically designed GBL tasks with accessible databases. However, it is important to highlight

that, in SG tasks, ToT can differ from effective learning time because there are distracting activities like time spent on understanding poorly designed instructional scenarios or computer-based games and interfaces, processing incoherences, understanding game mechanics, and social interaction (Admiraal, Huizenga, Akkerman & Ten Dam, 2012) which does not directly relate to learning. Measuring methodologies should therefore be based in quantitative and qualitative data (see figure 3). Since Berliner 1990, the importance of measuring ToT correctly has been heavily stressed, not only because of relating it to achievement, but because of the difficulty, which online contexts could overcome, of monitoring real students' ToT (which may not be effective learning time, as there are technical

Figure 3. Scheme for measuring temporal variables in GBL environments

issues, understanding the game mechanics, collaboration and group interaction other than learning construction).

In conclusion, we propose that more experimental and case studies should be conducted in the field of time and computer-based learning, in particular, focusing on students' ToT in active-learning tasks, such as SG, which are being widely implemented, but nonetheless need experimental support to show their overall effectiveness, through the use of

a consistent measurement process. TP should also be measured using self-reported online tests such ZTPI, which could allow researchers to better understand students' engagement and attitudes in computer-based and SG tasks. Future studies could support the theoretical conclusions highlighted in this review and make it possible to establish a consistent framework for measuring temporal variables in computer-based environments in general and for SG activities in particular.

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