The Impact of Technology Integration on Student-Designed Games

by

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Abstract

Student-designed games (SDG) is the process in which students create, organize, practice and refine their own games within certain limits established by the teacher (Hastie, 2010). Recent research has proposed different methodologies to teach SDG, and among these, technology integration (TI) was proposed by Hastie, Casey and Tarter (2010) and by Casey, Hastie and Rovegno (2011) when using a wiki for game design. In spite of becoming an innovative methodology for teaching SDG, it is not clear how TI may improve or diminish students' experience and learning.

The present research analyzed how TI has an impact on a SDG teaching unit, and it addressed five research questions: (1) How technology integration has an impact on a teacher's pedagogy? (2) How technology integration has an impact on students' physical activity engagement? (3) How technology integration has an impact on students' enjoyment/ engagement? (4) How technology integration has an impact on students' communication? (5) How technology integration has an impact on students' game characteristics/ architecture?

The researcher taught two SDG units in a Junior High School, one with TI and another without TI. Within a participatory action research methodology, these questions were answered following analysis of data collected with six different methods: observations (field notes), Edmodo discussions, interviews, survey, lesson plans and pedometer count.

The executive answers to the five key questions were: (1) the TI group was taught with more autonomy, whereas the non-technology group needed more support to complete their tasks;

(2) the non-technology group reported a higher physical activity engagement than the TI group; (3) the non-technology group reported higher levels of enjoyment when comparing to the TI group; (4) group members from the non-technology group were able to communicate better, while inter-group communication was better in the TI group; (5) boys reported to focus on designing strategic games whereas girls focused on designing ludic games.

In conclusion, TI was considered a harder teaching methodology that required more experience with SDG and with TI. Moreover, there was also a higher appreciation for SDG among the students that were taught without TI. Nevertheless, TI provided more equality among students as they were given more opportunity to share their ideas in online discussions. Future research may consider a hybrid model that focuses on the major benefits that can be derived from each teaching condition.

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Table of Contents

List of Tables

List of Figures

Chapter 1. Introduction

A student-designed games (SDG) teaching unit could be described as the process in which students create and practice their own games, and in which the teacher as facilitator is able to guide and establish certain limits (Hastie, 2010). The concept of SDG emerged in the late 1960s for the first time in the physical education literature where Mauldon and Redfern (1969) introduced the idea that children were experts in game playing and therefore, they should have more liberty to create their own games. From its initial idea until the late 1990s, most of the research on SDG did not present any empirical data. Rather the discussion was limited to various definitions that characterize what is, and what is not, SDG.

Delimitating the understanding of SDG was the first step of the literature. Most research focused on discussing the different teaching methodologies that could be used. Given that students are empowered with the content that is developed in class, there were many papers advocating that SDG should not be confused with a 'ball rolling' concept. As a result, many teaching methodologies were created to approach this new physical education content. Nevertheless, not until recently, these methodologies were not applied as interventions to discuss their potentialities and limitations.

In the past few years, there has being a growth of empirical research in SDG. Most of the current research has focused on the different possibilities of teaching SDG. Among these methodologies are: the jigsaw classroom (Hastie & Casey, 2010), multiple students roles (Giménez, 2011), and the usefulness of wikis to design games (Hastie, Casey & Tarter, 2010;

Casey, Hastie & Rovegno, 2011). The introduction of wikis to SDG has brought the concept of using technology integration when teaching SDG.

Technology integration in physical education (TIPE) is the term used to describe the concept of using technological devices and software to support, facilitate and improve teachers' practice in order to enhance students' experience and learning. TIPE has a similar history to SDG. As an even newer area of research, publications describing TIPE still present most of their findings without any empirical data. Due to the enormous range of possibilities of different technologies, TIPE research presents the aggravating fact of always being behind the latest technological trends. As a result, most of TIPE's research focuses on how to use new technologies as instructional guides that describe the features of a given device.

Among the research that does present empirical data, there has been two foci, those being teacher education as well as professional development and application. Publications in the area of teacher education and professional development have presented research on how new teachers and established teachers acquire their knowledge of using TIPE in their classes. The TIPE application research focuses on the implementation of K-12 and higher education interventions, seeking to explore different possibilities of teaching physical education classes while using technological support.

The application of TIPE in K-12 education has reported diverse possibilities in using technology in physical education. Studies have reported positive responses to the usefulness of internet websites to teach theoretical physical education content (Thornburg & Hill, 2003) as well as in motivating students to be more participative in physical education (Lazerte & Lathrop, 2006). Moreover, videos have also been used to support students in their process of learning fundamental motor skills (Clarke, 2008). Each intervention has shown to propose different

teaching styles when applying different technologies for different purposes. Therefore, there has been a growing need to discuss how TIPE may affect teachers' didactics. Like SDG, TIPE has also show a growing need to understand how technology integration should be implemented, that is, how teacher practice is modified when teaching a physical education unit that involves technology integration.

Although there are a growing number of studies that present positive outcomes while implementing TIPE, it is still not clear how these outcomes are optimized or diminished when comparing the use of technology integration with another teaching unit that does not use technology integration. In other words, the question remains as to: what are the benefits and issues from using technology integration? In addition, it is also important to understand how teaching styles are affected when using technology integration. One particular question that needs investigating is whether there is a need to make modifications on how students are taught when using TIPE?

SDG presents similar problems given there is a growing need to compare how different teaching conditions affect students' experiences and learning. Given that there are SDG studies that have introduced technology integration in their teaching, it would be important to know how TIPE incorporation affects SDG teaching. In other words, the important question remains as to what are students' responses to each teaching condition. Other questions include: what are the characteristics from each teaching condition (with and without technology integration) that improve students' overall experience? In order to identify the most appreciated characteristics and understand why and how they affect students' experience in SDG, a comparison between technology integration and non-technology teaching conditions in SDG is needed.

The present study has the purpose of analyzing the impact of technology integration in a SDG teaching unit. The study offset up to deliberately compare two SDG teaching units: one that used technology integration and another that did not use technology integration. The group that used technology integration was required to design their game outside of class while using Edmodo (a social media website). The group that did not use technology integration performed all their game design tasks within their regularly scheduled class time class. Both interventions were taught by the researcher himself, involving a methodology known as participatory action research (PAR). As a result, the researcher was able to experience the daily challenges that each teaching condition provided. In addition, PAR also enabled the researcher to provide a contextualized perspective in which the researcher was able to present enriched data that enhances the understanding of each given situation.

The study was conducted in a Junior High School in the southern region of the United States. 82 eighth and ninth grade students from two classes received five week interventions that were analyzed by six different methods: observations (field notes), Edmodo (group discussions), interviews, survey, pedometer count, and lesson plans.

Research Questions

The purpose of this research was to analyze how technology integration has an impact on a student-designed games teaching unit in physical education. More specifically, the research addressed the following research objectives:

i. To gain better understanding on how technology integration has an impact on a teacher's pedagogy in a student-designed games teaching unit.

ii. To gain better understanding on how technology integration has an impact on students' physical activity engagement in a student-designed games teaching unit.

iii. To gain better understanding on how technology integration has an impact on students' enjoyment/ engagement in a student-designed games teaching unit.

iv. To gain better understanding on how technology integration has an impact on students' communication in a student-designed games teaching unit.

v. To gain better understanding on how technology integration has an impact on students' game characteristics/ architecture in a student-designed games teaching unit.

Chapter 2. Literature Review

The present research focuses on two topics: student-designed games and technology integration in physical education. Considering that both topics have limited empirical research, this literature review focuses on presenting an overview on how each topic was developed. First, student-designed games is presented in two sections: (1) Student-designed games: from the roots to the latest, (2) Student-designed games: what we claim to know, what we actually know, and what we need to know. The first section provides a chronological overview of the academic research that has been conducted in this subject matter. The second section presents what have been researched with empirical data and what have been claimed without evidence, clarifying what topics are more needed with further research.

Secondly, technology integration in physical education is presented in three sections: (1) The physical education teacher education and professional development in technology integration, (2) The application of technology integration in physical education, (3) Developing technology integration in physical education literature: empirical research that may support this goal. Due to the lack of research, this topic is not presented chronologically but in sections according to the different themes that are examined. The first section provides research that focus on understanding how much technology has been used in schools and how teachers learn to use this technology. The second section focuses on research that investigates interventions that use technology integration in diverse educational settings. The third section provides a

discussion on how technology integration research has been developed and what needs further examination.

Following these outlines, a brief discussion is made of how student-designed games and technology integration in physical education might relate to one another in academic research and practical interventions. Finally, the study's research questions are presented.

Student-Designed Games

Student-designed games have been referred in many different ways in the literature, such as: games making (Almond, 1983; Cox & Ledingham, 1988), child-designed games (Rovegno & Bandhauer, 1994), games invention (Curtner-Smith, 1996), and inventing games (Butler & Hopper, 2011). Although there may be slight discriminations in each of these terms, they are all part of the same subject matter, that being, the development of the constitutive rules of a new game by a group of young people. Nevertheless, it is important to demarcate the understanding of the subject matter in order to ensure clarification of the object of study as well as to avoid misinterpretations. According to Hastie (2010, p. 3) "by definition, games making in physical education is a process where students create, organize, implement, practice, and refine their own games within certain limits presented by the teacher". Hastie (2010) choses to refer to this practice of teaching as student-designed games (SDG) which has been the term chosen to be referred throughout this study. In the following, a chronological review of SDG is presented in order to understand what has been research and what have been the major findings up to date.

Student-Designed Games: From the Roots to the Latest

The first major reference to influence SDG started in 1969 with the book entitled "Games Teaching: a new approach for primary teaching". Mauldon and Redfern (1969) presented the principles not only for SDG but for all new physical education models that arose to approach

games teaching. The book discusses major topics that would become part of SDG development, such as: the usefulness of games in education (and particularly in physical education); the complexity of games (how playing games involves the development of multiple domains: physical, cognitive, social and moral); the child's developmental stages while relating to games playing (similarly to what Piaget (1971) showed while reporting how each child stage related to a different game form, from exploration and symbolic games to social and construction games); and even the first classification of games (that would be used by Thorpe, Bunker and Almond (1984) in their games classification and that would be essential for SDG didactics).

In addition, Mauldon and Redfern (1969, p. 6) advocate how children should be considered the experts in this subject matter by stating "courses for teachers appear to concentrate on 'up-to-date' methods of coaching specific techniques and organizing numbers so as to [sic] mould children in adult patters, rather than on fundamental educational issues or about children themselves (and who knows more about 'playing' or about 'games' than they?)". More specifically, the authors recognize the importance of SDG as they value the idea of giving students the opportunity to make up their own games as they would be dealing with problem solving situations and understanding the relationship between the rules and successful game play.

In the 1980's the discussion concerning SDG focused upon their educational outcomes as well as how they should be taught. These first papers that focused on SDG did not present any empirical data. For example, Almond (1983) advocated how SDG were able to teach students to 'find out for themselves' why rules were so important in a game. Other outcomes reported by the author focused on the social domain, once the unit promotes students working together as a group, having to cooperate and gaining communication skills as they would have to present their

game to others and even to the teacher. In addition, the author also acknowledged the importance of having ownership of a game as something to be meaningful to students. The paper provided the first strategies on how to teach SDG by teaching students what is part of a game (rules, scoring system, methods of restarting the game, skills, strategies and players specific roles and positioning).

Cox and Ledingham (1988) presented the first paper strictly oriented to teach teachers on how to conduct a SDG unit. The authors presented three options of teaching: the structured approach, the limited choice and the open choice. The authors also reported that it is important to give freedom to students gradually, rather than have them make all game decisions in their early experiences. In the structured approach, students would only be able to choose to modify a few rules or equipment from a few options given by the teacher (similar to a multiple choice test); in the limited choice, students would be able to modify rules from games that they were familiar; at last, the open choice would give students the liberty to create their game from scratch.

In the 1990's there was an even bigger focus on how to teach SDG. Again however, most research was descriptive as authors sought to enlighten the process of teaching SDG. Like the 1980's, this decade would not present studies with empirical data. Rather, teachers and researchers would share their experience while implementing SDG but without rigorous academic methodology that could support their claims. Smith (1991) was one of the first authors to clearly relate the Teaching Games for Understanding (TGfU) model while using SDG. The author presented SDG as a possibility of teaching within the TGfU approach once students would gain understating of how rules impacted game play. The author presents a three step process when using SDG: selecting the games category, playing modified games presented by the teacher and inventing games. The idea of incorporating Thorpe, Bunker and Almond (1984)

games category[1] and therefore delimitating the games that would be designed by the students would be largely used by many other authors later on.

Rovegno and Bandhauer (1994) presented a summary of many findings that were observed in SDG while the authors and their undergraduate students were performing a series of SDG units in an elementary school. The purpose of their article was to enlighten teachers and researchers about a numerous of misconceptions that they have come across when teaching SDG. Like other constructivist models in which have been misinterpreted as "ball roller" (Chandler & Mitchell, 1990), SDG had to overcome the idea that empowering students to create their own game did not mean an 'education anarchy' in which there is no educational objective or strategy of teaching and Rovegno and Bandhauer (1994) were able to enlighten readers about some of these misconceptions.

Within the proximity that has been suggested between SDG and its capacity to promote an understanding of games, SDG was also presented as a new alternative to promote critical thinking in physical education (Cleland & Pearse, 1995; Rovengno, Skonie, Charpenel, & Sieving, 1995). As stated by Almond (1983) students would have to 'find out for themselves' how rules impact games and therefore it would encourage them to have a reflexive attitude while designing their games.

Curtner-Smith (1996) acknowledges the potential of SDG (if well implemented) in being able to develop all three domains of a child (psychomotor, cognitive and social). Once again, the author presents the three step process on how to teach SDG in elementary school (selecting the games category, playing modified games presented by the teacher and inventing games). In addition, Curtner-Smith also presents a series of new particularities that teachers are ought to

[1]The games categories were presented by Thorpe, Bunker and Almond (1984) as a classification of all games in four categories: target games, striking and fielding games, net/wall games and invasion games

know when teaching SDG: calling attention on how each student may have a different approach when designing their game as some may plan the whole game before trying out and others testing every new rule; the different roles that teachers may take during the process (advisor, observer and equal status to the students); how teachers are often needed to intervene in the games design (as previously stated by Rovegno and Bandhauer (1994); and how students present different social behaviors when working in group.

In the first decade of the 21st century it was possible to see the beginning of a shift in the SDG literature. Unlike previous decades, there was a genesis of studies which presented empirical data. There were also more diverse perspectives addressing SDG. These new studies were no longer exclusively focused on what and how SDG could be taught, approaching SDG in forms such as: an assessment tool; presenting its ability to motivate students; discussing pre-service teachers response to this approach; and comparing students' behaviors in physical education classes while playing teacher-designed games to SDG.

Hastie and Curtner-Smith (2006) presented SDG as an assessment tool as the authors used a hybrid model that combined TGfU and Sports Education. Although SDG is not presented as the focus of that paper, it shows its versatility in the literature while being used as an assessment for evaluating students' game appreciation. In this study, besides designing their own games, students would have to explain why they chose specific rules. As a result, students would have to show an understanding on how each rule affected the designed game in terms of its playability, enjoyment, inclusiveness and risk/rewards strategies.

Oliver, Hamzeh and Mccaughtry (2009) used SDG on a feminist post-structuralist perspective. The authors identified the reasons why a group of girls from two elementary schools would not participate in physical education classes regularly. Within interviews, the authors

pointed that the girls would consider themselves distant from the schools' physical activity culture. As a result, SDG were used as an approach that is able to create a new environment in which students would be able to relate and therefore become active. Although the authors do not show teaching strategies that were consistent to the SDG literature, the concept of promoting the creation of new games designed by students presents a breaking ground as SDG reach the critical theories.

Butler, Gomm, Russell, Siess and Sullivan (2009) reported pre-service teachers' responses while teaching SDG. It was the first study found in the literature that presented SDG as part of the physical education teacher education curriculum. As a result, SDG could be proliferated as teachers would have formal training on how to teach SDG. This same study refers to SDG as a form of teaching the concept of democracy as previously conceptualized by one of the authors in Butler (2006). This shows one of the major features of SDG when first emerged: the potential to develop students' social domain as they are highly encouraged to engage in groups to design their games.

André and Rubio (2009) describe the different students' behaviors while playing different forms of games: exposed games (teacher-designed games), modified games (traditional games modified by the students), and spontaneous games (games that students created on their own while playing with their friends outside of school). The authors reported a growing autonomy by the students when comparing each form of game design, i.e. the more ownership the students had for the game, the less they would request the teacher for class management and officiating. In other words, the students reported an 'out of school' behavior by not requesting adult supervision and showing a more playful environment as they played their own games.

The current research (beginning of the second decade of the 21st century) shows a significant growth of studies in SDG, having empirical data supporting the claims in most of the studies. Showing the same trend described in the previous decade, current research appears to have an even bigger pluralization on how to approach SDG. The studies includes: new strategies on teaching SDG; the creation of not only games but equipment as well; the integration of SDG with technology; and supporting data of what students learn in SDG.

Giménez (2010) presents the idea of creating homemade equipment for modified and SDG in the target games category. According to the author, target games with human targets have been banned from schools for being considered unsafe games. However, acknowledging that students favorite games from this category were the ones that had human targets (once they were moving targets and therefore more challenging), the author considered the creation of safe homemade equipment as an alternative to prevent these folkloric valued games to be banned from school. The same concept of designed equipment for SDG was introduced by Hastie and André (2012), but these authors also incorporated the idea of teaching game appreciation while students design their equipment and games. According to this study, the students were able to understand the relationship between the equipment design and skills (e.g. small balls are better for games that required throwing whereas bigger balls were better for games that required kicking). In addition, this was the first study with supporting data that identified different approaches when students are designing their game, reporting differences between genders and skill levels.

Acknowledging that during a SDG unit it is possible that some students take the lead of designing the game while others work as mere supporting roles in the process, two studies present teaching strategies to avoid this pitfall. Hastie and Casey (2010) presents the jigsaw

classroom method in which each student is responsible for designing a specific part of the game and therefore ensures that every student takes part while designing the game. In addition, this methodology promotes important social goals in physical education, such as the supportive and positive interdependence among students. Also concerned with the inclusiveness of every child while creating new games, Giménez (2011) presents the concept of giving different roles to each student involved in the SDG process, similarly to what is presented in the Sport Education model (Siedentop, Hastie, & der Mars, 2004). The roles presented by the author were: player, equipment manager, captain, secretary and evaluator.

The incorporation of technology to SDG was first presented by Hastie, Casey and Tarter (2010) in a study that presents a wiki as a tool to create games. The study describes how the students, physical education teacher, librarian and SDG expert (the researcher) were able to be interconnected as students designed their games and reported its steps through the wiki. Among the studies major findings are: students were highly engaged; the physical education teacher and SDG expert were able to provide immediately accountability with constant feedback; and better outcomes (games designed) as there was a great deal of commitment by the students and teachers. However, the study does acknowledge the need of increasing out-of-class workload for the teacher as the students would engage in the game designed throughout the week.

Although SDG have been claimed as an approach that promotes the development of the social domain once students had to work together to design their games, until very recently, there were not much empirical data that was able to support this claim. Casey and Hastie (2011) developed a study in which they investigated students' responses while engaging a SDG unit. The authors major findings were: students did respond positively to SDG and they made an effort to include every student in the process; students sought for games that were innovating,

that avoided skills that could only be performed by a few (therefore being inclusive once again) and that were influenced by popular culture (from popular movies); and last, students enjoyed their freedom of choice while designing their games. In addition to gaining understanding of how students responded to SDG, more empirical data was needed to identify what students learned from SDG. Casey, Hastie and Rovegno (2011) once again used wikis with SDG to investigate what were the students learning while designing their own games. The authors major findings included: gain of game appreciation by understanding how rules impacted the game and how rules and tactics were interconnected; and understanding how the environment (court or field dimension) impacted the game.

Although other books in the past (Morris & Stiehl, 1989; Lichtman, 1999) have been somehow related to SDG (presenting how teachers could modify games and listing a number of examples of modified games), it was in 2010 that the first book exclusively dedicated to SDG was first published. Hastie's (2010) "Student-designed games" presented a number of teaching strategies and examples of SDG that were successfully implemented. The book also presented a template for each game category with leading questions that students need to address when creating a game. The book can be considered groundbreaking for giving physical education teachers guidelines on how to teach SDG. In addition, it also added a fifth category of games: the tag games, which were not included in Thorpe, Bunker and Almond (1984) first categorization of games.

After five decades since the idea of SDG first emerged, much has been claimed but little has been supported with empirical data. SDG have been claimed as the 'hero' of physical education, being able to address every domain of a child's development (psychomotor, cognitive and social) and tackle many issues that are commonly related to physical education classes.

Unfortunately, this phenomenon of self-coronation is not new in physical education. Physical education itself has been claimed as an educational discipline able to address not only many educational issues but also issues that have not been well addressed by society as a whole. Mandigo, Corlett and Lathrop (in press) have identified that physical education has claims of being able to tackle social injustices, sexually transmitted diseases, violence, youth delinquency, life threatening diseases (obesity, type II diabetes, and high blood pressure), promote understanding among historical enemies, among others. On the other hand, the reality have shown that physical education has promoted many undesirable outcomes despite its intention (Ennis, 1996). In summary, like physical education, SDG need to differentiate its potential (what have been claimed) to what it is known (what have supporting empirical data).

Student-Designed Games: What We Claim to Know, What We Actually Know, and What We Need to Know

In order to provide a critique of what has been developed in the SDG literature, the study presented by Antunes et al. (2005) is used as a theoretical framework to explain the evolution and weaknesses of what has been developed up to date. Antunes et al. (2005) were able to establish seven major groups that categorized the main areas of physical education academic production; four of these categories will be adapted to explain the evolution of SDG literature production: (1) characterization, (2) purpose, (3) learning process and (4) physical education teacher education (which will be named as SDG teacher education). The characterization category refers to studies that tried to answer the question: 'What consists a SDG teaching unit?' In other words, defining everything related to the organization of the SDG unit (teacher's role, number of students per group, duration and all the procedures). The purpose category refers to studies that sought to understand how SDG could be used to reach physical education goals and

objectives. The learning process category refers to studies that seek to optimize students learning in SDG teaching units. The SDG teacher education category refers to studies that seek to understand the process of providing formal training for implementing SDG.

According to Antunes et al. (2005) the evolution of physical education academic production could be noticed when moving from the first two categories (characterization and purpose) to the last two (learning process and teacher education). The reasoning for this analysis is that an academic production of a field must first delimitate the subject matter (characterization) and define its usefulness (purpose) before it seeks to enhance its implementation (learning process) and formally train others to apply it (teacher education). Following this same train of thought, it is possible to understand how SDG literature has progressed up to date and what its remaining weaknesses are.

The characterization of SDG has been its major advance in the literature. This category of research has been the focus of SDG studies from its emerging idea with Mauldon and Redfern (1969) until very recently with Hastie's (2010) book to explain the process of teaching a SDG unit. Although the great majority of the studies that tried to characterize SDG do not present supporting data, it is not a major drawback in this form of research, once the delimitation of this form of teaching is theory based and with trial and error studies that may not require such a rigorous data collection. For instance, Rovegno and Bandhauer (1994) were able to report ten misconceptions of SDG by only observing students in an elementary school. The study did not report any other form of data collection that could have been triangulated. In spite of its 'lack of rigor' it became one of the most cited studies in the area for being responsible to delimitate what should be part of SDG and what should not. Many other studies that were either theory based or without rigorous methodology have also contributed to characterize the SDG literature (Almond,

1983; Butler, 2006; Cox & Ledingham, 1988; Curtner-Smith, 1996; Giménez, 2011; Hastie, 2010; Smith, 1991).

Although the characterization category may not require much empirical research to delimitate SDG, in the purpose category it is essential that empirical data are able to support if SDG is or is not able to reach physical education goals and objectives. SDG have been claimed to teach students to: develop motor skills (Mauldon & Redfern, 1969; Rovegno & Bandhauer, 1994); gain game appreciation (Almond, 1983; Curtner-Smith, 1996), think critically (Cleland & Pearse, 1995; Rovengno et al., 1995), develop social skills (Butler & Hopper, 2011; Curtner-Smith, 1996) gain understanding on the concept of democracy (Butler, 2006), and to motivate unmotivated students (Oliver et al., 2009). These are just a few examples in which SDG have been claimed as a versatile teaching format that is able to teach almost any physical education goal. However, *none* of the studies cited above provides any empirical data that is able to support this claim.

There are only three studies that presented supporting data while reporting what students learned when involved in a SDG teaching unit. Casey and Hastie (2011) have reported extensive findings on how students responded positively while being engaged in a SDG unit, being able to develop teamwork and include every student's voice when designing their games, therefore teaching positive social skills. Hastie et al (2010) and Hastie & André (2012) were two studies able to report that students did gain game appreciation while participating in a SDG unit. Therefore, some of the claims that were presented in previous research without any supporting data were confirmed by empirical research. However, this does not diminish the necessity of extensive empirical research to learn more of what SDG is able to teach and what may be a false claim. Hastie (2010) present SDG as a potential approach to reach seven standards developed by

the International Council for Health, Physical Education, Recreation, Sport, and Dance (ICHPER-SD) and the United Nations Educational Scientific and Cultural Organization (UNESCO): (1) movement competency and proficiency, (2) knowledge and application of movement concepts, (3) healthy-enhancing fitness, (4) physically active life style, (5) personal and social behavior, (6) understanding and respecting individuals differences and (7) personal meaning derived from physical activity. Although it is exciting to consider that SDG may promote so many learning related to physical education, much research with supporting data is needed to ensure that these goals can be reached with this form of teaching.

Once SDG literature is still in the process of understanding what it can actually teach, it comes with no surprise the fact that the last two categories (learning process and SDG teacher education) presents the smallest progress up to date.

Within the learning process category, a couple of studies exist that seek to optimize some of the issues related to SDG teaching in order to provide students a better learning experience. As mentioned previously, there has been two studies that presented successful interventions to ensure that every student is part of the process of designing a game, one of them presented the jigsaw classroom project (Hastie & Casey, 2010) and the other offered specific student roles in the SDG process (Giménez, 2011). In addition, another study also analyzed how students responded to technology integration while participating in a SDG teaching unit (Hastie et al., 2010). As a result, more empirical research is needed to gain understanding on how students learn best in SDG teaching units. Many of the research questions may arise from the same inquiries related to the physical education learning process research. For instance, Hastie and André (2012) compared male and female students and low skill and high skill students in terms of their designing approach. The authors reported that girls were more planners (plan the whole

game before trying the rules) while boys were more doers (tried every new rule while playing the game). In addition, the same study found that despite many differences among low skilled and high skilled students, they all sought for games that avoided on waiting for turns (e.g. baseball). So what would be the best form of learning: a diverse group of students that would have to learn to accommodate different expectations or separated homogeneous groups that are able to relate to each other better and therefore provide better outcomes? These questions related to gender and skill level differences are very often approached in the physical education literature. Hence, looking into the questions that have already been investigated in other forms of teaching but applying these questions in SDG teaching units may improve the literature understanding on how students learn best in SDG.

In addition, the research related to the learning process category would also have to address the different forms of use that have been given to SDG. According to Darido and Rangel (2005) there are four major topics that compose a teaching unit: goals/ objectives (what is the purpose of the lesson?), content (what will you be teaching?), strategies (how will you teach it?) and assessment (how you will evaluate?). SDG have been approached as a content (Hastie & André, 2012), as a strategy (Oliver et al., 2009) and as an assessment (Casey et al., 2011). Although, there is no reason to think that SDG can only be used in one of these forms, it important to understand how each form is applied to suit its purpose.

The SDG teacher education category has only one published study, showing that in spite its growing acceptance, SDG is still not part of the formal curriculum on most physical education teacher education undergraduate programs of universities. Butler et al. (2009) is the only study that analyzed how pre-service teachers responded while teaching a SDG unit. Although the study does report a positive response, there is not much evidence on how they were formally trained. In

addition, the study reports a very particular form of approaching SDG as the author uses the invention of games to teach students about democracy. Therefore much research is needed to understand how undergraduates should be introduced to SDG and once again addressing its particularities when approaching SDG as a content, strategy or assessment.

In summary, there has been extensive effort to define SDG and the literature has shown maturity to delimitate what can be considered SDG and what should not. In the process of understanding which physical education objectives and goals can SDG address; there has been recent progress that shows a transition from assumptions and hypothesis analysis to empirical investigations. Understanding students' learning process in SDG is currently in its initial phase of investigation, and much can be accomplished by promoting different forms of interventions already proposed in the literature or looking into some of the issues also presented in the physical education teaching literature. Last, SDG teacher education may be optimized by integrating the other inquiries above-mentioned with pre-service teaching or outreach programs promoted by universities.

Technology Integration in Physical Education

Research involving the integration of technology in physical education (TIPE) has a very brief history. Mohnsen's (1995) "Using technology in physical education" first edition was published seventeen years ago, establishing the landmark of when technology integration in physical education (TIPE) was first introduced in the academic literature. In terms of technological advances, seventeen years can be considered a very long time, during this time period, many technological devices that could be related to physical education application were launched: Dartfish (1997), iPod (1998), Flip-camera (2006), Nintendo Wii (2006), iPhone (2007), iPad (2009), Xbox Kinect (2010). In addition, other devices that were already launched

prior to 1995 were becoming popularized for being more affordable and user-friendly, such as pedometers, digital cameras, laptops, and portable projectors. Nevertheless, this same time period can be considered very brief for the development of TIPE as an academic subject matter that is able to enhance physical education teaching. In order to gain ripening as an academic subject matter in the physical education research, first, it is important to gain an understanding of its purpose (what is TIPE's role in physical education) and its characterization (what consists TIPE?) (Antunes et al., 2005). Unfortunately, due to its brief history neither of these topics is yet clarified in the literature.

In 2005, the National Association for Sport and Physical Education ([NASPE], 2005) published a revision of the guidelines for physical education teacher candidates to establish the standards for physical education teachers. NASPE's revisions were made in order to meet the National Council for Accreditation of Teacher Education ([NCATE], 2005) standards that were publish earlier in the same year. Among the ten standards that were defined by NASPE/ NCATE, technology was one of them, therefore, establishing the importance of including TIPE as part of the physical education teacher education (PETE) curricula of universities. Within these standards, NASPE seeks to ensure that every physical education teacher develops the knowledge and ability to use technology in order to enhance students' experiences and learning. Nevertheless, the definition of technology is not clear and changes constantly. As a result, many questions related to the use of technology by physical education teachers may arise when considering these guidelines. Mitchell (2006, p. 24) considers the addition of this standard as 'contentious' while rising a series of questions, including: "What is appropriate technology in which candidates should develop competence? Should all candidates implement the use of heart rate monitors or pedometers into their teaching? Should candidates use a computerized fitness

program such as Fitnessgram to measure and record fitness scores? Should candidates use digital video to record skill performance for later student analysis?" These questions are placed in a provocative form to call attention to the reader that although NASPE obligates every future teacher to know how to implement technology in their teaching; it is still vague how this should be done. However, Mitchell (2006) agrees with NASPE's (2005) guidelines as viewing technology as a tool, meaning that the diverse devices or software should be used to improve students learning.

The idea of having TIPE as a supportive tool appears as a logical choice while considering the possible choices. As mentioned previously, there are four topics that compose a physical education teaching unit: goals/ objectives, content, strategies and assessment (Darido & Rangel, 2005). Considering that the goals/ objectives and contents should be related to the physical education curriculum (and not to the technology education curriculum), the tools provided by TIPE should be either related to the teacher's strategies while seeking on different approaches to enhance students learning or while assessing students' performance and learning.

In light of this, the majority of TIPE studies have limited their purpose to sample how diverse technologies can be used in physical education classes. In other words, most of the research in this area has only focused in presenting diverse ways to use technology as a supporting tool without presenting empirical data that is able to support the successful usefulness of technology in physical education. The two TIPE's textbooks presented in the in the literature (Castelli & Fiorentino, 2008; Mohnsen, 1995, 2010) also follow this same trend of presenting a series of examples on how to use technology in physical education.

As mentioned previously, the technological advances and academia advances have a very different pace. Therefore, the studies that work as 'instructional guides' describing how to use a

specific technology in physical education are likely to always have room in physical education journals that have teachers as their major audience. However, the present literature review will focus on presenting studies with empirical data that show to have a significant contribution to the better understanding of TIPE. The studies found in the literature were broken down into two major categories: (1) teacher education and professional development and (2) application. The research under teacher education and professional development is related to understanding how physical education teacher education and ongoing professional development courses can enhance teachers' preparation for feeling more confident and competent to apply TIPE in schools. The research under application category presents some form of intervention in all school levels, including K-12 and higher education. In the following, the literature review will be divided in the categories that were presented, showing research-based studies that have shown a significant contribution for the understanding of TIPE.

Prior to presenting the literature review, it is important to acknowledge a delimitation from the papers that were reviewed: they are all related to physical education programs. In other words, after-school programs or any other intervention that may have been implemented in the school setting but it is not part of physical education regular classes will not be included in this review. It is understood that many extra-curricular activities (very often related to combating obesity) have reported many interventions with technology integration, but they represent a different environment and different challenges to be overcome, therefore these studies would not assist the understanding of technology integration in everyday physical education classes.

The Physical Education Teacher Education and Professional Development in Technology Integration

The research involving physical education teacher education (PETE) and professional development (PD) in TIPE were broken down into two major focuses: initial analysis and teacher training (PD and PETE). The initial analysis research seeks to gain understanding of whether current physical education teachers are using TIPE and what are the major incentives and barriers for the improvement and expansion of TIPE in schools. PD research seeks to gain understanding on what kind of interventions have had a bigger impact in physical education teachers in order to promote TIPE in schools. The PETE research seeks to gain understanding of the different forms of formal training in undergraduate and pre-service teachers that may enhance TIPE in schools.

Identifying the barriers and motivations for TIPE

The following three studies are part of the initial analysis research, all these studies together are able to provide a broad analysis on how TIPE has been implemented in diverse scenarios once each study was conducted in a different country (United States, England and Turkey). These were the only three studies found in the literature that would fall under the initial analysis investigation in the past ten years, although their different origins and backgrounds occurred by chance, it is important to acknowledge the differences and similarities on how technology integration may have in different places.

Although they all seem to agree with the belief that current physical education teachers have not been given any formal training in their undergraduate teacher education program, they have also given different options and approaches to resolve this matter. Thomas and Stratton (2006) present the first major difference while approaching TIPE implementation in England

(when comparing to the approach adopted in the United States). The authors call attention to the fact that despite recognizing the importance of technology integration in all subject areas, the British Educational Communications and Technology Agency's (Becta) does not require that physical education teachers use technology in their classes until empirical research can prove the benefits of this integration. As a result, formal training is not required in current PETE programs in England. As previously reported, the United States had the opposite approach, requiring that all future physical education teacher candidates should have formal training in technology integration.

Thomas and Stratton's (2006) study identified the English TIPE throughout four major aspects: (1) what equipment were the teachers using; (2) what kind of training did the teachers receive; (3) what were teachers' attitudes towards TIPE; and (4) which teaching approaches were they taken when using TIPE. The study applied a survey with 231 physical education teachers from all parts of England. Findings showed: (1) the most used technological device was the CD player; (2) despite not requiring TIPE, 41% of the teachers received professional development workshops by educational government agencies; (3) 92% of the physical education teachers valued the integration of technology to their classes; (4) TIPE was most used as an assessment tool, ranging from 30% to 50% depending on each part of the country that was being reported. In spite of being able to give an overall picture of TIPE implementation in England, it was not clear how many of the teachers that responded the survey actually used TIPE regularly. The English teachers reported a massive support on the use of technology in physical education but it is unknown how much is actually implemented. In addition, despite the government support in professional development, teachers also considered this training as ineffective.

Yaman's (2008) study had a similar approach to Thomas and Stratton (2006). In this Turkish study, the author applied a questionnaire with 64 questions for physical education teachers from 81 different provinces of Turkey. The study was able to identify what were the major devices used in TIPE and who used the most. Apart from physical education equipment, blackboards were the most used supporting tool (50% of the participants), followed by television, videocassettes and CD players (all with 35% of the participants). Although the author does not discuss these findings, the present review suggests two hypotheses that may explain this outcome: (1) the teachers use these technologies the most because they were the ones that they have the most access; (2) the teachers use these technologies the most because they know how to use them. In England, the CD players were the most used technology because they were part of most schools equipment (Thomas & Stratton, 2006). The study was also able to report the teachers' three major characteristics that fit the profile for integrating technology the most: female, having a master's degree and having received formal training. These were the three characteristics that reported statistical difference, suggesting that once again, formation (in training and in years of education) plays an important role in TIPE.

The study presented by Woods, Karp, Miao, and Perlman (2008) follows similar procedures from the other initial analysis studies presented, however, unlike the other two studies, it relates to a particular region of the United States, instead of applying the survey in multiple regions of the country. The study applied a survey in the northwest region of the country, having 114 physical education teachers responding the survey through e-mail. The survey was designed to investigate teacher's perception in TIPE, more specifically: (1) the teachers' perceived competence in applying TIPE, (2) where the teachers learned to use technology, (3) teachers' application of TIPE. The research findings were: (1) male teachers

reported a significant higher difference in their perceived competence when comparing to female teachers; (2) there was no consensus where teachers learned to use technology, having internships, fitness gyms, sport participation and exercise science courses among the responses; (3) the three major reasons why teachers use technology in their classes were: student assessment, visual aid and understanding individual development (pedometers and heart rate monitors that showed students' progress).

Another American study that may enhance our understanding in identifying the usefulness of technology in physical education is presented by Russell (2007). Although the author does not provide such a broad analysis by focusing in teachers' perceptions and attitudes to use videogame technology in classes, it is also enlighten to identify teachers major barriers. The study applied a survey with 36 K-12 physical education teachers to gain understanding on their willingness to apply this form of technology in physical education classes. The study major findings were: (1) teachers that had a more positive attitude to technology were more likely to integrate this new approach in class; (2) teachers that had better attitude towards technology had a better understanding of what this new approach could provide in their classes; (3) secondary teachers presented a better attitude in implementing this technology; (4) teacher with less teacher experience (less than five years) had better attitude in incorporating this new technology in their classes. Although these results do not mention the importance of training teachers in order to use TIPE in their classes, it is likely that the teachers' positive attitude is related to their knowledge in technology as a whole. This claim is supported by the fact that less experienced teachers, and therefore younger, had a better attitude, once technology have been more part of their life when comparing to older teachers.

Another important finding from an American perspective is reported in the study presented by Ince, Goodway, Ward, & Lee (2006). According to these authors, another important restraint that plays a role in using TIPE in their classes is time. The study findings show that teachers may take up to five minutes to hand out pedometers to their students which is over 15% of class time for elementary school. This may be a good explanation why elementary teachers are less likely to implement technology in their classes, as younger students are less autonomous and therefore more time is necessary to manage these devices. On the other hand, Thomas and Stratton's (2006) study claims that in order to avoid time as a major restrain in TIPE, it is important that students should to be trained to help teachers in organizing these devices.

In summary, although the challenge of ensuring that TIPE is part of every school may have multiple reasons that transcend school resources and teachers willingness to embrace this form of teaching, one common denominator came across all studies: formal training. The more educated and aware of what technology is able to do, the more likely they were to use TIPE in their classes.

Preparing physical education teachers to use technology

There are two formal ways to train physical education teachers to use technology: in their PETE and while they are working in schools with PD programs. Only one study of each case was found in the literature.

Ince et al. (2006) proposed an experimental research in order to compare if teachers that received PD in TIPE were more likely to use technology in their classes while comparing teachers that did not receive the same training. The PD proposed in the study involved four forms of intervention: giving the teachers a number of technology devices (computers, digital cameras, PDA, heart rate monitors, pedometers, Fitnessgram and lesson and assessment

templates); (2) a two day workshop to learn how to use the given equipment; (3) five day workshop to teach curriculum models (sport education, tactical, teaching social and personal responsibility, cooperative learning and fitness); (4) ongoing support via e-mail, phone and personal visits for a full academic year. Within a pretest/ posttest procedure, the research analyzed the influence of the PD program in teachers' perceived competence and attitude towards TIPE. Although the research shows a positive influence in the PD intervention, neither of the variables (perceived competence and attitude) reported a statistical significant difference. The study suggests that the random selection of the control group might have an influence in the study's outcome given there were a great number of younger teachers in that group. Although the study does not discuss the possibility of proposing an inefficient PD program, future studies should also consider different forms of interventions in order to compare the outcomes.

Another two studies used technology to promote PD programs. These studies did not focus on preparing teachers to use TIPE, but they used the internet as a form of distance/ online learning to promote PD. In Slovenia, Majeric, Zvan, and Kolenc (2008) reported how electronic learning communities have had an impact in PD of physical education teachers, helping teachers with didactic materials and teaching plans. The study also shows that e-mails and internet forums were the most used ways that mentors (teachers involved in developing PD programs) chose to communicate with students and teacher seeking for professional support. Another similar study analyzed how physical education teachers have used NASPE's listserv to provide mutual support with professional issues, teaching activities and strategies and even TIPE (Pennington, Wilkinson, & Vance, 2004). According to the authors, almost 8% of the analyzed messages related to the discussion on how to incorporate technology in physical education, the subject messages ranged from teachers ideas to book and online courses recommendations.

Unfortunately, no empirical research has been reported that describes successful implementation of TIPE in PETE undergraduate programs. Gubacs (2004) presents the idea of introducing TIPE education at Montclair State University, using a project-based learning process in which students are encouraged to create projects in physical education using technology devices. The study shows every step of the process from defining the project idea until its implementation and assessment but it does not provide a research-based evaluation of the program. Nevertheless, Sobral, Faro, and Edginton (2008) provides an analysis of the first year of a PETE master program focused in TIPE. The authors reported that students were able to have a better understanding of technology integration and that they were able to relate to multiple slopes of physical education that ranged from physical fitness to pedagogy strategies and curriculum assessment.

Despite its modest appearance in literature, formal training in TIPE appears to be a growing segment of PETE and PD programs. These studies are fundamental to gain the perception that teachers need to not only know how to operate these technologies but also understand how to relate to physical education objectives. Ince et al. (2006, p. 439) presents a few principles that teacher-training institutions should consider when teaching TIPE, four are presented as the core guidelines: " [1] Do not rely on one course to teach the operation of technology, but instead integrate technology into coursework in content and methods classes; [2] Require teacher candidates to use technology in their field placements; [3] Provide technology to them, when it is not available at their school sites; [4] Provide teacher candidates with information as to how they might access grants to support technology once they are in service."

The Application of Technology Integration in Physical Education

The research involving the application of TIPE is majorly composed by non-empirical research that works as 'instructional guides' to use diverse technological tools. As a result, it was extremely challenging to find research that provided supporting data that was able to justify a proposed intervention. In the following, application research is broken down into two categories, according to the level of education in which it is focused: K-12 and higher education.

K-12 technology integration application in physical education

The following studies show how TIPE application requires a much deeper understanding than just knowing 'how to use' a specific technology, clarifying the pedagogy behind the technology integration.

Thornburg and Hill (2003) propose the use of an internet website for teaching and assessing knowledge based health related instructions related to a fitness unit of a middle school physical education class. The twenty seven students that took part in the study accessed the website in the school library as part of the requirements for physical education. While using the website, students answered questions related to nutrition and physical activity engagement. The questions were designed in a way to encouraged students to evaluate their own health behavior. In addition, the website provided a nutritional analyzes and assigned other websites in which students were able to research about nutrition. The intervention major focus was to replace a knowledge-based instruction that would have to been given by the physical education teacher within a lecture approach with an online instruction and assessment. The results reported that 80% of the students enjoyed this approach and the majority also reported an understanding of "eating right" (75%) and "being fit" (87%). More importantly, the students reported that the

web-based instruction encouraged them to think more critically about their eating habits (55%) and activity habits (63%).

A similar approach is presented by Lazerte and Lathrop (2006) which also uses an internet website designed to influence students' participation, motivation and attitude towards physical education. In this study, the internet access did not have a designated time, so students accessed the internet in different places (in their own homes, in friends or relatives houses and in the library). Unlike the Thornburg and Hill (2003) study, this website did not have a specific aim of what students were supposed to learn, it presented a variety of thirteen options (e.g. 'healthy living', 'get moving and practice your skills', 'sports trivia' and 'talk to the teacher') in which students could navigate according to their own choice. A pretest/ posttest design was used to investigate the website's influence on students' physical activity engagement. The findings were positive, reporting that 35% of the students were able to learn physical activities that they would be able to do with their families and that the majority would either use the website frequently (38%) or almost always (24%). The teacher was also interviewed and confirmed that students showed to be having a more positive attitude towards physical education classes.

Hastie et al. (2010) also used an internet tool to analyze the impact that would have in physical education classes. Nevertheless, these authors would have a different approach, as the students would not use the internet to learn a specific knowledge, instead, they would be using a wiki[2] to relate to their peers and teachers while designing their own games that were ought to be played in their physical education classes. The study involved 28 male students from ten and eleven grade (ages between 14 and 16), the physical education teacher, the librarian and the researcher as the student-designed games (SDG) outside expert that could provide more specific

[2]A wiki is an online software that enable users to create and edit their own web-pages. In addition, the wiki provides an open-editing system in which allow a 'intensely collaborative' in which empowers anyone to edit any page

feedback. The students had only one class per week, but they would be able to relate to each other and by using the wiki. The students were broken down into small groups to design their games. Each group had a wiki-manager that was responsible for editing the wiki and make the game's modifications official as they progressed. The teacher, librarian, SDG expert and the other students were able to input comments as the design progressed. The purpose of the study was to investigate the impact of TIPE, the research major findings were: (1) 'the extended classroom', i.e. the 40-minutes physical education class was extended throughout the week as students were constantly engaged in developing their games and updating the wiki; (2) 'immediacy accountability', i.e. teachers were able to provide constant feedback throughout the week (although this also represented more workload for the teachers); (3) 'better games', once there was a much bigger engagement than the mandatory 40-minutes per week, the outcomes were also significantly better than expected; (4) sharing ideas, i.e. students not only shared ideas and thoughts among group members but also interact with the members of other groups that were dealing with the same process; (5) 'positive interdependence', i.e. students would have to rely on each other, promoting a positive social relationship that even gave voice to unskilled students that had a history of not having a major role in physical education classes.

The only study found in the literature that did not have the internet as the major technological tool was presented by Clarke (2008). In the study, the author used digital video discs (DVD) to teach motor skills to students. The students were broken down into pairs and received a portable DVD player to watch how to perform the skill that they were learning. The idea of breaking students into pairs was that each student could provide feedback on peer performance while watching their performance and the video. A total of 109 students and 6 teachers from five different middle schools participated in the research. After the intervention,

students reported their experience with the DVD learning by responding to a survey, and teachers were interviewed to provide their perspective. Although some students showed resistance, the majority reported having a positive experience, particularly enjoying coaching other peers, being able to learn on their own pace and feeling empowered to be trusted with such an expensive device. Teachers also had a positive response and recognized that in order to make this form of teaching work, teaching styles had to be suited to this approach, breaking students into small groups, empowering them and promote critical thinking as students would have to coach others.

Although there is a limited literature that provides empirical data that is able to support TIPE, an important conclusion may be taken from these studies: different technology designs require different teaching styles. The two website studies limited students' actions to navigation of the internet and expect a behavior change in terms of their nutrition or physical activity engagement, showing to relate to a more traditional style in which students should acquire their knowledge from a given database and react positively. On the other hand, the studies with the wiki and the DVD learning, students were encouraged to take action while creating their own game or coaching another student, showing to relate to a constructivist approach that empower students and require their engagement in the learning process.

Higher education technology integration application in physical education

Only one study that applied technology integration in undergraduate physical education classes was found in the literature. Hastie and Sinelnikov (2007) presented the use of an electronic portfolio to assess a volleyball class for undergraduate students. The study presented an overall purpose of developing a digital assessment for physical education in higher education,

analyzing if students were able to complete an electronic portfolio[3] and if the portfolio itself was able to assess: (1) their enjoyment in class; (2) their team affiliation; (3) their learning process of developing and publishing pages. The seventy students were taught within a Sport Education[4] approach for a fifteen weeks period and had the electronic portfolio as their only assessment tool. All electronic portfolios were sent to five different sport education experts and they all agreed that the students presented all features of sport education in their web-page. In addition, a survey was implemented to analyze students' perception to this form of assessment. Students showed to have a positive response to the use of portfolios, increasing their team affiliation, and enhancing other forms of learning not expected in the class (e.g. designing the web-page). However, students also recognized that this approach was more challenging than other physical education classes and that some students had to work harder to compensate others that were not as engaged.

Despite the lack of research in physical education in higher education, most colleges in the United States require at least one physical education course among the elective courses for every major (Leenders, Sherman, & Ward, 2003). As a result, TIPE in higher education may play an important role in assessing these courses, since higher education evaluation in general has reported a growth in using technology (Millwood & Terrell, 2005). More importantly, this form

[3]In physical education, portfolios are used to sample students' performance to serve as the measure of learning. The digital portfolio uses different forms of electronic technologies, that are able to collect and organize different type of medias (video, audio, graphics, text), and to transform them into computer-readable formats (Hastie & Sinelnikov, 2007).

[4]Sport Education is a physical education model that seeks to provide a more authentic sport experience by including six major features in the physical education classes: season, team affiliation, competition, record keeping, culminating event and festivity (Siedentop et al., 2004).

of assessment not only ensured that students were evaluated in their courses but also enhanced their overall experience and learning, showing to be an efficient form to evaluate the students.

Developing TIPE Literature: Empirical Research that May Support this Goal

As previously presented, TIPE academic research is still developing, having no clear delimitation and full comprehension of its full potential. Even with the growth of empirical research production, it is likely that this subject matter will always have a feeling of falling behind due to the fast pace technology industry. Nevertheless, this should not be a reason for discouragement, as technology integration may revolutionize physical education as it has been doing with so many other areas of our daily life. Thus, this final topic will be focusing in identifying needed research that may support our understanding of TIPE's full potential. The same categories and subcategories presented in previously are considered when analyzing how each particular area of TIPE can support the understanding of this subject matter as a whole.

The studies focused in identifying the barriers and motivations for TIPE in schools should be largely expanded. In order to understand what promotes and what restrain TIPE, it is necessary to identify what causes these reactions as much as possible. In light of this, future initial analysis research should not only focus on 'what equipment is used' and 'what is the profile of a teacher that promotes TIPE', but also identifying 'what are the region major needs'. In other words, in order to promote authentic technology integration, it is important to contextualize what is needed and expected from each place, approaching not only physical education teachers but also students, school administrators, and policy makers. From the current literature, the Thomas and Stratton (2006) study can be taken as an example given they were able to break down their results among the different parts of England. Nevertheless, this study did not identify what is expected or needed in each region. This form of approach may require a joining

of forces with other research areas, but this should not be a restraint for providing a reliable and contextualized integration of technology in physical education.

The studies that focus on formal training to promote TIPE were divided in two forms: PD workshops and programs for teachers that are already settled in schools and PETE programs for teacher candidates. In the proposed PD program presented by Ince et al. (2006) there was a focus on providing resources and support for the teachers, but the program still lacked in integrating to the teachers reality. Once again the integration portion of 'technology integration' appears to be missing. Prior to showing how teachers should incorporate technology, it is also important that researchers understand what are teachers' expectations and fears. Therefore, the PD research should have a three step process: (1) interviewing teachers and students in order to understand their expectations; (2) proposing an intervention that may relate to teachers and students' needs; (3) evaluating the success of the proposed program. Although it might not be as effective, an alternative to this process would be the creation of multiple interventions for PD programs and giving the teachers the opportunity to choose which would best fit their needs.

The PETE programs studies may be considered the most challenging form of TIPE research. The few studies that reported how undergraduate and graduate programs are preparing future teachers to use TIPE were mostly descriptive, showing that PETE programs are still seeking for an identity on how to teach TIPE. Although much can be learned from TIPE application research, the focus of PETE studies should be related to answering the following question: 'Are we being successful in teaching our students to use TIPE?' In order to answer this question it would be necessary to create a tracking system, i.e. verify if students graduating from each PETE program are using TIPE. This form of approach may require longitudinal or trans-

sectional methodologies which would raise difficulties on the research implementation, but it would be an effective form to evaluate if teachers are able to use TIPE after years of graduation.

The studies focused on the application of TIPE were divided according to their school level (K-12 and higher education). In the studies related to K-12, there were a few good examples of TIPE usefulness to enhance students learning and assessment and even to increase class time (Hastie et al., 2010) and to avoid taking activity time away from students (Thornburg & Hill, 2003). In addition, the most important finding from these studies was related to the pedagogy behind each intervention, showing that different technologies and purposes require different forms of teaching. The teaching style behind each intervention should be the centerpiece of TIPE application research, understanding the teaching styles for each intervention may be the key factor that enables TIPE proliferation in schools. In light of this, another form of research not found in the literature is proposed: comparing teaching units with and without technology integration. It is important to understand what kind of learning may be highlighted and what can be restrained while using technology integration. TIPE is not being proposed as the 'answer of all physical education problems' and understanding its best fit may require a comparison to a form of teaching that does not use technology.

Last, the research involving application of TIPE in higher education can be considered the easiest form of conducting research among all categories. As aforementioned, most universities have physical education courses being offered for every student major, and many of these courses are taught by graduate physical education majors which is a clear connection to researchers. This creates a perfect scenario for the researcher: many participants available, graduate students that are able to implement an intervention and collect the data, resources from the university and support from staff specialized in technology. In spite of this supporting

scenario, this was the category that reported the least amount of research. Not only is this scenario inclined for this form of research, it also has a great potential to incorporate physical education students, therefore the research itself could be part TIPE's education in the PETE programs. As aforementioned in Hastie and Sinelnikov (2007), TIPE may help the creation of assessments in higher education physical education; in addition, it may also help the learning process of students as proposed in the K-12 application studies. Once again, the teaching styles should be an important piece of the research, ensuring that TIPE usefulness relates to the form of teaching that is being proposed.

In conclusion, there are diverse ways in which TIPE academic research may be developed. However, the most important learning that can be taken from this review is that in order to promote a significant development in TIPE academic research, more attention is needed in the 'integration' component. Technology has been so successful in changing our life for being able to cut-corners while doing multiple tasks. Therefore, technology integration requires the integration between technology and your audience and your goals. In technological terms, it is necessary that TIPE academic research establishes a good connection between hardware (the machine) and software (what is the machine programed to do).

The Connection between Student-Designed Games and Technology Integration in Physical Education

Education has been moving from a knowledge-based approach towards a research-based approach. In other words, it has become more important to be engaged in the process of learning and finding out on your own than memorizing content without asking why or sometimes not even understanding the subject matter. Information is no longer a privilege as our society organization has turned it increasingly public. Therefore the educational system has had to

modify its priorities, this changing process started with the development of constructivism. According to Rovegno and Dolly (2006) constructivism emphasizes the importance of students being actively engaged in the subject matter in order to understand what is being learned. As a result, the teacher would have a new role in this approach, performing as a facilitator rather than an instructor, therefore, the so-called constructivist approaches would be considered student-centered.

As a result, constructivism would be the major theoretical framework for many physical education models that arise in order to create an environment in which the student had an active learning process. As constructivism started to become well-known in the 1970s, the first physical education models arose in the 1980s and 1990s, such as: Teaching Games for Understanding (Bunker & Thorpe, 1982), Sport Education (Siedentop, 1994), Sport for Peace (Ennis, 1999), among others. Although these models have shown a concern to engage students in the learning process, it still did not give students the opportunity to feel more empowered in terms of the content that is being developed.

SDG and TIPE appear as possible alternatives to modify this scenario in which the student are empowered to be an active learners but are constrained in terms of the content they should learn and develop. SDG and TIPE present different roles that may be complimentary. On the one hand, SDG is based on the foundation that students should create their own games in order to focus on the learning of something meaningful and at the same time relates to physical education contents as the discipline should also address its educational goals. On the other hand, TIPE is commonly associated as a supporting tool that does not have specific educational goals related to physical education; instead, it provides strategies that may enhance students experience while learning different subject matters. In order to illustrate a clearer scenario why SDG and

TIPE are able to establish a positive relationship, two major rationales are presented: (1) the theoretical framework behind SDG, (2) the search for creativity and integration.

As previously stated, SDG appear as an alternative that not only is student-centered but also empowers students in providing the content that will be explored. As a result, although SDG relates to constructivism in physical education (Rovegno and Dolly, 2006), SDG came to introduce constructionism in physical education. Constructionism is a form of teaching that give students the opportunity to design and think about the subject matter that is ought to be learned while creating something new (Kafai & Resnick, 1996). Kafai and Resnick (1996) introduced the concept of constructionism while developing a technology integration project. Fifth grade students were asked to develop mathematics videogames (games that provided mathematics problems and challenges) to younger students that were able to teach the subject matter to this younger audience. The project showed the value of developing an understanding of the subject matter as students sought to develop entertaining ways to teach math. Therefore relating SDG, technology integration and constructionism, but being related to mathematics and not physical education. Therefore, the current study suggests the same principal of integrating all these three concepts, but referring to the discipline of physical education.

Designing a new game and using technology is commonly related to the usefulness of creativity and for this matter these two approaches may also establish a good relationship in physical education. Although SDG are commonly related to games that already exist and therefore it does not mean that it seeks for something completely new, its creative essence does seek for a change. In most SDG research, the authors are able to report that students identify elements of the games that students wish to avoid (e.g. like waiting for turns in striking and fielding games) and change this reality. Likewise, TIPE is often used to simplify duties that may

be tedious or overwhelming into more interesting or simplified ways (e.g. assessment tools), i.e. it also seeks for creative alternatives that are able to enhance the overall experience. Therefore the idea of creativity in which SDG and TIPE relate does not have to do with the creation of something new (although it may occur), but it does relate to the idea of creating something meaningful and more pleasurable.

In addition to its creativity essence, both SDG and TIPE have been claimed to be so powerful and versatile once they are able to relate to multiple possibilities, empowering not only the students for creating something that is meaningful to them, but also teachers for being able to orientate these approaches towards uncountable directions. As a result, SDG and TIPE can be highly empowered by the concept that has been changing our life in the 21st century: integration. Both SDG and TIPE have been able to relate to multiple physical education models, other school disciplines, and even different school environments. Therefore it is natural to suggest that SDG and TIPE are able to work together towards a common goal as they have been able to relate to other subjects and approaches that were not as versatile.

At last, SDG and TIPE would together be promoting the "education as a liberty practice", concept presented by Paulo Freire in 1970. According to Freire (1970) the educational system ought to change from a 'banking education' to a 'freedom education'. Banking education was the name given to the established educational system in which teachers were described as knowledge owners that ignored students' knowledge and backgrounds and were responsible for depositing the content and values in students' minds. Freedom education was the alternative presented to change this reality. In this new educational system, the students' backgrounds, interests and knowledge would now be considered. The freedom education would not only change the concept on how students should be taught but also what should they be taught. The content presented

would have to be a meaningful learning, i.e. students ought to engage in learning contents that would relate to their daily life. As a result, the SDG would be the meaningful learning in which they would be able to relate and TIPE would be used as a supporting tool to accomplish this goal.

Research Questions

The purpose of this research was to analyze how technology integration has an impact on a student-designed games teaching unit in physical education. More specifically, the research addressed the following research objectives:

i. To gain better understanding on how technology integration has an impact on a teacher's pedagogy in a student-designed games teaching unit.

ii. To gain better understanding on how technology integration has an impact on students' physical activity engagement in a student-designed games teaching unit.

iii. To gain better understanding on how technology integration has an impact on students' enjoyment/ engagement in a student-designed games teaching unit.

iv. To gain better understanding on how technology integration has an impact on students' communication in a student-designed games teaching unit.

v. To gain better understanding on how technology integration has an impact on students' game characteristics/ architecture in a student-designed games teaching unit.

Chapter III. Study Design and Methodology

Design

The present study was conducted using a participatory action research design. According to McTaggart (1997), participatory action research (PAR) is the process in which the researcher takes part in the proposed intervention. In educational settings this means that the researcher also plays a role as a teacher, having an ongoing interaction with students and blending activities of teaching, data collection and reflection. PAR enables the researcher to provide a practical point of view as s/he deals with the same challenges as other teachers. In addition, PAR is able to contextualize the environment in depth as the researcher is able to experience how s/he influences students' learning and actions.

The PAR design follows Lewin's (1946) cyclical model, having three stages in the cycle: plan, act and reflect (see Figure 3.1). This spiral orientation that keeps returning to the initial phase of planning establishes a good connection to the educational setting as students' needs, achievements and aspirations have to be reevaluated constantly. Considering that the study focus on understanding how technology integration (TI) has an impact upon a student-designed games (SDG) teaching unit, the study was designed to have two ongoing cycles concomitantly. One cycle was designed for a SDG teaching unit that does not have TI and another cycle for a SDG teaching unit that did have TI. In other words, there were two physical education classes focusing on SDG, but each class had different plans, actions and reflections once one used TI

while the other did not. Each intervention was presented with different cycles as TI requires a differentiated pedagogy when comparing with a class without TI.

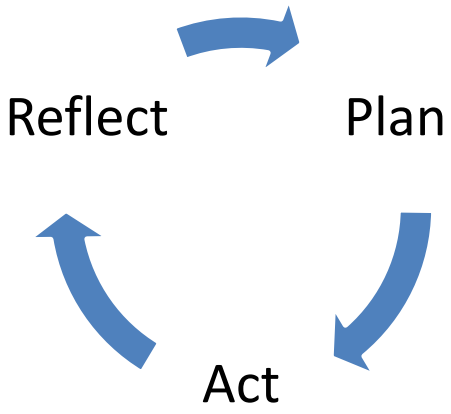

Figure 3.1. Lewin's cycle model

Prior to the study, there was no delimitation of how many classes would be allocated for each SDG teaching unit. According to Papert (1996) when students are dealing with problem solving situations, it is important to provide the time that they require. Acknowledging that SDG require problem solving that involves creativity, discussion, reflection, and several trials, Papert's (1996) 'taking time' theme was considered an appropriate rationale for this study. However, in order to consider the SDG experience complete, students had to be involved with five stages: (1) SDG introduction, (2) learning about game design, (3) playing each other's games, (4) games' refinement, (5) establishing the final game. Each stage required a specific number of lessons that varied according to the students' understanding. Each lesson had Lewin's cycle model reaching full circle. That is, the teacher planned, acted (taught) and reflected each lesson before moving to the following lesson. This ongoing commitment remained until the end of the intervention (see Figure 3.2).

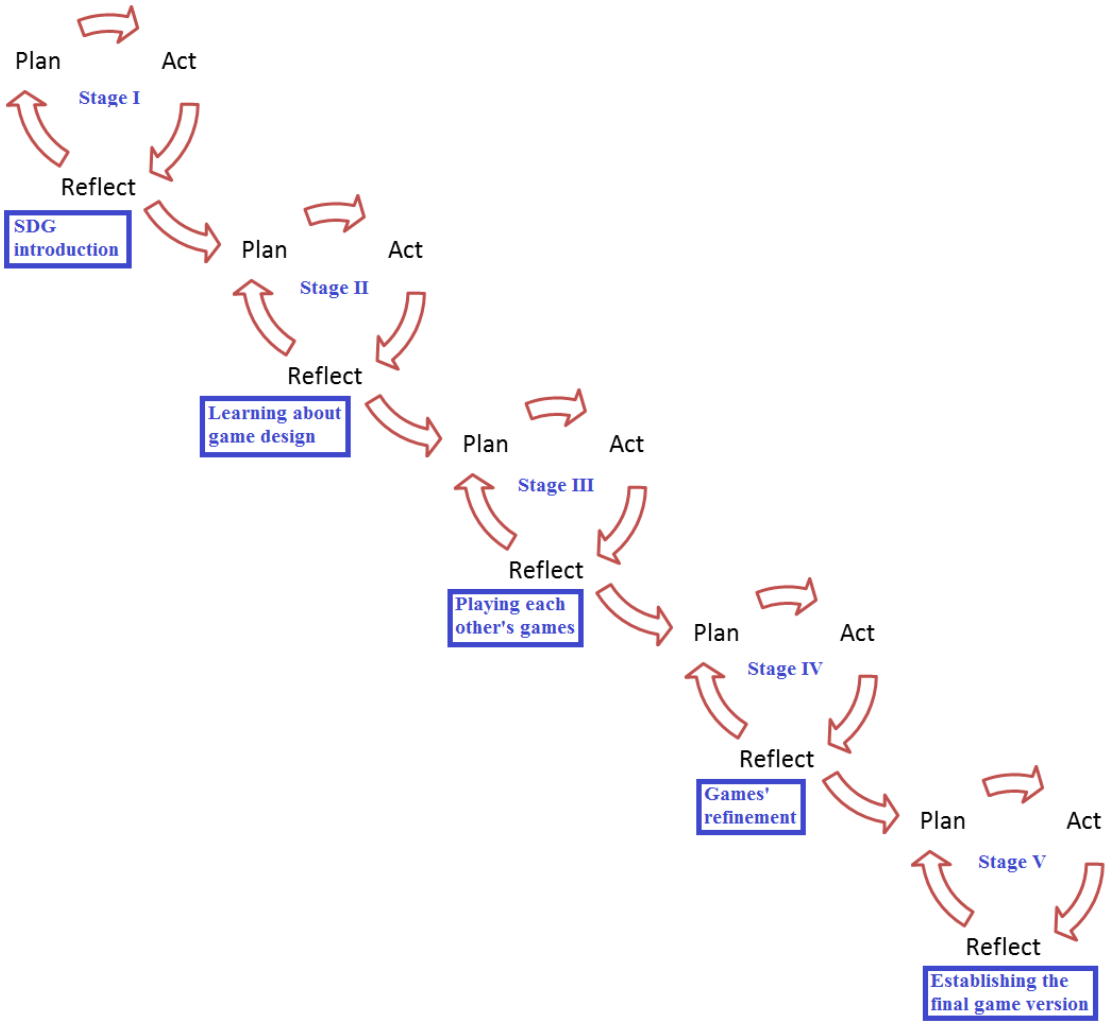

Figure 3.2. Study design five stages using Lewin's cycle model

The SDG introduction (stage 1) was the process of checking students' previous knowledge, introducing the concept of games categories (Bunker & Thorpe, 1986) and assessing their understanding of the subject matter. This stage acted as preparation for starting the game design where students learned how games were categorized and what improved a game's playability. The game design (stage 2) involved learning about students' roles (e.g. registering the game while designing it), leading questions to design their games, and the process of game design. This stage gave students the guidelines to design their game. For instance, Hastie's (2010) game design leading questions call attention of what needs to be answered in order to

avoid pitfalls in a game design. In spite of giving students the freedom to create any game from a given category, it was important that students had a sense of direction of what needs to be accomplished while designing their games. Playing each other's games (stage 3) involved students experiencing other groups' games and giving feedback so each group could work on their refinements. This stage not only helped other groups to visualize how their games could be improved, but also helped students to realize how each game's playability could be improved while experiencing different points of view. Games' refinement (stage 4) was the process of changing rules and reconfiguring games to enhance the final version of the game. Students from the same group were able to discuss the final rules of the game after receiving feedback from the other groups. Establishing the final game (stage 5) was the process of registering the game's playbook in a way that other students that never played the game were able to play the game without any further explanation. Following this five-stage process, the two classes had their games exchanged, that is two games from each class were chosen to be introduced in the other class in order to observe students reactions.

Although both SDG teaching units (with and without TI) had all five stages that were mentioned, it is important to acknowledge that there were differences in how each class designed its games. The students from the non-technology group performed all game design activities in their physical education classes. That is each lesson provided time for students to discuss and write how their game would be. This non-technology class was not required to do any activity outside the school. On the contrary, students that had TI performed all game design activities outside of the physical education classes. That is, each lesson was focused on playing games, increasing the time that students had to try out their games and limiting the discussions in class

time. Therefore, Edmodo was introduced as virtual hub in which students were able to communicate with group members, peers from other groups and the teacher.

Edmodo (www.edmodo.com) is a website designed to create a virtual classroom environment in which teachers and students are able to communicate online. Edmodo can be described as the 'educational Facebook'. That is, it has a similar design to Facebook making its navigation intuitive and user friendly, since Facebook is a well-known social media interface. However, unlike Facebook, Edmodo is a restricted website. The teacher is able to control who is part of the online classroom, limiting the group members that are able to read the teacher and students posts. The students from the TI class used Edmodo to design their own games, posting their rules ideas, diagrams of the game court and discussions that could be limited to group members or open to every student in class.

In summary, each class had to reach the same goals and had the same process of designing their game (from the game design introduction to writing the game's final version); nevertheless, the pedagogy adopted with each class was different. The non-technology group was guaranteed more time to discuss their games and write all their rules with all group members sharing their ideas face-to-face. However, less time was given to play all games which may diminish their full understanding of each game. The TI group was guaranteed more time to play games and therefore had more time to evaluate their overall experience. Nevertheless, since all their game design had to be done after class, they needed to be able to relate to each other online and also be committed to do work outside of the class.

Participants and setting

The participants in this study included 82 eighth and ninth-grade students (34 male, 48 female) from a Junior High School located in the southern region of the United States. The

school enrolled 1,100 students of which 25% received free or reduced school meals and 87% had English as their first language. The school presented the following racial distribution: Asian (10%), Black (26.5%), Latino (3%), White (60%) and Multi-race (0.05%).

The school selected for this study offered one laptop for every student in school, and therefore every student was eligible to volunteer to participate in the either of the proposed interventions. The students attended the proposed interventions during their physical education class. The school offered physical education classes every other day in a process that resulted in students participating in two classes one week, and then three on the following week. Therefore, the intervention was designed in a way that the researcher would teach a class every day, alternating the TI and non-technology groups. Although there was no allocated time to end the project, ultimately, the SDG intervention consisted of ten 75 minutes lessons for the TI group and eleven 75 minutes lessons for the non-technology group spanning for 5 weeks. All participants provided assent to participate and their legal guardians gave informed consent. The study protocol was approved by the university's Institutional Review Board for human subjects (See Appendix F).

Although all lessons were planned and taught by the researcher, there were two physical education teachers present during all lessons. The physical education teachers supported the researcher with equipment and class management, supervising students' activities and providing game instructions as students were broken down to smaller groups. Both teachers were highly interested since the beginning of the project, they constantly asked questions about upcoming activities or what were the findings reported up to that point, they also reported students reactions during class constantly. All students showed respect and affection for the teachers which was important to create a positive atmosphere from day one. At last, it is important to call

attention that the teachers constantly reinforced the assignments that were given by the researcher as they had more authority. This was particularly important with the technology group once they had outside of school assignments.

The students became members of 17 construction teams that remained together for the duration of the project. Each of the two groups was asked to choose their group members having one single rule: every group should have between three to five members. The non-technology group was formed by 31 students (12 male and 19 female) and had a total of 7 groups (all single-sex). The technology group was formed by 51 students (22 male and 29 female) and had a total of 10 groups (2 coeducational, 8 single-sex).

Data collection

The research presents a multi-method design, having a total of six different methods: pedometer, observations (field notes), Edmodo, interviews, surveys and lesson plans. Besides Edmodo that was only used to collect data from the TI-group exclusively, all other methods were used in the same way to collect data from both groups. Each method was designed to have a significant contribution to answering the research question that was addressed. In the following, each method is briefly explained.

Pedometer – this portable device was used to count the number of steps a person takes by detecting the motion of the person's hips. Each student wore a pedometer during every lesson of the SDG teaching unit.

Observations (field notes) – The researcher used a portable digital voice recorder to make personal observations about students' actions during all lessons. The observations included descriptions, analysis, students' quotes and informal interviews with students during lessons.

Edmodo – Since the TI-group was required to complete most of their game design outside of school, Edmodo was used as a tool for students to communicate with each other while designing their games. As a data collection method, Edmodo may be seen as an extension of the observations, once the researcher was able to visualize posts from all students while they designed their games. Edmodo data collection was used from the day they start to use the website (third lesson) until the end of the teaching unit.

Interviews – At the very end of the intervention, interviews were conducted with each game design group separately. The questions were developed according to what was reported in other methods during the intervention. Therefore, the interviews were used for two purposes: (1) to double check what was reported in other methods; (2) to seek for further explanations on why/ how to enhance students' experience (See Appendix A).

Survey – In the last day of the intervention, each group was given a survey to complete. Both groups completed a 5-question survey to report their enjoyment in the SDG unit. In addition, the TI group also completed 10 extra questions to provide background information about their daily use of technology devices. Both surveys were anonymous to ensure that students felt save to report any dissatisfaction with the SDG unit (See Appendix B).

Lesson plans – As part of a participatory action research, the researcher himself was one of the participants, he was analyzed in his role as a physical education teacher. The lesson plans were used to analyze the strategies, content and evaluations included in each lesson to enhance the students' experience and optimize their learning.

Data analysis

The research seeks to gain understanding of how TI has an impact on a SDG teaching unit. In order to address this question with more clarity, the research question was broken down

into five categories. On the following, each category of the research question is restated along with the explanation on how each method was designed to answer the research question.

How TI has an impact on teacher's pedagogy in a SDG teaching unit?

Observations (field notes) – The observations of the teacher's pedagogy were used to describe how each lesson had to be modified for each group. The observations were reported as a self-perception evaluation in which the teacher kept a daily journal that helped him to plan and evaluate each of his lesson plans and actions in class.

Lesson plans – The lesson plans plays an important role in Lewin's (1946) three stage cycle (plan, act and reflect). The lesson plans establishes a good connection between the reflection and planning necessary to teach each lesson. An analysis on how each lesson plan had to establish different strategies to reach similar learning goals was used to provide an overview how TI impacted SDG pedagogy.

How TI has an impact on students' physical activity engagement in a SDG teaching unit?

Pedometer – The step count was used to assess students' physical activity engagement in the SDG teaching unit. At the end of the intervention, a repeated measures analysis of variance (ANOVA) was conducted in order to compare the TI group step count with the non-technology group step count at two time points (first including stages 1 and 2 and second, including stages 3,4 and 5). The selection of the time points were based on the activities conducted on each stage. That is, on stages 1 and 2, the activities were led by the teacher and therefore there were minor differences between the two groups. Stages 3, 4 and 5 had activities led by students and therefore they were completely different when comparing the two groups. This analysis was used to evaluated whether TI provided more, less or the same amount of physical activity during the SDG teaching unit. A 2 (gender) x 2 (teaching condition) ANOVA was also conducted to

establish a comparison of physical activity engagement by group (TI and non-technology) and by gender.

How TI has an impact on students' enjoyment/ engagement in a SDG teaching unit?

Observations (field notes) – By reporting students' reactions during each activity, it was possible to gain understanding on how students liked or disliked activities as well as their commitment in the process of designing their games.

Edmodo – When visualizing all students' posts, the researcher was able to identify how often students post and with what level of details students discussed while designing their game or while posting comments about other games. These posts were used to analyze how engaged and excited the students showed to be in each stage of the SDG teaching unit.

Survey – A 5-question Likert-type scale survey gave students the opportunity to rate their overall experience in the SDG unit. The ratings from each group were compared with a one-way ANOVA in order to analyze if TI provided more, less or the same amount of enjoyment/ participation. In addition, the TI group also had ten extra questions to report their daily use of technology that were reported within descriptive statistics (means, standard deviations and frequencies).

Interviews – The questions related to students' enjoyment and engagement were developed according to the findings reported in the observations, and Edmodo. The interviews sought to find which factors improved/ worsened the students' experiences in the SDG teaching unit.

How TI has an impact on students' communication in a SDG teaching unit?

Observations (field notes) – By reporting students' social interactions during each lesson, it was possible to gain understanding on how students related to each other, answering

questions such as: How did students communicate while designing their game? How did they relate to peers from other groups (e.g. receiving feedback about their games)?

Edmodo – The TI-group reached a social interaction in physical education that was not only limited to face-to-face relationship. The posts that were published in Edmodo were used to analyze if the website was able to promote good or bad social interactions when students were working together online.

Interviews – The interviews sought to find how social interactions changed when groups work together in the physical education class or online through Edmodo. The interviews sought for descriptions from the participants in order to reinsure if the analysis reported by the observation were accurate in describing how the social interactions changed from one group to another.

How TI has an impact on students' game characteristics/ architecture in a SDG teaching unit?

Observations (field notes) – By reporting students' discussions during each lesson and during their game design in particular, it was possible to gain understanding on what kind of characteristics were students seeking when designing their games. Moreover, the observations also focused on establishing a comparison of the final outcomes of the TI-group and the non-technology group, i.e. the observations sought to answer the question: was one group able to produce better games than the other?

Edmodo – The TI-group had many of its discussions in Edmodo, as a result, the website was used to analyze if the discussions related to game-design showed that the students had a better/ worse understanding of the subject matter when comparing to the other group.

Interviews – The interviews focused on asking questions that encouraged students to explain the reasons that led their game design, i.e. what were they trying to promote for those who would play their games (e.g. participation, challenge).

Each of the six methods contributed on the data analysis of the five inquiries, some methods were used to answer more than one inquiry while others were exclusively used in answering one inquiry. The pedometer count and the survey were the only two methods that provided data that received statistical analysis. The pedometer count analysis involved a repeated measures ANOVA while the survey used a one-way ANOVA to evaluate if there were statistical differences between the TI group and non-technology group.

The remaining four methods (observations, Edmodo, interviews and lesson plans) followed a systematic process of inductive analysis and comparison among methods having the protocols proposed by Denzin and Lincoln (1994) and Lincoln and Guba (1985). Although all qualitative data received the same procedures while being analyzed, it is important to acknowledge that once each inquiry used different methods, there is a dissimilarity in terms of which method was compared to another while cross-referencing. First, the observations (field notes) and Edmodo were exanimated to establish the first interpretations. Second, these interpretations were compared with the interview transcripts (lesson plans in the teacher's pedagogy inquiry) in order to confirm or contradict the preliminary interpretations. When accumulative data confirmed the same concept, themes were generated. Each category of the research question generated a number of themes and sub-themes that explained the differences and similarities reported in SDG units taught with TI and without TI.

Trustworthiness

The present research used two methods to ensure trustworthiness: triangulation and ethnographer observer. Triangulation is the process in which multiple methods are used to

analyze the same research question, providing a more holistic perspective and reducing the likelihood of misinterpretation (Stake, 2002). Overall, the research used six different methods that were used for different research questions. Besides the quantitative analysis on physical activity impact due to TI that only used one method (pedometer), all other research questions had between two to four methods analyzing the same subject matter. Therefore, the data collected with one method was either reevaluated with another data collected from another method (in order to guarantee research rigor) or further explanation was drawn as each method provided complementary information regarding the subject matter that was being analyzed.

The ethnographic observer is the process in which another researcher, that is to be considered an expert on the studied subject matter, takes a supporting role to ensure that the proposed theoretical framework is being properly delivered (Hastie & Buchanan, 2000). The ethnographic observer, undertaken by the researcher adviser, attended many lessons of both groups (TI-group and non-technology group) and had several meetings to discuss the intervention pedagogy in order to provide his perspective on: (1) how SDG was being taught; (2) reinsuring that the TI group and the non-technology group were both receiving a quality SDG lessons that were equivalent despite their pedagogy differences; (3) making his own observations (in class) regarding each research question in order to work as a member check when the researcher was drawing analysis of students' actions. Therefore, the ethnographic observer not only reinsured that the researcher was providing accurate analysis when writing about his observations in class, but he also played an important contribution for the plan, act and reflect loop that was part of the participatory action research methodology.

Chapter IV. Results

The results of this research were broken down into five categories according to the research questions. Each category (pedagogy, physical activity, enjoyment, communication, and game characteristics) is presented in terms of the themes and sub-themes that were generated from the data analysis of multiple methods. As previously mentioned, the two classes that attended the SDG intervention were broken down into groups that designed the games. Table 4.1 (non-technology groups) and Table 4.2 (groups with TI) provides a summary of the game created by each group as a reference point for the discussion as it outline key elements of the game, students' gender and involvement in game design.

Table 4.1
Game summaries from students of the non-technology group

Name of the game	Students' gender and grade	Games details
Ultimate Basketball	4 boys 3 eighth-graders 1 ninth-grader	Concept: Mix of basketball and football. Played with a basketball but player had to get to an end-zone to shoot the basket. Setting: regular basketball court with end-zones starting at the free-throw line. Play with 2 teams of 4 players each. Use a basketball. Scoring: Put basketball in regular basketball hoop Progression: Regular basketball dribbling throughout the court. No dribbling in end-zone (just passing).
Streetball	3 boys All eighth-graders	Concept: Adaptation of football played in a basketball court. Setting: regular basketball court, using the basketball keys as end-zones. Play with 2 teams of 5-6 players each. Use a football. Scoring: 6 points for a touchdown. Extra points: basket from the free-throw (1 point) or basket from the 3-point line (2 points). Progression: 4 downs to get to the end-zone – running and passing.

Tinezz	4 boys All ninth-graders	Concept: Variation of speedball (game that used both hands and feet to progress with the ball) Setting: Indoor court with walls and no boundaries. 1 soccer goal at each end of the court. Play with 2 teams of 5+ players each. Use a dodge ball. Scoring: 1 point for passing the ball to a teammate in the center circle after 3 passes or 1 point for kicking the ball in the goal. Progression: Dribbling with the feet or passing the ball with using the hands.
Wall ball mix	5 girls All eighth-graders	Concept: Variation of wall ball Setting: Half indoor court with a wall. Designate 1 goal area for each team (each goal area is next to each other in the same wall). Play with 2 teams of 5 players. Use a tennis ball. Scoring: 1 point for catching the ball after throwing in the wall. Progression: Every player must receive the ball before throwing scoring.
Balloon ball	5 girls All eighth-graders	Concept: Create an invasion game using a kin-ball Setting: Regular basketball court, using the basketball keys as end-zones. Play with 2 teams of 4-5 players each. Use a kin-ball (35' radius). Scoring: 1 point for catching the ball inside either of the end-zones. Progression: Volleying and passing.
Bags to Mats	5 girls All ninth-graders	Concept: Game uses bean-bag for easy to throwing and catching Setting: Indoor court with walls and no boundaries. 1 designated area (mat on the wall) at each end of the court. Play with 2 teams of 5-10 players each. Use a bean bag. Scoring: 1 point for throwing the bean bag in the mat and 2 points for touching the bean bag in the mat while holding it. Progression: Running and passing.
Hogball	4 girls All ninth-graders	Concept: Soccer played with a 'horizontal' net (wide baseline – ball must cross all of it) Setting: Indoor court with walls and no boundaries. Play with 2 teams of 5 players each. Use volleyball. Scoring: 1 point for scoring in the soccer net. Progression: Dribbling and passing.

Table 4.2
Game summaries from students of the TI group

Name of the game	Students' gender and grade	Edmodo usage	Games details
Hoopball	5 boys All eighth-graders	Moderate to very high *one of the players from this group got the Edmodo App	Concept: Mix of basketball and football. Player had to get to an end-zone to shoot the basket. Setting: Regular basketball court with 9ft^2 end-zones. Play with 2 teams of 5-6 players each. Use a foam ball. Scoring: 1 point for getting the ball in the basket. Progression: Running and passing (no dribbling). Players lost possession if tagged with two hands.
Ground Quidditch	5 boys All ninth-graders	Low to moderate	Concept: Used a goal similar to Quidditch (Harry Potter's game) by hanging a hula-hoop from the basketball hoop. Goalkeeper with a bat would protect the goal. Setting: Indoor court with one goal box of 5ft^2. Play with 2 teams of 4-6 players each. Use a foam ball and one bat for each keeper. Scoring: 1 point for getting the ball in the goal. Progression: Passing only.
The Game	4 boys All eighth-graders	No usage to very low	Concept: Knock down cones from the other team's territory. When a cone is hit, a player is eliminated (target game). Setting: Indoor court with 6 cones on each side. Play with 2 teams of 6 players each. Use 6 dodgeballs. Scoring: team that eliminate all other opponents wins Progression: Throw the ball to hit the cones.
Handball	3 girls All eighth-graders 2 boys 1 eighth-grader 1 ninth-grader	No usage to low	Concept: Variation of ultimate football Setting: Indoor court with end-zones starting 6 feet from the baseline. Play with 2 teams of 5 or more players. Use a football. Scoring: team gets one point for scoring a touchdown. Progression: Running (first play only) and passing.

Hula	3 girls All ninth-graders 2 boys All ninth-graders	No usage to very low	Concept: Mix of handball and tag (similar to a game that was presented to them). Setting: Indoor court with 2 small soccer nets and 4 hula hoops by the side of the court. Play with 2 teams of 5-6 players. Use foam ball. Scoring: 1 point for getting the ball in the net. Progression: Running and passing. If player get tagged he must swing the hula-hoop ten times to get back in the game.
2 person kickball	5 girls All ninth-graders	Moderate to high	Concept: variation of kickball (striking and fielding game). Setting: 7 bases spread in a rectangle format inside an indoor court. Play with 2 teams of 8-10 players each. Use dodgeball. Scoring: run seven bases to score a point Progression: All kickers must have a partner. When kickers run they must be holding hands with their partner.
Catch the Frozen Kin	4 girls All eighth-graders	All very high	Concept: tag game with a prison. Use a kin-ball to tag players (tag game). Setting: Use an indoor court. Set a jail that takes 1/3 of the court space. Play with 3 teams of 3-7 players each. Scoring: 2 teams are runners and 1 team is a tagger. The tagging team must put an entire team in jail in less than five minutes to score one point. Progression: Tagging team must use the kin-ball to tag runners. One of the taggers may tag without the kin-ball to be able to protect the jail (runners may safe their teammates by tagging them back).
Flag War	5 girls All eighth-graders	High to very high	Concept: Mixture of capture the flag and dodgeball. Setting: Use an indoor court. Place a flag on both ends of the court and place 5-10 balls. Play with two teams of 10-20 players each. Use soft dodgeballs. Scoring: recuperate the flag from opponent team's court wins the game. Progression: Running - when on the opponents' court capture the flag (may be tagged and must go to jail). Throwing - Players from your team may throw grenades (balls) to eliminate opponents on their court.

Noodle	5 girls All ninth-graders	No usage	Concept: Capture the flag with multiple flags. Setting: Use an indoor court. Divide the court in half and place 8 hula-hoops with 8 different objects inside (cones and different balls). Play with 2 teams of 5-6 players each. Scoring: recuperate the most number of objects in 5 minutes (or recuperate or before 5 minutes). Progression: Running and tagging.
Dodge shoot and capture	5 girls All ninth-graders	High to very high	Concept: Capture the flag variation. Setting: Divide the basketball court in two. Each end of the court should have a flag on one side and a hula-hoop with a basketball on the other side. Play with 2 teams of 5-7 players each. Scoring: recuperate the flag from opponent team's court wins the game. When tagged – must go to jail (hula-hoop with basketball – may have a 'jail break' when making a basket). Progression: Running and tagging.

The Impact of Technology Integration on the Teacher's Pedagogy

The themes and sub-themes from the teacher's pedagogy are presented in Figure 4.1.

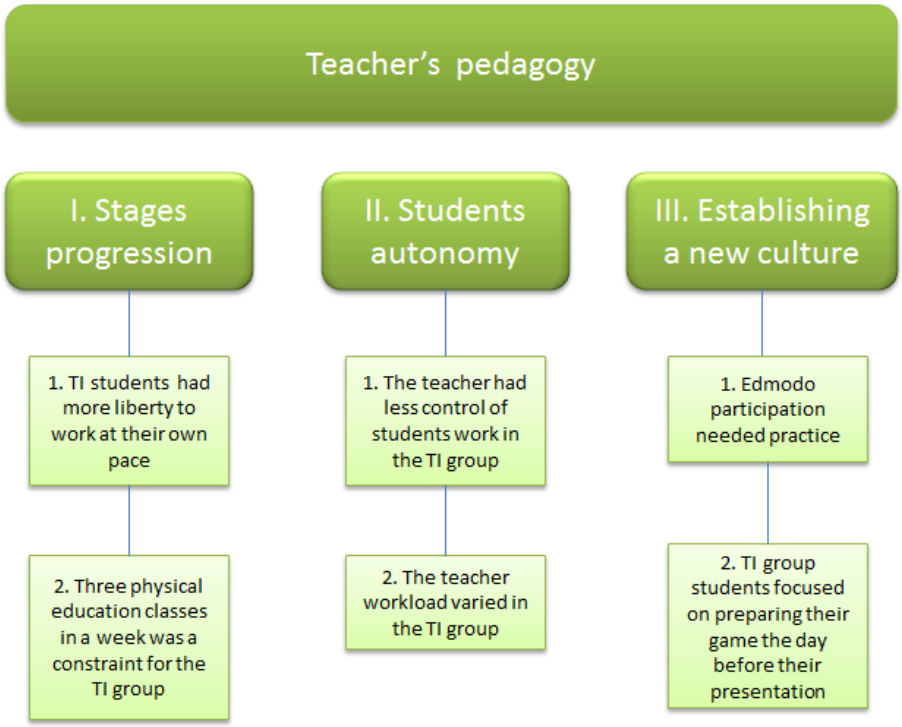

Figure 4.1 Teacher's pedagogy themes and sub-themes

Theme 1 – Stages progression

The non-technology and TI classes both had the five stages of SDG: (1) SDG introduction, (2) learning about game design, (3) playing each other's games, (4) games' refinement, (5) establishing the final game. Nevertheless, the forms in which each stage was conducted had to be designed differently. The non-technology class presented linearity in the SDG stages, i.e. there was a clearer delimitation from one stage to another. The TI class did not present this linearity, meaning that although all elements of each stage were taught, they were developed concomitantly. This differentiation was due to the fact that students worked on their games outside of school and therefore each group had the opportunity to be working on different stages of process at the same time. Figure 4.2 shows how each stage was developed along the unit.

<table>
<tr><td>Classes</td><td colspan="2">1</td><td colspan="2">2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr>
<tr><td rowspan="2">Non-technology</td><td colspan="2" rowspan="2">(1) SDG introduction</td><td colspan="3" rowspan="2">(2) game design</td><td colspan="4">(3) play each other's game</td><td rowspan="2">(5) playbook</td><td rowspan="2">play other classes games</td></tr>
<tr><td colspan="2"></td><td colspan="2">(4) refinements</td></tr>
<tr><td></td><td colspan="2">stage 1 alone</td><td colspan="3">stage 2 alone</td><td colspan="2">stage 3 alone</td><td colspan="2">stage 3 and 4</td><td>stage 5 alone</td><td>final day</td></tr>
<tr><td>Classes</td><td colspan="2">1</td><td colspan="2">2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr>
<tr><td rowspan="3">TI</td><td colspan="4" rowspan="2">(1) SDG introduction</td><td colspan="4">(3) play each other's game</td><td rowspan="3">play other classes games</td><td rowspan="3">no class</td></tr>
<tr><td colspan="3" rowspan="2">(2) game design</td><td colspan="4">(4) refinements</td></tr>
<tr><td colspan="4">(5) playbook</td></tr>
<tr><td></td><td colspan="4">stage 1 alone</td><td colspan="3">stage 1 and 2</td><td colspan="4">stage 3, 4 and 5</td><td>final day</td></tr>
</table>

Figure 4.2 SDG stages in each class

Subtheme 1. TI students had more liberty to work at their own pace

Given that physical education classes do not usually deal with homework, a student's development is restricted to his/ her participation in class. The same scenario was repeated in the non-technology class. All assignments were done in class and each group of students did not have much opportunity to work at their own pace (they could not be far ahead or behind). Thus, all groups had very similar amount of time to invest in each given task.

The TI class was able to give more liberty on how much time each group was designated to invest in each stage of the game design. Groups that felt more engaged and confident were able to present their game first while others were still discussing game ideas. As a result, the entire teaching unit had more than one activity going on at the same time and the five stages were more interrelated. For instance, when students presented their game for their first time, they were already able to make the first refinements as well as starting the playbook process; they did not need to wait for others to present their game to start this process.

Subtheme 2. Three physical education classes in a week was a constraint for the TI group

The non-technology group was designed in a way that each group was able to pick up their assignments exactly where they left off in the previous class. Therefore, having two or three classes per week did not interfere with their progression. Nevertheless, the TI class had to design their game outside of class, and as a result, they seemed overwhelmed when they only had one day to prepare for class. Students reported that they had many other activities after class and it was an overload when they had to design their game in a short time (even though they have committed themselves to do it). In addition, it was hard for them to 'meet online' as some of them planned to do the work together so they would only be able to meet at night.

Theme 2 – Students autonomy

There was a substantial difference in the development of students' autonomy in each of the SDG classes. Once all activities in the non-technology group were done in class, these students had not shown to develop much autonomy throughout the semester. In other words, they needed more assistance to fulfill their responsibilities. On the other hand, the TI group seemed more able to deliver their assignments with less help from the teacher. Although the teacher tried to reply posts in Edmodo and repeat many times that he could be contacted in Edmodo, students wrote a direct post asking for help only a few times.

The behavior reported by each group required a different approach when the teacher was dealing with each group. The non-technology group was taught in a 'filling the blacks' pedagogy in which the teacher presented a more restricted pathway and students would complete the tasks as they were given. The TI group was taught in an 'open-ended' pedagogy in which the teacher posted questions and tried to instigate their creativity, seeking to provoke their critical thinking.

Subtheme 1. The teacher had less control of students work in the TI group

The teacher was completely aware of students work in the non-technology group. The teacher would know which group was struggling and needed more help and which group was able to fulfill their assignments by themselves. This awareness enabled the teacher to direct his attention for those that showed to be lost. For instance, the group that created 'Ultimate Basketball' had serious communication issues on their first day of game design and they were struggling in designing an invasion game as they kept creating different target games (shooting games with a basketball). With just a few minutes of observation and a brief conversation, the teacher was able to explain the leading questions to create the game and they were able to start brainstorming ideas during the first day of game design.

The teacher had less awareness with respect to the TI group. Edmodo was not used on regular basis by some groups (and they hardly ever asked for help); and although they were all able to complete the tasks, there were some groups that the teacher would not know exactly how their creative process progressed until he conducted the interviews. On the one hand, as students did not share how they created their game, the teacher was not able to give as much feedback to students during their design process. On the other hand, students may have been encouraged to think more critically before the teacher would jump in and show what were the issues with their design.

Therefore, the non-technology group gave the teacher the ability to give more feedback during the game design process whereas in the TI group, the teacher would give the feedback after the students had already experience their game. In the first case, the students would be somewhat prevented from making novice mistakes, whereas in the second scenario students would make these mistakes but would be able to understand them as they experienced and therefore having a more enriched discussion after the game.

Subtheme 2. The teacher workload varied in the TI group

The non-technology group did not present much variation in terms of planning and preparation for the class. As this group did not work together outside of school, the teacher's workload was restricted to preparing the upcoming class as all students were in the same pace and required similar feedback at a given time. As a result, the workload with respect to teacher preparation remained almost constant as students had little autonomy development.

The TI group did present a big variation in terms of the requirements for planning and preparation for class. Between the beginning of game design (stage 2) and the middle of playing each other's game (stage 3), there was a high demand for teacher attention as students dealt with

many new challenges. Besides having to design their own games, the students from the TI group also had to learn how to work on Edmodo. Although students considered Edmodo user-friendly, it did require learning and therefore it would also require more teaching and planning from the teacher. In this process, the teacher had to (1) help students logging in Edmodo, (2) create video tutorials explaining Edmodo's interface and tools, (3) follow students game design progression in Edmodo, (4) deal with technical issues while dealing with the technology (e.g. when presenting a video in class that would teach a game, the teacher was unable to reproduce the sound of the video and therefore had to change his initial approach).

However, it is important to acknowledge that by the end of the SDG teaching unit, the TI group required less planning and workload as most students would be able to take responsibility for their assignments. As a result, the TI group was even able to finish all their assignments and SDG stages in only 10 lessons instead of the 11 lessons that were required in the non-technology group. This difference may seem irrelevant at first glance, but it is important to call attention to the fact that the TI group had 51 students while the non-technology group had only 31 students. In other words, the teacher had a bigger workload with the TI group as the preparation, support and feedback were ongoing beyond the time allocated for physical education classes, but it would also be more productive spite of having more students.

Theme 3 – Establishing a new culture

Only three out of the 82 students reported to have had some previous experience in designing their own activity in physical education, therefore the SDG was a new scenario for the great majority. Having the responsibility of providing the content that was going to be developed in class was not a challenge for the teacher as most students seemed to enjoy this freedom of choice. A quote from one interview may illustrate this matter: "You don't get to do what you like

to do in PE a lot of times, like a lot of games in PE are kind of stupid, but when you make your own game, you actually get to do what you like to do". Although a few students reported disliking this responsibility, the great majority enjoyed being able to design their own game. A quote from an interview illustrates that dissatisfied students rather have the regular physical education class because they did not have to worry about anything else besides being active: "I rather be playing games than sitting around and writing in my laptop." It is important to call attention that the TI class only used their computer in class in two occasions.

Nevertheless, when the responsibility of creating a new game also required work outside of school, another new culture was also established: physical education homework. This was a harder culture to establish. Students did recognize that many were not use to this workload and seemed dissatisfied. A quote from one interview may illustrate this matter: "I rather do the work in class because if everything [game design] is at home I think I forget about it or I procrastinated and not do it." Even students that showed to be enjoying this process and liked to create the game outside of school recognized that needed to get used to this responsibility. A quote from Edmodo illustrate this matter:

- Teacher: "Billy (pseudonym), I want to make sure you understand that your group recognized that you were working on the game - this is something new for you, I'll give the support you feel needed - when I said that they could change the manager, I was saying that if you felt overwhelmed you did not need to do it - I want this project to be something enjoyable not a burden. I'll make sure I will talk to you tomorrow. Sorry if you interpreted in any other way - I am trying to give the support that I feel that each student need."
- Billy – "Thanks, I just need to get used to checking Edmodo along with my other homework. It just takes a little getting used to."

Subtheme 1.Edmodo participation needed practice

The challenge of establishing Edmodo as part of the physical education culture for the TI class did not come as a surprise for the teacher. In order to avoid any technical issues or excuses that students were not being able to login, the teacher made the login during on designated class at the beginning of the unit. However, being able to login all students was only a minor challenge. The bigger challenge was getting students used to logging in to Edmodo outside of school. In order to encourage students, the teacher focused on three actions: (1) make Edmodo look 'fresh', (2) making the interface user-friendly, (3) including entertaining content in Edmodo.

Although Edmodo is a closed environment in which only students in class are able to visualize the page, the website still works as a social media. That is, the content of the website is designed by the posts and replies of the teacher and students. Recognizing that there is a clear comparison between Edmodo and Facebook (the most popular social media), the teacher thought it was important to keep adding new content to Edmodo. In other words, the teacher tried to give some new information to students even if they logged in every day. Social media websites have a 'snowball effect' in which one new post may result in a reply that may generate other comments. In addition, in order to maintain a personal attention, the teacher also posted comments to specific groups (as each group was able to communicate with each other as a private conversation) to encourage their adherence to Edmodo.

Although Edmodo interface looks familiar to most students as it has a similar design to the popular Facebook page, there are a few differences that needed to be taught. First, the teacher 'tagged' (labeled the comment where it could be found in a folder with similar topics) every topic that he wrote so students would be able to find them easily. Second, the teacher created

instructional videos teaching each tool that could be used in Edmodo and how to access all the information.

Last, the teacher was able to include videos that were at the same time entertaining and related to the subject matter. Every other day, the teacher included videos of different games that are less common in the American culture, in order that students would be able to have a reference of other games that they may have never seen it before. Below the video, there was a poll where students voted if they liked or disliked the game. The poll was used to measure students' use of Edmodo. The videos became very popular among some students as some made comments and even came to class with questions. After watching the videos, students would place comments on Edmodo, here are a couple of quotes after watching "Slamball", a basketball game that have trampolines: "Looks so cool! Wish we could do it!" and "What are we, the Globetrotters?! :D Yeah.... this is a little dangerous..." Other students came to class and asked the teacher if all of those games were actual real. Every time a student went to talk about the videos, the teacher would ask if they voted on the poll, some of them recognized that they did not.

Overall, Edmodo had a moderate adherence; the survey reported that in average students logged in to Edmodo one time per week (see Table 4.9 and Figure 4.9). It is important to acknowledge that many students complained that they were unable to watch the videos that were posted in Edmodo since the school blocked access to the YouTube website on all the laptops given to the students by the school. The teacher tried to circumvent this issue by posting a few videos to a different website provider, but these sites were also blocked by the school. Considering that this constraint may have led to students' disappointment, this may also have contributed to a higher adherence in Edmodo. This became clear to the teacher's attention when he asked the whole class if they saw the instructional videos that taught them on how to use

Edmodo. Many students complaint that they did not have access to any video in their computer and that made it harder for them to use Edmodo.

Subtheme 2. TI group students focused on preparing their game the day before their presentation

Although it is not possible to quantify how much each group concentrated their effort throughout the SDG teaching unit, it was clear that the activity on the Edmodo site became more intense by the groups that were presenting in the upcoming day. From a teacher's perspective this was considered an issue as the teacher wanted to follow students progression and give feedback in a diffuser way. As a result, there were times in which the teacher was not online while the students were meeting and he was unable to anticipate a few issues that students would probably have while playing the game with the proposed rules.

The Impact of Technology Integration on Students' Physical Activity Engagement

The results of the students' step counts in the two teaching conditions are presented in Table 4.3.

Table 4.3
Physical Activity Engagement Means by Group, Gender and Time

Teaching Condition	Mean (SD) Stage 1/2	Mean (SD) Stage3/4/5
Non-tech	1959.80 (775.62)	2620.19 (810.94)
Girls	1455.80 (461.13)	2079.03 (447.45)
Boys	2757.81 (399.05)	3477.03 (398.96)
TI	1947.85 (640.56)	2183.96 (741.98)
Girls	1608.43 (507.27)	1742.28 (542.87)
Boys	2400.40 (510.93)	2772.85 (534.94)

A repeated measures ANOVA determined that the accumulated step count during lessons in the non-technology group were significantly higher than the TI group, F (1,76) = 70.37, p < .001, partial ε^2 = .481. There was also a statistically significant interaction between the two time points and the groups on the students' overall step count, F (1,76) = 14.39, p < .001, partial ε^2 = .159.

In terms of students' gender, there was a significant difference between girls and boys F (1,76) = 124.94, p < .001, partial ε^2 = .622. There was no significant interaction between the two time points and gender, F (1,76) = 2.30, p = .133 partial ε^2 = .029.

Table 4.4 and Table 4.5 present the follow up analysis of step count, analyzing the interaction between group and time and the interaction of group and gender.

Table 4.4
Comparison of Physical Activity Engagement by Group and Time

Group	Stage 1 & 2	Stages 3,4 & 5	*F*
Non-tech	1959.80 (775.62)	2620.19 (810.94)	39.91**
TI	1947.85 (640.56)	2183.96 (741.98)	20.07**
F	0.01	6.11*	

*p < .05, ** p < .01

A one-way ANOVA determined that the accumulated step count during stages 3, 4 and 5 in the non-technology group was significantly higher than the TI group, F (1,79) = 6.11, p = .016. There was no statistical difference in the accumulated step count during stages 1 and 2 when comparing the non-technology group and the TI group, F (1,79) = 0,01, p = .940.

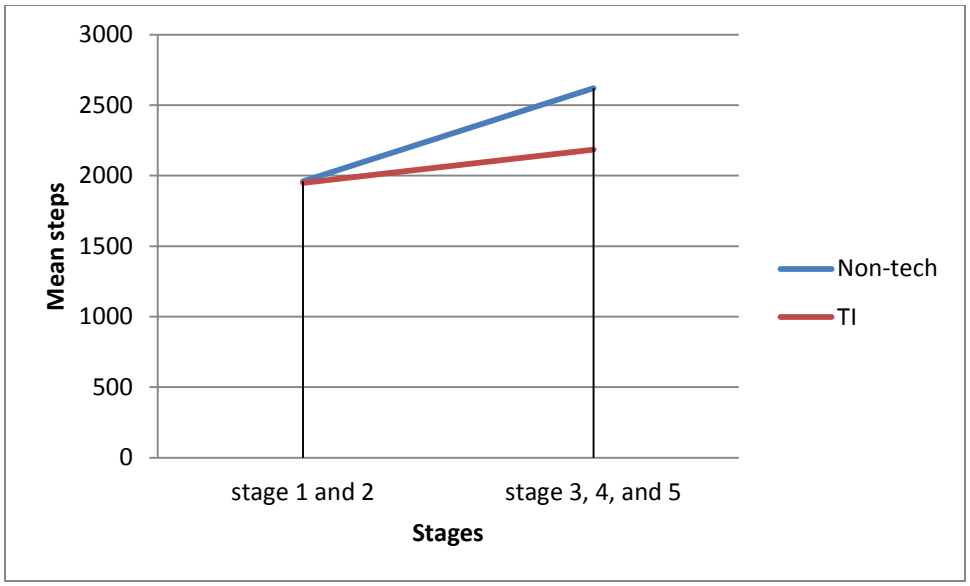

Figure 4.3 Comparison of physical activity engagement by group and time

Table 4.5
Comparison of Physical Activity Engagement by Group and Gender

Group	Girls	Boys	*F*
Non-tech	1671.21 (348.81)	3134.28 (327.48)	135.49**
TI	1669.03 (491.34)	2574.02 (474.14)	41.93**
F	0	13.09**	

** p < .01

A one-way ANOVA determined that the accumulated step count performed by non-technology boys were significantly higher than TI boys, F (1,79) = 13.09, p = .001. There was no statistical difference in the accumulated step count when comparing non-technology girls and TI girls, F (1, 79) = 0, p = .987.

A one-way ANOVA also determined that the accumulated step count performed by boys were significantly higher than girls in both groups, in the non-technology, F (1,30) = 39.91, p < .001; and in the TI group, F (1,48) = 20.07, p < .001.

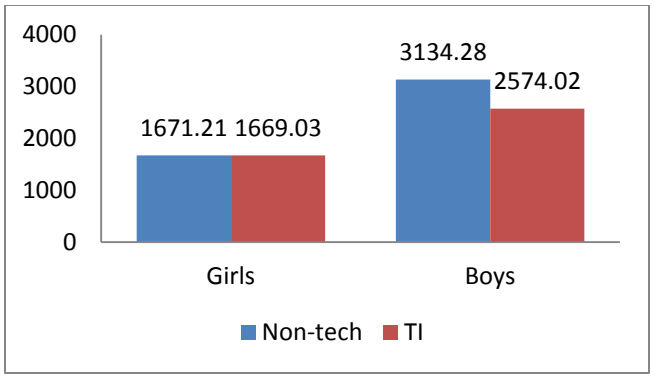

Figure 4.4 Comparison of physical activity engagement by group and gender

The Impact of Technology Integration on Students' Enjoyment/Engagement

The themes and sub-themes from students' enjoyment/ engagement are presented in Figure 4.5.

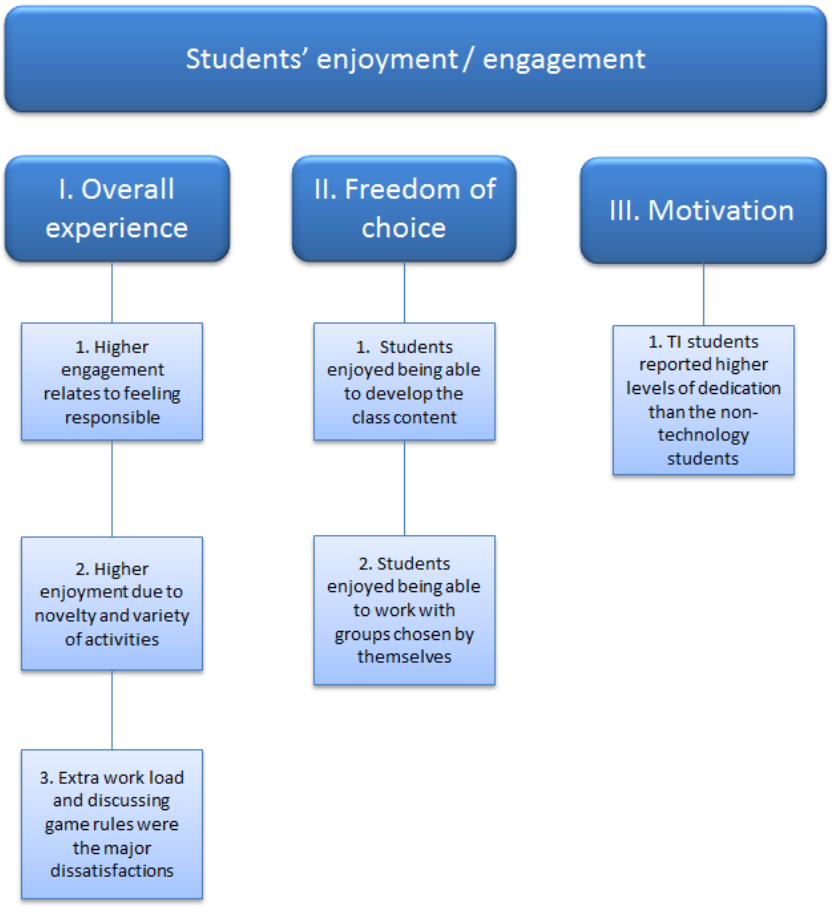

Figure 4.5 Student's enjoyment/ engagement themes and sub-themes

Theme 1 – Overall experience

The results of the students' overall experience (enjoyment and participation) in the two teaching conditions are presented in Table 4.6 and Table 4.7. Table 4.8 and Table 4.9 present TI students' technology involvement in their everyday life.

Table 4.6
Comparison of students overall experience by group, gender and group x gender

Variable	Wilks'	Sig
Group	.853	.039
Gender	.827	.016
Group x Gender	.921	.305

Table 4.7
Comparison of students overall experience in each group and each gender

	Group			Gender		
DV	Non-tech	TI	F	Girls	Boys	F
Q1	7.86 (1.30)	6.31 (2.57)	8.48**	7.11 (2.40)	6.5 (2.21)	0.88
Q2	3.07 (0.81)	2.83 (0.88)	1.45	3.15 (0.76)	2.59 (0.89)	7.09**
Q3	3.64 (1.13)	3.60 (1.05)	0.01	3.91 (0.94)	3.21 (1.12)	9.42**
Q4	4.07 (0.66)	3.65 (0.90)	5.58*	3.82 (0.85)	3.76 (0.85)	0.06
Q5	3.97 (0.92)	3.77 (1.04)	1.00	3.91 (0.96)	3.74 (1.05)	0.11

*p < .05, ** p < .01

Table 4.8
TI students' technology usage and interest

	N	Minimum	Maximum	Mean	Std. Dev.
Q1-2) Number of devices per person	50	.25	3.33	1.27	.620
Q4a) Computer hours - school	46	1	8	4.12	1.941
Q4b) Computer hours - home	45	0	6	2.41	1.646
Q5) Do you like technology?	52	3	5	4.40	.774
Q6) Do you like laptops in school?	52	1	5	3.92	1.135
Q7) Do you like laptops in PE?	52	1	5	2.77	1.198
Q8) Did you like Edmodo?	52	1	4	2.58	1.091
Q9) How often you used Edmodo?	52	1	5	2.94	1.335
Q10) What kind of tech do you prefer?	52	1	3	1.79	.536
Valid N (list-wise)	43				

Table 4.9
TI students' internet access in their houses

Q3) Do you have internet access in your house?		Frequency	Percent
Valid	yes	50	98
	no	1	2
	Total	51	100.0

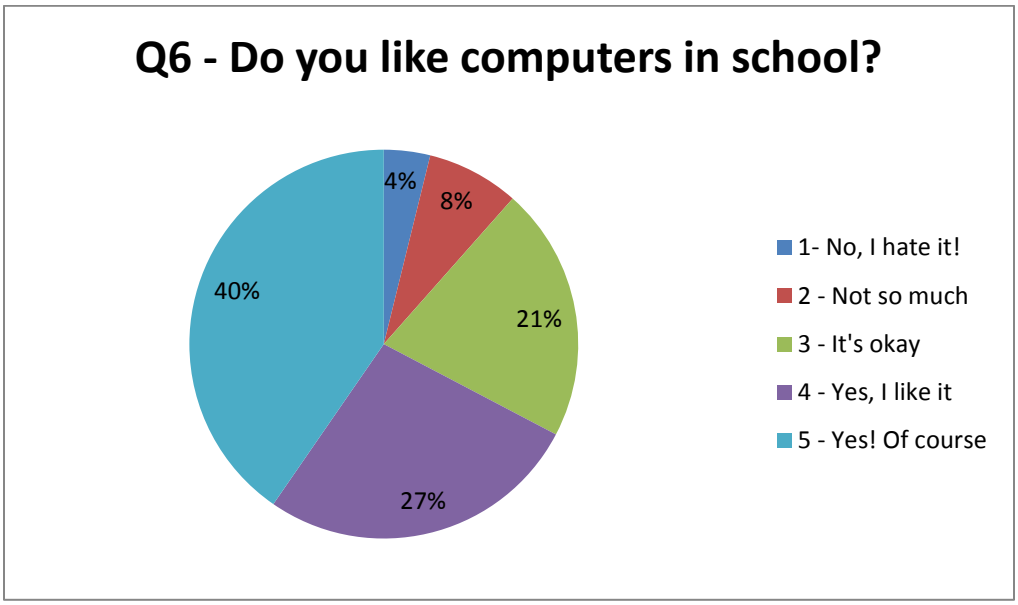

Figure 4.6 Students enjoyment of having laptops in school?

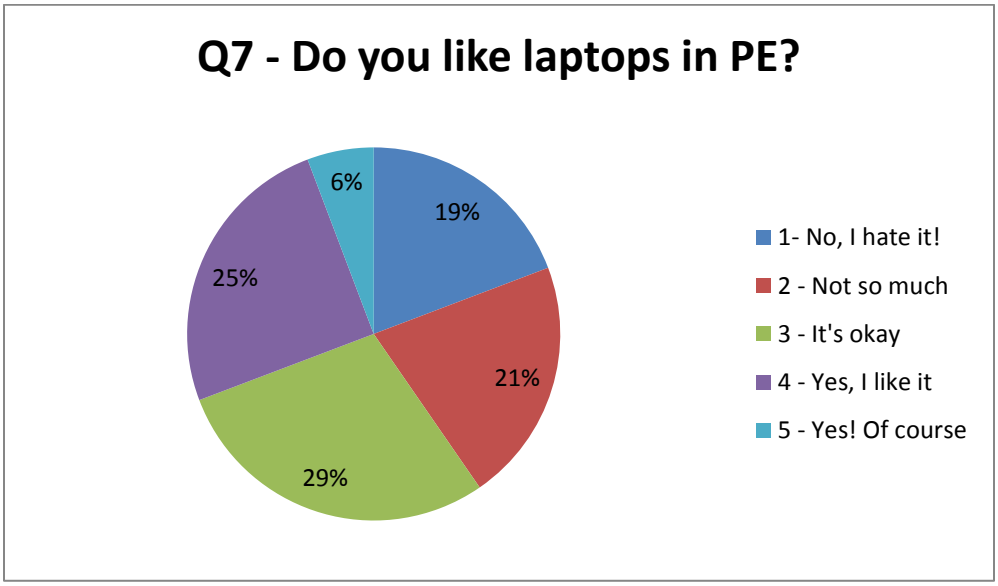

Figure 4.7 Students enjoyment of having laptops in physical education?

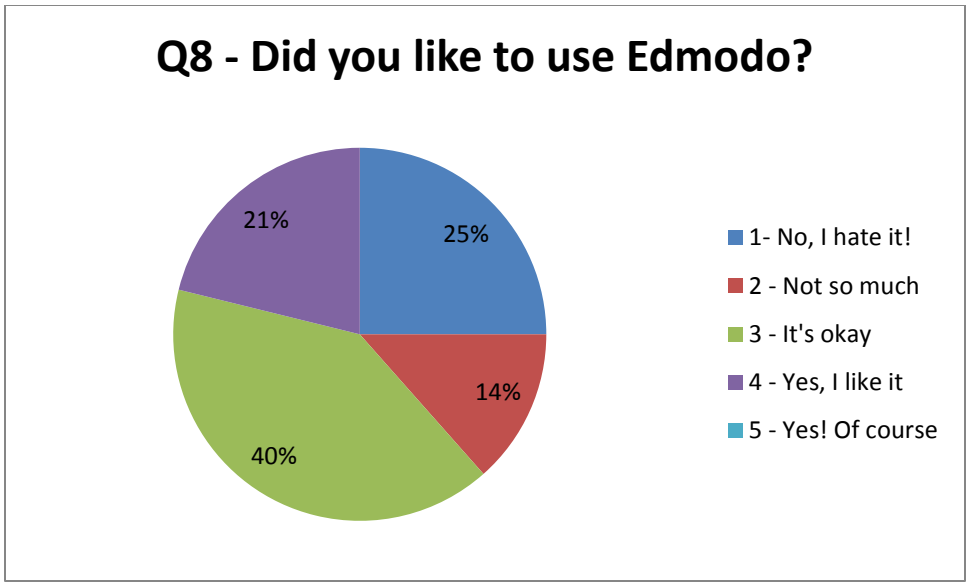

Figure 4.8 Students enjoyment of using Edmodo

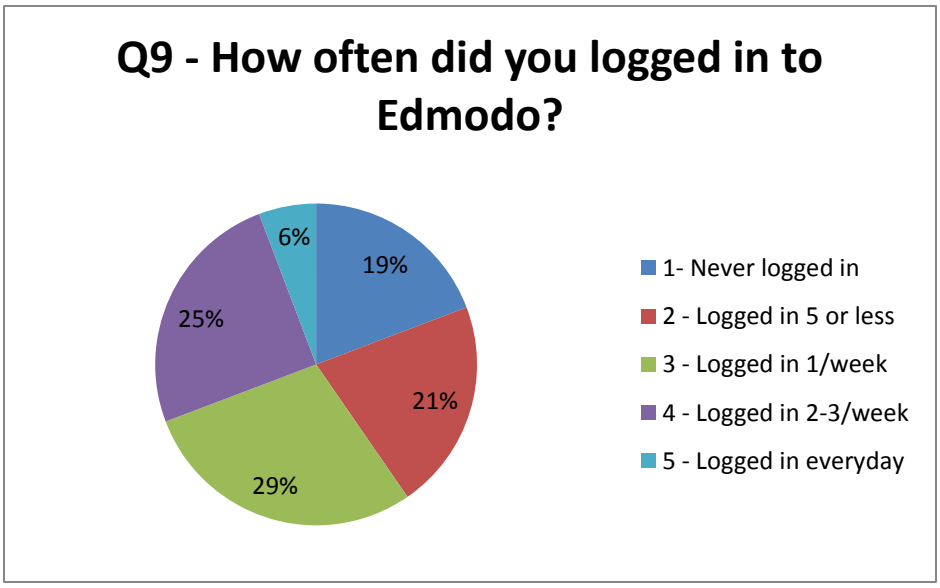

Figure 4.9 Students adherence to Edmodo

Sub-theme 1. Higher engagement relates to feeling responsible

Students from both groups felt responsible for having to deliver the game that was going to be played by their peers. The assignment of designing a game that was a commitment that they had established with the teacher, along with peer pressure that would experience their game, both played important roles to encourage students to have a higher engagement in physical education.

One eighth-grade boy from the non-technology group explained his commitment to the assignment: "In regular PE some people can just do little work and get a passing grade, but like this [SDG], we have to make sure we get everything done, we really have to try it". Although students felt that they had to do some extra work that they were not used in physical education classes, most of them felt comfortable with the work load, as reported by an eighth-grade girl from the TI group: "it wasn't a big thing, it was something that you could do a little at each time, it was more relaxed than other homework." An eighth-grade boy from the non-technology group reported a similar perception: "I don't think it pressured us, I think it forced us to be more involved, not in a bad way though."

One eighth-grade boy from the TI group explained how he felt some peer pressure as he saw the game design process as a competition: "I like the challenge, I like competing with people, I am very competitive. I was trying to make the best game that you could possibly make." A ninth-eighth-grade girl from the TI showed that she felt good about herself when peers liked her game: "when you watched other people having fun [while playing your game], it made you feel good." This feeling of peer pressure influenced the characteristics of the game students designed, as reported by an eighth-grade student from the non-technology group: "I felt, it [our game] was like what everyone wanted soccer to be because you can touch the ball with your hands without stopping." There was one group of girls from the non-technology group that

reported feeling embarrassed that there were unable to design a game that others could play. As one of the members noted: “when we were writing down, it [the game] made sense but when we actually played the game, it was confusing. And when we taught the game and they didn’t get it…it was embarrassing because we couldn’t actually think of a game.”

Sub-theme 2. Higher enjoyment due to novelty and variety of activities

Designing their own games was something new to the great majority of students and novelty played an important role when students reported the major characteristics from SDG that they liked. A ninth-grade girl from the TI group share this opinion: “all PE games are the same…we have been playing the same PE games every year; these games [from SDG] are different and you have the ability to say what you want if you don’t like it or if you do like it.”. Another ninth-grade girl from the non-technology group report a similar perception: “Some PE classes we just do the same games, [in SDG] we had time to learn different experiences”.

The SDG teaching unit provided a mixture of focusing on one game for a long period and at the same time providing a variety of game experiences. On the one hand, students were able to discuss their game from the moment they started to design it (stage 2) until the establishment of the playbook (stage 5). Students reported that they enjoyed this opportunity of thinking constantly about one game for a longer period. A ninth-grade boy from the TI explain his satisfaction: “[we] spend more time with it, because in regular PE you learn one game in one day and then you come back the next day and you learn a new game, a whole different game, which you can get kind of sad you left behind the old game but in this way…with Edmodo, you get to stick to one game, play around with it, and then explore it.” On the other hand, while each group was designing and refining their own game, everybody had the opportunity to play different games which remained the perception that they were constantly experiencing something new. As

students learned about the variety of games that they would be able to play, they got excited and wanted to extend this excitement of discovering new games. A quote from an eighth-grade boy from TI represents this feeling of trying something new: "I wish we would play a few of the games I saw on Edmodo."

Sub-theme 3. Extra work load and discussing game rules were the major dissatisfactions

Although most students reported that they did not mind having assignments, the major issues identified by students who indicated that did not enjoy SDG as much as other physical education classes were related to the work load and in-class assignment.

The non-technology group did not have any homework activity, therefore all their complaints related to stopping the game to make reviews. According to one eighth-grade boy: "if I am in the middle of a game, I don't want to stop and write some stuff and then go back playing that game or not play that game at all." Dissatisfied students felt that the process of constantly playing and stopping the game (time given to discuss refinements) would break the flow needed in play time. Boys (especially those who were highly skilled) reported a higher level of discontent with the scenario that promoted discussions in the middle of game play. When inquired if they would rather do the game design and refinements as a homework assignment, they agreed that this would be the best solution.

The TI group did have homework assignments but their in-class discussions were minimal, therefore, their major complaints were related to the extra work load that they were not used to have in physical education classes. Among the major complaints was that they had a difficult time relating to each other saying that Edmodo did not help in the game design and that they were not used with having homework assignments in physical education. Boys reported a higher level of discontent with this extra work load, although there were girls who also reported

dislike with this new scenario. When asked if they liked to do design the game outside of class or if they felt obligated to design it, an eighth-grade girl answered: "half-and-half, I wanted to play our game, but I did not want to have to work."

Theme 2 – Freedom of choice

A common characteristic that students enjoyed in the SDG was their freedom of choice. Students from both groups and from both genders reported that they felt empowered as their opinion played an important role in the class development. The research findings were unable to report any difference between the two groups. That is, the SDG pedagogy did not seem to influence the students' "freedom of choice" perception.

Sub-theme 1. Students enjoyed being able to develop the class content

The most unanimous opinion among students from both groups was that SDG gave them the freedom to make their own choices with regards the content developed in class. Hence, this perception played an important role in their overall enjoyment. According to students, this freedom was not common in most of physical education classes they had experienced up to date. An eighth-grade girl from the non-technology group illustrates this perception: "you got to do what you wanted to do and other people get to do what they wanted to do…there are some PE games that you don't like and some games that you do like".

It is important to call attention to the fact that although students had this perception that they would enjoy the content because they developed themselves, most of the activities that they experienced were either developed by the teacher or by other students. For instance, the TI group had a total of ten classes, five of those classes were conducted by activities led by the teacher (in order to illustrate non-traditional games), and in the remaining five classes, students were able to play their own game only twice for half the period of the class. In other words, students would

only play their own game for an equivalent period of one out of ten classes. However this did not diminish their perception of developing the class content once every group had the opportunity to give suggestions on how each game could be molded to improve game play. Students often reported that the game enjoyment increased after they had a quick discussion that would change a rule in the game. A quote from an eighth-grade girl from TI group is representative with regards to the students need to stop the game and make suggestions. She noted "that made it more fun…because a lot of the games weren't that involved [optimize participation] until you made revisions."

Developing the class content was also enjoyable due to the feeling of ownership. That is, students felt proud and excited to see that other students were playing a game that was created by them. A quote from a ninth-grade boy from the TI group illustrates this perception: "It made the games more enjoyable know that you and your group came up with it, you kind of know what to expect and at the same time you would not know how would people handle it and that was kind of the fun way…the surprise" Another ninth-grade boy from the TI group suggested this same idea: "Mind set of really this is my game and we came up with it just how you feel behind that really cool."

Sub-theme 2. Students enjoyed being able to work with groups chosen by themselves

In other physical education classes, besides having control of the activity that was being developed, the teacher would also designate which group of students would work together. In both classes of SDG, students had the liberty to choose their group members in which they would not only work together to design their game but also play together. The great majority of students believed that they would not enjoy designing their own games if they would not be able to do with group members who were not chosen by them. The majority of students showed a

concern at not being able to show their own personality or share their opinion while working with peers who were not their friends. One eighth-grade girl from the TI group illustrated this point of view: “I know I can be bossy, so if I am bossy, they [referring to her group members] will tell me to stop being bossy and other people may be shy to tell me to stop being bossy.”

Gender differences were once again mentioned by many students when discussing group membership. Boys showed a concern with respect to working with girls because they believed that their ideas about games are different from their own. An illustration of this point may be taken by this eighth-grade boy from the non-technology group who said: “well boys are more dominant [higher skill level] and girls games taught little to no skill…and girls have very different opinions on things…and if you need to cooperate it would be hard to do with different opinions.” Girls also showed a disbelief of being able to work with boys, as they believed that boys would not work properly. In this case, an eighth-grade girl from the TI group noted that “boys just say random things and we would have to write everything.” Two groups of girls said that they would like to work with boys, but once again, they showed the same concern. An eighth-grade girl from the TI group illustrated this scenario as follows: “I think it would be fun to work with boys because they have different perspectives…but it would be fun if they would actually put in the work, because some of the guys are just like ‘I don’t care’.”

The appreciation of playing the games with your own group members was also appreciated, especially by girls. One ninth-grade girl from the non-technology group pointed out the importance of playing with girls on your team: “they [boys] are all mean; they ‘hog’ the ball and don’t let you contribute”. Girls often complained that boys would mistreat them for missing a play and/ or losing possession of the ball, while girls would not mind if they were not good and would even ensure that everyone got to participate in the game. Boys, on the other hand, were

more concerned to have a balanced game when playing, so they did not value if they would be playing with their group members or not. A boys group from the TI class admitted that they changed players a few times with other groups in order to ensure that the game was even.

Theme 3 – Motivation

Students from both groups reported several factors that motivated their engagement in the SDG teaching unit. Each group did not report differences in terms of what would motivate them to have a higher dedication in their game design. Among the major reasons identified as stimuli were novelty, challenge and obligation.

The most common motivating factor was novelty. That is, students had not experienced any similar process of developing their own games in physical education. Many even mentioned that they had never experienced this freedom in school all together. The novelty of playing many different games therefore, was motivating in terms of experiencing something new. The challenge of creating a new game also had an intimate relationship with the novelty of the experience, as reported by a ninth-grade girl from the TI group while referring to her major motivation to design their game: "we never knew what to expect how people would see it [our game]".

There were three groups of girls from the TI group that considered the obligation (assignment) of creating a game as their major motivation (this was the only factor that was identifiable by a single group). All these groups showed to have a high engagement during the game design process, but their feeling of obligation did not diminish their enjoyment as they reported to appreciate the overall process. These groups showed a higher commitment to their school assignments and therefore it appeared as a motivation as explained by one eighth-grade

girl: “I didn’t have a motivation, it was just habit, when a teacher gives you homework, you say, ok, I’ll do it.”

Sub-theme 1. TI students reported a higher dedication than the non-technology students

Although non-technology students reported a high level of enjoyment and participation, none of the students reported that they dedicated any time towards designing their game outside of class. Given that all TI students were required to design their game outside of physical education classes, it is predictable that the majority of groups (8 out of 10) dedicated after-school hours to designing their game. Although it is important to report that students were able to be hold accountable to do their ‘homework’, it is important to call attention on how much time they dedicated to complete it, as there is not a fine line defining when the game is ready. Five out of ten groups had students that would enter in Edmodo every day or every other day showing a commitment in searching for new ideas and discussing game rules/ scenarios of their own games with their own group members or with members of other groups.

It is important to call attention that this form of intervention had a ‘snow ball’ effect. That is, the more people are involved, the bigger it gets and the more they enjoy. In other words, even a highly dedicated student would not be able to feel very motivated if others would not login to Edmodo, as the discussions were created by a group of students. One eighth-grade girl explained this idea: “few more people could have said stuff [in Edmodo], but they didn’t. Like in our game we only had a few people… I didn’t mind that some people didn’t [write] as long as an amount of people did because if nobody does it, it is no fun at all, but if ten people do it, then it is fine because at least you can get a discussion.” Despite being dependable on others to enjoy themselves more, TI students that felt highly motivated by SDG had the opportunity to maximize their engagement while logging into Edmodo.

The Impact of Technology Integration on Students' Communication

The themes and sub-themes from students' communication are presented in Figure 4.10.

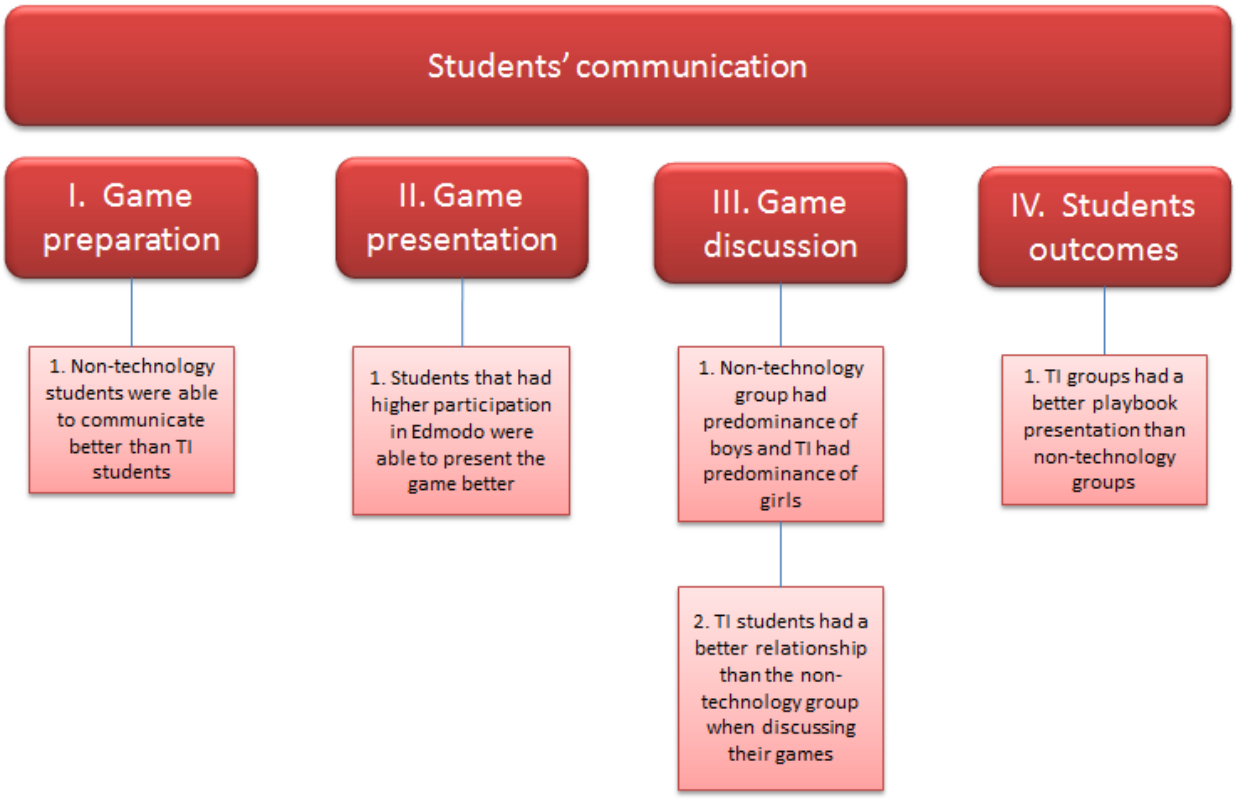

Figure 4.10 Students communication themes and sub-themes

Theme 1 – Game preparation

Students from the non-technology and TI both reported to not have any personal issues with their group members while designing their game. The communication among group members was considered friendly and for the most part productive. The most non-productive communication was reported by ninth-grade girls from both non-technology and TI. These girls admitted that they sometimes 'lost track' of their discussion and start talking about something that was not related to game design. However, they considered this behavior as typical when working in groups and that it did not interfere with their productivity. Unlike eighth grade girls and boys, these girls would break down the game design into smaller assignments and while a

few members were working, others were able to chat about something else, as they reported in this interview: “Oh yes, we would get off track, but we did get it done! While others [group members] were talking about the game we would hold on our own conversation”.

Students from the TI group also admitted that it was harder to be unproductive in Edmodo as reported by an eighth-grade girl in the interview: “It’s hard to get distracted in Edmodo…you don’t want to waste comments”. It is important to call attention to the fact that the environment created in Edmodo is different from a face-to-face conversation. While analyzing students work in Edmodo it was possible to notice that the conversation had linearity. That is, students would keep track of questioning and answering one topic at a time. In the group discussions in class, the environment was completely different, as there were times where several students would speak at the same time and carry parallel conversations, even when being productive.

Sub-theme 1. Non-technology students were able to communicate better than TI students

Non-technology students did not report any issues of communication while designing their games. Groups of different genders showed to have different forms of approaching game design but none of them were considered to be off task for a very long time. Two out of the three groups formed by boys designed their game in a very active manner. That is, they did not sit down for long and talk about their game plans, they discussed a couple of ideas and start testing with a ball just after a few minutes after they were given the assignment. The group formed by ninth-grade boys had a similar behavioral pattern as reported by the girls groups. All four groups formed by girls discussed their ideas for a long time, doodle court diagrams and even talked about a few specific situations before trying their game.

On the other hand, the TI students reported difficulties in designing their game outside of class. Many groups chose not to use Edmodo while designing their game. Although Edmodo is designed for students to place comments in different time periods, none of the groups approached game design in this form. In other words, all groups wanted to meet when designing their game and therefore meeting online was sometimes a challenge and inconvenient so students would chose to relate in more direct ways such as talking to each other between classes and talking on the phone. An eighth-grade boy illustrates this scenario: "You would call somebody and say: "get in Edmodo, but by that time, you already called so what was the point?" There were four groups that showed to have a very active participation in designing their game while using Edmodo. Of interest, all these groups were formed by girls (two 8th graders and two 9th graders). These groups showed to have a similar approach reported by the girls in the non-technology group in which they would discuss all their rules one-by-one.

Among the other six groups, the three groups formed by boys talked about the game design while meeting with each other between classes. Two of these boys groups would still use Edmodo for minor game design activities such as exchanging court diagrams and place reminders which show that they were logging to Edmodo but they chose not to design the game with this platform. The two co-ed groups and the remaining group formed by girls did not specify how they designed their game.

Theme 2 – Game presentation

In the game design stage, students were given a chance to practice how to teach a game in the "learn-teach-play" (LTP) lesson in which they had to read the rules of an unknown game and introduced them to another group that did not know the game. Both non-technology and TI students reported similar skills while presenting their games. In spite of having an oriented

experience on how to teach a game, most students felt challenged when presenting their own game, showing that more LTP experience was needed to approach this challenge better.

One characteristic that was reported by both groups is that boys tended to present the game faster than girls. Boys were usually very excited about playing and had difficulty in focusing on their presentation. For example, they would overlook to see if other students were paying attention and did not give as many opportunities for questions. Girls, on the other hand, were calmer while presenting, they took longer while describing the rules, answered everyone's questions and even showed to be perfectionists with the game set up (they would not like using different equipment from what they had originally planned). In spite of being more careful, girls were not more successful when teaching their game. Like boys, most of them did not develop a logical order on their presentation, explaining rules in a random order and therefore raising difficulties for others' understanding.

Apart from their difficulties, all groups were able to teach their game and experience showed to be the most valuable tool in improving their presentation. Many students reported that this was the first time that they had talked in front of a big crowd and that they felt nervous while doing it. As a result, students were able to give better presentation when teaching their game for the second or third time.

Sub-theme 1. Students who had higher participation within Edmodo were able to present the game better

Although both groups reported similar issues when presenting their games, four groups (3 girls groups and 1 boys group) from the TI were able to present their games better than the others. They presented a more logical presentation, starting with general rules and moving towards more specific rules (e.g. starting with game set up and how to score, ending with

specific rules and violations). All four groups had one characteristic in common: most group members were very active in Edmodo. There were six videos of other games posted in Edmodo and four of those videos where instructional videos. That is, they explained the rules of the game step-by-step. In other words, students who were more active in Edmodo were more exposed to examples of how to teach or present a game. Nevertheless, there was a fifth group who was very active in Edmodo and still were not able to teach their game very well, showing that these instructional videos were able to support many students' presentations, but others still needed other form of support.

Theme 3 – Game discussion

The promotion of game discussion in non-technology and TI had very different approaches. In the non-technology group, students were able to discuss their opinion about the game immediately after their experience with face-to-face interaction with students that created the game as well as with other students that just participated in the game play. In the TI group, students discussed about the game after class while logging to Edmodo. The teacher would write a post asking for students opinions on the game that they played in class and each student had to reply this post giving their opinion on the game and explaining their reasons. The following quotes illustrate how this procedure was done in Edmodo (the first quote was posted by the teacher and the following quote was answered by a student):

- "If you are receiving this post please reply to the game you played last PE class presented by the 'Bear' and 'Tigers' (pseudonyms) groups. 'Bear' and 'Tigers members, you are also welcome to write your perception of how it go - are there any rules you would change? Specify which game you played: 'Bear' or 'Tigers'. Answer questions such as: 1) Did you like the game? Explain why or why not? 2) What rule would you change? 3) Was the game challenging? 4) Did the game needed strategies or teams would score based on luck? Write as many replies as you wish."

- "We played the 'Tigers' game. It was fun, but I think that the idea of passing the ball to another person is bad. The game ends too quickly. It would be better to have 2 dodgeballs on each team and the first group that gets all the 4 balls wins. Other than that, love it (:"

Sub-theme 1. Non-technology group had a predominance of boys and TI had a predominance of girls

The face-to-face interaction in the non-technology group was predominantly led by boys. That is, boys would talk longer (and many times louder) while giving their opinion about their experience in the game. Although girls did participate in the discussions, many would choose to not say anything. The participation in the discussion was also influenced by their skill level, meaning that students that presented a higher skill level were more participative than students with lower skill level.

The online interaction in the TI group (in the Edmodo website) was predominantly led by girls. That is, girls posted more comments and with greater number of details. This followed the trend that girls were more engaged in every online task given. Boys reported that sometimes they did discuss their games but chose to do it in person rather than going to Edmodo. The following quote illustrate this behavior: "We talked to the 9th grade male group a lot. They played our game and gave a lot of feedback in class but not in Edmodo."

Sub-theme 2. TI students had a better relationship than the non-technology group when discussing their games

The different forms of interaction (face-to-face versus online) also affected how students related to each other while discussing their games. The non-technology group registered a few unpleasant discussions as students were sometimes very critical about other groups' games or when game owners were sometimes unwilling to hear any suggestions. Although these unfriendly discussions were not limited between boys and girls, they did occur more often

between different genders. Here is a boy's quote explaining why he was refuting a girl's suggestion: "There would be groups that would want to mold the game to make it easier for them to play…saying like 'make the goal bigger', the goal is already big, it's them [the girls] that can't score". Apparently, the students from the non-technology had a difficult time of detaching the competition that occurred between game play and the game refinements. In another quote, a 9th grade student was able to verbalize this matter: "I think that everyone's opinion was heavily dependent on if they were good on the game or not, because I remember my group saying that they loved the game I came up with as opposed to anything else and I didn't enjoy the idea as much and I wasn't incredibly good at it."

The TI did not report any relationship issues when students were discussing the game in Edmodo. The online discussion took the game play excitement away from students, they never discussed about who won or who lost (which was common in the other group). They focused on discussing the refinements of the game. When asked if there was any time that they felt offended by a suggestion, all students from this group said that they did not. Edmodo changed the way students communicated to each other, by being less directive and reinforcing positive aspects as well as negative aspects. Two students explained this matter in a complimentary way: "Everyone said at least one thing, something nice and then they might have added a suggestion"; "If they said that something needed to be improved, they said it in a nice way".

Theme 4 – Students Outcomes

The social interaction promoted in SDG has shown to impact students learning. When asked in the interview: "What did you learn in the SDG unit?" All non-technology and TI students mentioned about their experience in communicating to each other. Students reported that working with each other requires learning. While referring to game design, one of the

students said: “we learned to be able to compromise” as the group discussed how each person had different ideas and they had to come with a consensus what would be the final word before they included as a game rule.

Nevertheless, the biggest challenge was not dealing with group members as all groups reported good relationship, their learning was communicating with other students while teaching a game. One 8th grade girl says: “I learned to talk in front of a lot of people, like a huge crowd when presenting, you set out really clearly and you have to start from the beginning, like you have to say first the most important things [about the game] …you learn by your mistakes.”

Students also recognized that they needed to have leadership skills as they were presenting their game to other students. As one 8th grade boy pointed out: “the teacher could be there when students are presenting the game, to get them all around [give the presenters authority] because other students don’t like to listen to kids specially when we were teaching 9th graders, they would think: all they are just 8th graders”. Due to the nature of the SDG unit it was not possible to have the teacher’s presence with all students at all times, but the students still showed improvement in their communication skills by calling peers attention when presenting, using visual aids (they would demonstrate specific rules/ game situations) and check for their understanding.

Sub-theme 1. TI groups had a better playbook presentation than non-technology groups

Students from the non-technology group and TI experienced a different process when writing their playbooks. The non-technology students started their game design by completing a poster with leading questions to design an invasion game (see Appendix C). After completing this poster, students would play their game, make their refinements and settle the final rules in a playbook portfolio (see Appendix D) only at the end of the SDG teaching unit. The TI students

had the opportunity to start designing their game while answering the leading questions of a PowerPoint presentation posted in Edmodo (see Appendix E). The same PowerPoint presentation that was used to present the leading questions was able to be used to establish the game's final rules in a playbook. As a result, students had the ability to change their playbook as they would make modifications to their game.

When comparing the playbooks from the non-technology group with the TI group, it was noticed that the non-technology group playbook provided less information about their games. The most common issues found with the non-technology playbooks were: (1) unclear diagram, (the drawings were not well done and most of them did not include any caption specifying what each drawing represented), (2) rules were simplified, (most playbooks missed rules that would lead to violations and their writing was unclear or confusing). Although the non-technology group were given a designated space to include each rule that was asked in the portfolio, none of the playbooks completed most of the space given.

Besides being able to deliver a better playbooks by addressing the overall rules better and giving better diagrams (with captions), the TI group also included an extra features that went beyond the initial requirements: most of the playbooks included illustrations that went beyond the game diagram, such as pictures of equipment that were used in the game. In addition, there were two playbooks that needed extra attention: (1) the group that designed the game "Flag war" presented their playbook in a storyboard format, describing players' actions and consequences while being in 'war', (2) the group that designed the game "Catch the frozen kin" did two playbooks, the PowerPoint presentation as all the other groups and a video presentation while explaining the game to another group. Although there were good and bad presentations in both

groups, the overall presentation from the TI students were better and they had the opportunity to go beyond the minimal requirements.

The Impact of Technology Integration on Games Characteristics/ Architecture

The themes and sub-themes from games' characteristics/ architecture are presented in Figure 4.11.

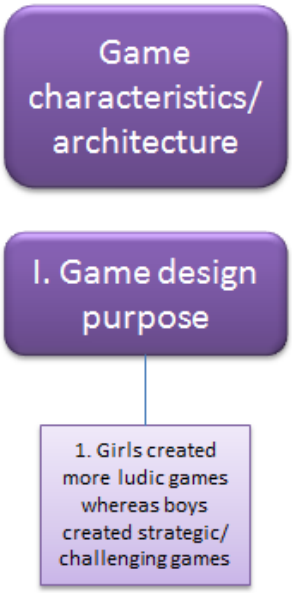

Figure 4.11 Game's characteristics/ architecture themes and sub-themes

Theme 1 – Game design purpose

The different results in game design purposes were led by gender differences rather than the impact of technology use in the teacher's pedagogy. Although students in both groups had the opportunity to create their groups as heterogeneous as they wished, there were only 2 out of 17 groups that were formed by boys and girls; all the remaining 15 groups were constituted by students of the same gender. In addition, there were only 3 out of the 17 groups that were formed by students of different grades. However, the researcher was unable to report any noticeable difference between groups of different grade levels. The following results do not present any

differentiation between non-technology and TI groups as the game design purposes showed to be very similar and consistent in both scenarios.

Sub-theme 1. Girls created more ludic games whereas boys created strategic/ challenging games

The most unanimous opinion among boys and girls when defining their game purpose was that they think differently. According to a 9th grader boy (non-technology): "girls have a different opinion about games…it is like that bouncing ball game [balloon ball], it is a very simple game, it is like a game of keep up [keeping a balloon without touching the ground]." Another 8th grade boy (TI) show a similar perception: "all girls games were kind of capture the flag, it was less skill and more luck". Boys from both groups were able to identify that girls' games were more ludic. As mentioned by one of the boys, 3 out of the 5 games designed by girls in the TI group had some components that related to capture the flag, which is a game that is played by younger children. In addition, the games designed by girls presented less challenging skills. Most of the girls games focused on locomotor skills (e.g. running and dodging) or manipulative skills that were not very challenging (e.g. catching a bean bag and volleying a kin-ball).

According to a 9th (non-technology) grader girl, boys have a different perception about game play: "they act like this is the Olympics, so if you mess up, they freak out…and then it is the end of the world". Another 8th grade girl (TI) describe boys games' as being "more sporty" while referring to the fact that games were more 'physical' (involving more aggressiveness), involved harder skills. When boys created their games, they focused on the promotion of competition, and each player's dexterity in performing a specific task.

Table 4.10 illustrates how boys and girls groups answered two questions related to game design.

Table 4.10
Non-Technology and TI Single-Sex Groups' Response to Game Design

Question	Boys response	Girls response
When proposing new rules on your own game or others, what were you trying to do?		
Turn the game more strategic	4	1
Make the game easier for me to play/ win	1	3
Include everyone in the game	1	5
If someone could not play my game, it was:		
My fault (as a presenter)	2	5
Their fault	4	2
Undecided	0	2

As shown in Table 4.10 boys tend to modify the game to turn it more strategic and girls show a concern on including everyone in the game. In order to illustrate these reactions, two examples are given: (1) the group of girls that created "wall ball mix" included a rule that every player from the offensive team had to touch the ball before they would score; (2) the group of boys that created "Ground Quidditch" made a few modifications on the keeper's box in order to establish a balance between offense and defense (in order to make the scoring goal not too easy or too hard). Therefore, boys sought to design games that involved a higher skill level and more strategic as they enjoyed the competition component of games; whereas girls sought to design games that were easier to play and/ or that would ensure everyone's participation in order to promote a more ludic atmosphere while playing.

Chapter V. Discussion and Conclusion

Discussion

The discussion of this research was broken down into five categories according to the research questions (pedagogy, physical activity, enjoyment, communication, and game characteristics).

The Impact of Technology Integration on the Teacher's Pedagogy

When comparing the two teaching conditions (non-technology and TI) to teach SDG, this study identified four elements that influenced the teacher's practice: (1) experience, (2) number of classes, (3) student accountability/ teaching style, and (4) school culture.

Experience

The SDG with TI condition was considered more appropriate for teachers with more experience with SDG and with TI. As previously mentioned, teaching SDG require a student-centered approach that deals with two forms of methodologies: constructivism (Rovegno & Dolly, 2006) and constructionism (Kafai & Resnick, 1996). In the present study, the game design process was broken down into five stages. In the non-technology group each stage was presented in a more discrete form, so it was easier for the teacher to notice if all groups were able to complete their tasks before they moved to the following stage. In the TI group, stages occurred concomitantly, so the teacher had to support students in different stages of game design and therefore it was harder to keep track of each group's work and provide the proper feedback. For instance, while there were groups that were working on their game refinements (stage 4) and

writing their playbook (stage 5), there were still groups who had not yet presented their game for the first time and therefore, they were still designing their game (stage 2).

The TI component also requires experience in order to provide all the necessary tools to design their games away from school. The technological interface chosen to conduct this study, Edmodo, is a good example why TI experience is needed. Although the teacher had experience with Edmodo and chose this interface due to its user-friendly design, students still needed to be introduced to its tools and features. As the teacher did not want to spend time in class explaining how to use Edmodo (although it occurred occasionally), the teacher chose to create instructional videos. The instructional videos were screen recordings in which the teacher showed how to navigate Edmodo. The production of these videos required the ability to use software that enabled the teacher to record his own computer screen. Although the teacher did not know how to record his own screen, he felt comfortable with his technological skills and believed that he was able to learn quickly in order to deliver the needed support. Therefore being able to deal with different technologies is an important factor to feel comfortable while teaching with TI. Inan and Lowther (2010) have shown that teachers had this same perception while analyzing the main factors that influenced teachers to use TI in their teaching. The feeling of readiness (capabilities and skills needed to integrate technology in instruction) was the most significant of all variables analyzed, overcoming even teachers' beliefs (how teachers perceived technology's influence on student learning and achievement).

Number of classes

In the proposed intervention, the TI students felt overwhelmed having to complete their SDG assignments in a short period of time. In addition, a longer time period between classes may not only give time for students to focus on their own game, but also post more comments

about their peers' games. Having a longer interval between classes would also be beneficial for the teacher. The teacher's workload in the TI group varied from time to time, but overall it was higher than the non-technology group. In the non-technology group, the teacher was able to check the game design progression of each group in class, but in the TI group, the teacher had to go on each group section of Edmodo to check the progress of their game. These findings were consistent to Hastie, Casey and Tarter (2010) who also reported a higher workload with SDG intervention that used a wiki when students were developing their game. In Hastie et al. (2010) study, the students constantly required the teacher's feedback while being active in the wiki.

Student accountability/ teaching style

The SDG with TI was considered more appropriate for teachers that felt comfortable in having less control of their students and therefore holding students accountable. SDG already requires a number of new situations that may be overwhelming for teachers and students, therefore it is important to consider the teaching style and the teacher-student relationship when choosing the teaching condition to apply SDG.

In the TI condition, students are much more autonomous as the teacher does not have control on how much effort and time is spent in each path of the game design. Students often had to decide when a discussion should stop and when it needed further consideration. There were times in which students were the ones that who needed the teacher's feedback, since it was very hard for the teacher to follow all game discussions. In other words, the teacher-student relationship should involve a lot of trust, since that the freedom of choice given to students involves responsibility. In the present study, students that were unable to show this responsibility focused on finishing their game design on the very last day before their game presentation.

Although SDG with TI requires more autonomous students, teachers should consider that each student has a different preference in terms of teaching styles. Schell (2004) reported that students tend to show a balance between 'watchers' and 'doers' with regards to their preference of teaching styles when learning physical education contents that were taught with TI. In other words, there is a balance between students that prefer to learn by doing and students that prefer to receive instruction before having any action. In the non-technology group, students received a more restricted script in which they had to follow step-by-step. Therefore, the non-technology group appears to be more appropriate for 'watchers'. In the TI group, students had more freedom and therefore it was more appropriate for 'doers'. Regardless of the teaching condition, it is important that the teacher identifies the tendency of each student ('watcher' or 'doer') in order to give them more freedom or more direction. Moreover, it is important to acknowledge that Hastie and André (2012) reported that each gender has a preference in designing their game. Boys are usually 'doers' (like to design their game by testing their theories) and girls are usually 'planners' (write the whole game before testing). This is another indication that it is important to provide different game design options to optimize their productivity.

School culture

When making the decision to include SDG, the teacher should consider the school culture when analyzing the most appropriate teaching condition. SDG alone may be considered a 'culture shock' for many schools as it breaks many paradigms: (1) the teacher is not the one responsible for developing the content, (2) students need to change their mindset from 'adapting themselves to games rules' to 'adapt the games to their own condition', (3) students may have to give up physical activity time to discuss about games' rules. This culture shock may lead the belief that SDG is just a new form of 'ball rolling' as Rovegno and Bandhauer (1994) were able

to identify as one of the most common misconceptions of SDG. For instance, physical education teachers and students believe that students understand why games have rules, penalties and boundaries, but they do not. It takes several trials before they can anticipate what a rule can provoke in their game.

School culture should also be analyzed when considering the usefulness of TI. In the present study, the school that received both forms of intervention had a very significant indicator that TI was appropriate; that is, all students carried a laptop given by the school. Although TI was common in almost every discipline in school, it was not a common practice in physical education. However, once students were familiar with the technological tools, TI in physical education was not considered an issue. The biggest culture shock was the introduction of homework assignments given in the TI group. Students were not used to having homework from physical education and it was considered an issue by many students. Mitchell, Stanne and Barton (2000) were able to report that despite teachers' positive response of using homework in physical education, few teachers use this procedure. In addition, the resistance of physical education homework may even come from their parents. For example, Tannehill, Romar, and O'Sullivan (1994) reported in a study that over 70% of parents were against physical education homework. In summary, it is important to understand what is considered a common practice in the school and what is not. Although SDG may lead the break of a few paradigms that may be overcome, breaking too many paradigms at once may lead to students' disengagement and discontent.

The Impact of Technology Integration on Students' Physical Activity Engagement

Non-technology students reported a higher physical activity engagement than TI students. The findings were surprising at first glance since TI students did not need to spend any time

designing their game in class. However, two main reasons had an important impact in these findings: (1) number of students, and (2) learning about TI.

Number of students

There was a significant difference in the number of students attending each physical education class. While the non-technology group had 31 students, the TI group had 51students. The difference in the number of students of each group must be acknowledged as a study's limitation when addressing TI impact in physical activity. Despite having 64% more students, the TI group had the same available space (two indoor gyms) for their physical education classes. During stages 1 and 2, the teacher was able to organize both groups in a way that would accommodate all students to be active during all game activities. However, when students designed their games and started playing in stages 3, 4 and 5, the TI group had a very different organization. Due to the great number of students, there would be a rotation between groups that would be active in the TI group (the games were designed in a way that only accommodated a limited number of students). The physical activity impact reports a statistical difference only in stage 3, 4 and 5, suggesting that the needed rotation of students during game play had a significant impact in physical activity.

Learning about technology integration

Although TI did not spend time designing their activities in class and kept their in class game discussions to a minimal, they had to learn about Edmodo and other technological features in order to design their game outside of class. The technological teaching sessions were not performed every class and they were not long, but they must be acknowledge as an extra activity that took physical activity time away from students.

When comparing physical activity engagement by group and gender, it was reported that only boys from the non-technology group had significant difference in comparison to boys from the TI group. Girls from both groups reported very similar outcomes. Although it was possible to identify what had diminished the TI physical activity, it is not clear why it had a bigger impact on boys. Apart from reporting higher levels of physical activity in the non-technology group, more research with the same number of students in each group would be needed to ensure if TI have a negative impact in students physical activity engagement.

The Impact of Technology Integration on Students' Enjoyment/Engagement

The enjoyment and participation in SDG was satisfactory in both teaching conditions as students reported a positive perception in both groups. Nevertheless, non-technology students reported a statistically higher enjoyment and higher feeling of engagement when comparing to the TI students. There were three major reasons that diminished the enjoyment of the TI group: (1) lack of TI culture in physical education, (2) homework in physical education, and (3) discontent with Edmodo.

Although students were accustomed to using their laptops in almost every other subject in school, they were not familiar with their role in physical education classes. After the intervention, 88% of students reported to be either indifferent or support the use of technology in all the activities in school; whereas, only 60% of students reported as either indifferent or support the use of technology in physical education. There is not a clear explanation why students felt different when considering the use of technology in school and in physical education in particular. Many hypotheses may be given, but three main reasons seem to have a better fit in this scenario: (1) the fact that they were not used to dealing with computers in physical education; (2) they felt that computers were taking physical activity time away from them

(although there were only two occasions in which they used computers in class), or (3) computers were majorly used to complete homework assignments and they did not want to have homework.

Homework seems the most probable contribution for students' dissatisfaction as it was an extra assignment in which they had never had to do before. Students did report to be dissatisfied in having homework assignments for physical education. In spite of that, TI students reported a higher dedication than non-technology students. That is, even having a lower enjoyment perception; they dedicated more time once they felt it was a school assignment that should be taken seriously. According to Hastie and Pickwell (1996) students are engaged in class either driven by their own interests or by being motivated. Thus, the feeling of being obligated to complete an assignment in the TI group overcame non-technology students' interest in SDG, leading to a higher dedication in their game design preparation. It is important to call attention that among the students that were dissatisfied in the non-technology group; the class discussion was considered a big issue (which would be equivalent to the TI homework assignment).

The Edmodo interface also led to the discontent of some students. Students did not report any difficulty in using Edmodo but only 61% reported to be either indifferent or support the use of Edmodo and only 60% reported to login to Edmodo once a week or more. The major issue with Edmodo was related to the fact that students did not chose to use Edmodo as it was presented to them. It was suggested that students would post comments in different times and lead towards a discussion that was ongoing and would eventually create a game. Students that did use Edmodo scheduled a time to meet their group members online, and students that did not use Edmodo claimed that it was hard to schedule a time that would accommodate everyone's agenda. Therefore, future interventions should either use an interface that facilitates students

meeting online at the same time (as it seems to be their preference) or when using Edmodo, students should be prepared to work without the need of meeting online. In other words, when using Edmodo to design games, students may have to learn to collaborate while working separately on their own.

When comparing gender differences, girls showed to have a higher appreciation for SDG. Girls reported to want to have other SDG experiences and when comparing to other physical education classes, they reported enjoying SDG much more than boys. These findings are consistent with the extensive literature that reports that physical education curricula are usually built for aggressive male students as they are able to dominate team-sports activities, the most common content developed in physical education (Cockburn & Clarke, 2002; Couturier, Chepko, & Coughlin, 2007; Ennis, 1996, 2011). In other words, in regular physical education classes, girls are not as empowered as boys (not only physically but also in terms of being able to give their opinion) and therefore, they are constantly restrained from participation and led to marginalization. SDG is able to create an equity that transcends gender and skill level differences, since students are empowered to create a game that relates to their own preferences. Therefore it is natural that girls enjoy this gain of power in physical education as they are able to express their opinion and even propose a game that they would like to play. Oliver, Hamzeh, and McCaughtry (2009) use this same trend of thought when proposing that disengaged girls create their own physical activities in order to propose higher levels of engagement.

Despite group and gender differences, students reported a positive overall response. Three major reasons created this positive environment: (1) feeling responsible, (2) novelty, and (3) freedom of choice.

The feeling of responsibility was one of the most cited reasons to enjoy the SDG unit. According to Lin, Myers and Yanes (2010) teenagers that feel responsible show a higher dedication towards school. The feeling of responsibility had also an intimate connection to ownership as students were proud to present their games to their peers. Students reported being proud when other students praised their game.

Novelty was also an important feature that led to students' satisfaction. There were many students who said that they were pleased because they usually play the same games every year. Couturier, Chepko and Coughlin (2005) reports that one of the main reasons that led students to not participate in physical education classes was having to take part in the same activities every year. As SDG always provide new games every time that it is implemented, this is an important characteristic that is able to please most students.

Freedom of choice was also cited by most students as a characteristic that was much appreciated. Students reported that they are not given as many opportunities to have this freedom of choice and that they were only supposed to do whatever the teacher would tell them to do. When reporting this frustration, students would refer to most of schools activities and not only physical education classes. It is important to call attention that this freedom of choice does not only bring advantages. For instance, students had the freedom to choose to play with their own group members when playing each other's games, but this led to a 'battle of sexes' (as groups were mainly formed by single-sex) on a few occasions that required the teacher's intervention. Although this scenario is unpleasant (and even avoidable had the teacher delegated the teams), it also empowers the teacher to negotiate students behaviors as their freedom of choice are negotiable according to their behavior (if they can or cannot be hold accountable).

The Impact of Technology Integration on Students' Communication

There are four elements that should be considered when comparing the two teaching conditions impact on students' communication: (1) group members' communication, (2) inter-group communication, (3) students' presentations, and (4) communicative outcomes.

Group members' communication

The non-technology group promoted a better communication among group members. The majority of the students from both groups (non-technology and TI) showed that they wanted to work together when designing their game, given that Edmodo did not promote this form of interaction, TI students had difficulty in using Edmodo while designing a game. In class, the non-technology students were able to approach the game design in different ways. The girls would remain sitting and discuss the entire game before they would test it, whereas most of the boys would not discuss their ideas for long without testing their theories. These finding where consistent to Hastie and André (2012) who found that girls were 'planners' while boys were 'doers' when designing their own games.

In the TI group, boys had significantly less participation in Edmodo than girls, showing that the game development of 'planners' and 'doers' may have played an important role. Edmodo was not a huge imposition for girls because they were still able to discuss each rule one by one before trying their ideas. However, if boys are 'doers' the online game design that was imposed by Edmodo does not fit their game design preferences. In summary, the non-technology group was able to accommodate different forms of game design whereas the TI group restrained boys' game development, leading to alternative methods such as students meetings to discuss the game between classes.

Inter-group communication

The TI group promoted a better inter-group communication. Although Edmodo was considered a restraint for developing the game design, it may be considered more 'democratic' when it comes to discussions that involve a bigger group. The teacher would post questions about the game and students would answer by replying to these questions or by making comments from other students' posts. Students who are constantly overlooked in physical education classes (e.g. girls and lower skill students) were the most active in Edmodo. This form of discussion was also considerate more appropriate since the teacher was able to initiate all groups' discussions by placing the focus of attention. Holland and Muilenburg (2011) reported similar findings showing that Edmodo was able to promote discussions with big group of students. The authors also recognized that students needed guidance to discuss the desired subject matter otherwise students would discuss personal matters.

In the non-technology group, students were able discuss about game refinements, but they were constantly led by the same students (generally high skill boys). The discussions were often distracted by other subjects such as who won the game or game situations that just happened. Moreover, the discussions constantly turned into arguments as students were still excited about the game.

Although many games discussions in Edmodo did not receive many comments, it is believed that the major restraint was the lack of time to complete the task. Students would only have one day to make their comment in Edmodo, given that they had physical education classes in every other day, so whenever they had a new class, they would play a new game and have to place a new comment. This assumption appears to be consistent with the literature that found that 70% of high school students were able to be actively engaged in Edmodo when given a week to

complete a publication that was given to them (Fardoun, Alghazzawi, López, Penichet, & Gallud, 2012).

Students' presentations

Both groups reported difficulty in presenting their games. The learn-teach-play (LTP) lesson showed to be an adequate form to approach their need to learn to present their game. However, much more support would be needed in order to ensure a better game presentation without the teacher's intervention. In the non-technology teaching condition, extending the number of LTP lessons would be the most appropriate form to aid students in their presentation.

In the TI teaching condition, the usefulness of LTP could be done with videos. That is, the teacher would be able to teach different games with instructional videos. This format may help students focus on the game presentation as it takes the excitement away (since they would not perform after the presentation). Moreover, instructional videos could also describe how games should be presented and students could even make their own instructional videos which may lead to better preparation and presentation. This format of teaching was originally planned for this group, but it was not possible to be implemented since students had online videos blocked on their laptops (YouTube and similar websites) due to school policy. The concept of teaching physical education content with videos has already reported positive findings in the literature. Clarke (2008) was able to report positive responses when using recorded videos to teach motor skills to children. Therefore, if there are no technical restrains, TI have more options to support students' presentations.

Communicative outcomes

The TI group was able to develop better communicative outcomes. The TI students presented much more elaborated playbooks than the non-technology students. The major reason

for finding such a gap between groups was due to available time and tools. With regards to time available, TI students had weeks to prepare their playbook, whereas non-technology students had to complete this assignment in one class only. In addition, TI students were empowered with all the technological tools of a computer. All TI students chose to use the PowerPoint software (which was presented as an option for them), thus, they were able to personalize their playbook with different backgrounds, pictures that related to their game (loaded from the internet), and present precise diagrams with tools that did not require drawing skills.

The Impact of Technology Integration on Games Characteristics/ Architecture

While the games' characteristics were not influenced by the teaching condition, there were differences related to gender. Boys showed to have more concern with promoting competition, and therefore their focus related to strategic games that encouraged the performance of high levels of particular skills. For instance, the game "Streetball" mixed skills from football and basketball, becoming very popular among boys but not as appreciated by girls. Girls showed more concern with designing games that were able to optimize all players' participation, having a ludic atmosphere that would not require much skill in order to play. For instance, the game "Noodle" was a variation of capture the flag with multiple flags in each team, ensuring everyone's participation (since there were many flags that enabled multiple foci in the game) and involving only locomotor skills which are easier to perform.

Boys and girls also had different responses when it came to changing their games. Girls tried to change their own game (or make suggestions to other games) focusing on everyone's participation. Boys tried to change their games to make it more strategic. Moreover, girls would blame themselves if other students would not be able to play their game, whereas boys tended to blame other students. These findings seem to be consistent with Hastie and André (2012) who

reported that girls were more likely to change their games more often to accommodate other students' needs.

These differences in reactions may well be reflective of the students' previous physical education experiences. While the most popular American sports such as Basketball and Football are constantly part of physical education classes and may play an important role to keep boys motivated, they may also have the potential to marginalize girls' participation. Azzarito (2011) calls attention to the gendered hidden curriculum that keep shaping the contexts of schools, praising activities that are historically predominant by boys and excluding girls. Therefore, the girls' concern for including every student in the game and even avoiding skills that were harder to perform may be a reaction to previous unpleasant experiences that problematized their own participation.

Conclusion

This study contributes to our understanding on how the incorporation of TI has an impact on the teaching of SDG. Prior to this study, there were only two studies that used TI in SDG (Casey, Hastie, & Rovegno, 2011; Hastie et al., 2010). However, this is the first research that analyzed the usefulness of TI when teaching a SDG unit, that is, the potentialities and limitations of teaching SDG when using TI. The use of TI in any physical education teaching component may present diverse possibilities, given the many different technological tools that may be used. The present study focused on using Edmodo as a communication tool while students designed their games outside of class.

The first conclusion drawn from analyzing the outcomes of this study is that TI was more difficult to implement when teaching SDG. There were more challenging situations that required the teacher to have a high level of experience with SDG and with TI. The teacher's relationship

with students also required a higher level of trust as students were much more empowered. Due to the need for completing homework assignments, students in the TI group reported lower levels of enjoyment when compared with the non-technology group. Moreover, in order to provide better outcomes with TI, it would be important to teach students on how to collaborate when working separately as it was needed in the online game design.

Having so many obstacles, one may question why any teacher would chose to use TI in SDG. There were, however, some very positive findings that came from the TI group. The most significant of these was that Edmodo was able to promote a more democratic communication among all students when discussing games' rules. While classroom discussions were led by high skilled boys, the online discussions opened doors to whoever was interested in discussing the game. In other words, having the chance of promoting equity in physical education may be a single reason that is worthwhile to use TI in SDG. Moreover, using TI enabled the teacher to provide online supporting materials and enabled students to produce better playbooks as they had access to supporting tools.

The second conclusion taken from this study is that students wanted to have a more direct interaction when dealing with their creative process which was diminished with Edmodo. Considering that online discussion during the games' refinements promoted more equality in physical education, three possible solutions are proposed to approach this problem: (1) create a hybrid pedagogy that is able to optimize the desired features of each teaching condition; (2) seek new TI options that are able to overcome issues found with Edmodo, (3) have different forms of implementing SDG.

A hybrid pedagogy would focus on the main features of the two teaching conditions that were studied: providing face-to-face interaction while designing the games, and providing online

games discussions. The face-to-face interaction should give students the ability to approach the game design in different forms (providing the freedom of being a 'planner' or a 'doer') as well as ensuring opportunities for the teacher to follow this process and give feedback. The online discussions would maximize students' participation and would also give more direction to these conversations as teachers would be able to post specific questions that lead these discussions. This proposed hybrid model could use Edmodo since this interface was considered appropriate for the post-game discussions.

Knowing that TI may use different tools that are likely to change over time, other TI tools may be considered when proposing a TI in SDG. For instance, Google Plus (a social media similar to Facebook) has online meeting tools that enable up to ten people to chat online (with video, audio and texting) and at the same time, having the ability to share the same PowerPoint presentation, videos and a white board (place where they can draw together). This interface enhances the online interaction and may overcome the issues found in Edmodo. However, Google Plus is not a closed environment in which the teacher has full control of who is participating. Therefore, finding a tool that is both powerful and safe for students is not an easy task.

The improvement of TI in SDG may also be possible while proposing different SDG methodologies. The present study developed a five-stage teaching unit (SDG introduction, learning about game design, playing each other's games, games' refinement, playbook), but there are other SDG teaching methodologies such as the division of roles (Giménez, 2011) and jigsaw (Hastie & Casey, 2010) that may be a better fit with TI.

The third and final conclusion taken from this study is that there were significant gender differences when dealing with SDG. Although this matter is not exclusively related to TI in

SDG, both teaching conditions reported different forms of approaching SDG. These differences included game design preferred, game characteristics and different levels of enjoyment. Further research focusing on gender differences in SDG may support teachers on how to approach each gender and enhance their SDG experience.

There are many forms of TI implementation in SDG and further research is needed to enhance our understanding in the subject matter. The present study was able to analyze many different factors that influenced students' learning and participation as well as factors that require teachers' preparation. While considering these factors, other interventions may be drawn and analyzing these new interventions may deepen our current understanding.

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Appendix A

Interview Guide

Interview questions

I. Introduction

1. Did you like the SDG unit?
    a. What did you like or dislike in particular?
2. Was this the first time that you had a SDG in PE?
3. What made you chose this group?
    a. Do you think you would enjoy as much with a group delegated by the teacher?
    b. Would you like to work with boys/ girls (different gender)? Why?

II. Students-enjoyment / engagement

In our class, we had 5 stages:

- SDG introduction
- Learning about game design
- Playing each other's games
- Games' refinement
- Establishing the final game

(Evaluate different answers from boys and girls)

1. Did you have a favorite moment and something that you did not like about it?
2. Is there something in this class that you wish we would not do? (considering SDG unit)
3. Is there something in this class that we did not do, but you wish that we did? (considering SDG unit)
4. Do you consider your engagement in this class the same as in other PE classes, higher or lower?
    a. (If any changes) what made it differently?
5. Did you mind having an assignment for PE?
    a. Boys x girls in Edmodo – state questions – like enjoyment/ participation in Edmodo.
6. Did you mind to stop playing to focus on the game design?
7. Did you work outside of PE for this class? If so, how much?
8. What would be the major motivation for you to engage in an out-of-class assignment?
9. Did you saw a purpose on this class?

10. What did you learn with it?

III. Levels of communication

1. How would you evaluate the communication within your group?
    a. Friendly / always introducing the opposites as well
    b. Efficient
    c. Pleasant
    d. productive
2. How would you evaluate your communication with other group members when they gave feedback about your game or when you gave feedback about their?
3. Did you like this form of communication?
    a. Discussions
    b. Edmodo
        i. Did everyone participate in Edmodo?
        ii. Did it bother you that some did not participate?
    c. Suggest another option?
4. Do you feel that Edmodo prepared you for class in any way?
    a. Liked the videos (did you watch the videos)
    b. Something else? – coneball slides
5. Did you liked when I placed specific comments on your game (privacy)?
6. Did you relate different to boys/ girls when talking about the game design
    a. Was the communication any different to you?
        i. Felt better/ worse talking to boys/ girls
        ii. Felt that listened to you more or less
7. Did you felt embarrassed at any point to give your input about something in class/ Edmodo?

IV. Game appreciation / learning – favorite games & why

1. We have a list of the SDG that you played which one was your favorite and tell me why?
2. What did you learn while designing your game?
    a. How many times did you change?
    b. Did you come up with more than one game?
    c. What did you learn about the rules you introduced – how they fit your game/idea?

3. What was your goal when designing your game?
    a. Novelty (New)
    b. Challenge
    c. Exploration/ intention
    d. Instant enjoyment
    e. Attention demand
4. Did you find the games that the boys/ girls designed more/ less fun or the same? Why?
5. Did you notice anything different in games designed by boys/ girls?
6. When proposing new rules on your own game or others, what were you trying to do?
    a. Turn the game more strategic
    b. Make the game easier for me to play/ win
    c. Include everyone in the game
7. If someone could not play my game, it was:
    a. My fault…
    b. Their fault…

Appendix B

Survey

Survey: Enjoyment/ Engagement **CIRCLE YOUR ANSWER!!!**

1. How would you rate your overall enjoyment in the SDG teaching unit? (1-10 rating)

1 2 3 4 5 6 7 8 9 10

2. Would you like to have more creating games experiences in PE classes? (1-4 rating)

No way probably not most likely yes, definitely

3. Comparing to other PE lessons in general, do you consider creating games in PE (enjoyment):

Much worse Worse The same Better Much better

4. Looking at your overall experience in creating games, do you think that your engagement/ participation was:

Very low Low Ok High Very high

5. Comparing to other PE lessons in general, do you consider your participation in creating games (participation):

Much worse Worse The same Better Much better

Survey: technology involvement in everyday life - **CIRCLE YOUR ANSWER!!!**

1. In my house, there are_____ computers (put the number of computers including desktops, laptops and tablets/ iPads)

2. In my house there are _____people living (number of people that live in your house)

3. Do you have internet access in your house? YES NO

4. How many hours you spend in front of your computer per day:
   a. In school: _____
   b. At home:_____

5. Do you like computers and technology devices?

No, I hate it!	Not so much	It's okay	Yes, I like it	Yes! Of course

6. Do you like to have laptops in your school?

No, I hate it!	Not so much	It's okay	Yes, I like it	Yes! Of course

7. Did you like to have laptops in physical education?

No, I hate it!	Not so much	It's okay	Yes, I like it	Yes! Of course

8. Did you like to use Edmodo in this class?

No, I hate it!	Not so much	It's okay	Yes, I like it	Yes! Of course

9. How often did you use Edmodo for this class?

Never logged in	Logged in 5 times of less	Logged in once a week	Logged in 2 to 3 times a week	Logged in every day or almost everyday

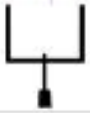
10. Do you prefer to learn about new software (programs) and/ or new hardware (devices) or do you prefer to work with software (programs) and/ or hardware (devices) that you know how to work?

I prefer to deal with programs and devices that I am already familiar	Either way is okay	I prefer new programs/ devices

Appendix C

Poster

Leading Questions for the Non-Technology Group

I	?	Options	Choice
Scoring	A. How do you score?	1. Goal (air or ground)   2. Gain possesion 3. Move ball over the line   4. Ball to a person in certain place	
	B. what are the goals?	 5. Size  6. Shape  7. Location  8. Angle 9. Number	
	C. What object are you going to use to score?	10. Ball (various types)  11. Puck, Flag, Sock, Bean-bag, Disc, Person only, other	

II	?	Options	Choice
Progression & Possession	A. How can you progress up the court or field?	 1. Pass	
		2. Throw 	
		 3. Run	
		4. Push 	
		5. Strike	
		 6. Drible	
		7. Kick	
		? 8. Ride, swim, etc ?	
	B. What implement is used ?	 1. Scoop to carry the ball	
		2. Stick to hit the ball 	
	C. How do you get possession?	1. After a score 	
		2. Interception	
		3. Tacke or Tag 	
		 4. Fumble or Strip	
		5. Rebound	
		 6. Violation	
		7. Out of play 	
		8. Opposition has no more returns	

III	?	Options	Choice
Rules & important details	A. how is the game organized?	1. How do you start the game or begin new period? 	
		2. How do you resume play following the score?	
		3. What are the consequences of rules violations? 	
		 4. What are the boundaries?	

IV	Diagram
Include: court design & boundaries, equipment (what and how many), number of players and disposition, referees needed, and any other important information	

Appendix D

Playbook Portfolio

Leading Questions for the Non-Technology Group

Name of the game:

- To play our game you will need

_____

_____

_____

- You play the game by using_____
- The goal/ end zone of our game is_____
- The game must have _____ teams and each team should have _____ players.

In order to score in the game you must:

_____

_____

_____

_____

- You start the game by

_____

_____

_____

- You resume game play after score by

_____

_____

_____

This is how the court of our game looks like

- (include a caption to your diagram)

In this game this is how you progress along the court:

_____

_____

_____

_____

_____

_____

In our game, you get possession of the ball by

_____

_____

_____

_____

_____

Here are some important rules of our game

_____

_____

_____

_____

_____

_____

_____

_____

If you do not follow the rules, there are consequences

_____

_____

_____

_____

_____

This game is cool because

_____

_____

_____

_____

_____

We created this game because

_____

_____

_____

_____

_____

Appendix E

Leading Questions and Playbook Portfolio for the Technology Integration Group

Invasion games leading questions

My game's name

This page is being presented with no personal touch
Your group is responsible for inputting everything

Add anything that you find appropriate: video, audio, pictures, written explanations – they are all welcome (and input your personal touch)

Erase everything that you find appropriate: explanation charts, questions, pictures, etc.

Introduction to your game

- Complete this page AT LAST when the game is COMPLETELY ready
- Number of teams and players per team
- Image of court/ field

Name each slide however you want, for example, this slide could be called: "welcome to the most amazing game you ever play" – once again: input and erase whatever you find necessary – this is just a guide to help you.

Remember that you can change any title and order of any page

Getting started…

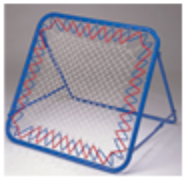
- Q1. How do you score?
  1. With a goal
  2. Gaining possession
  3. Move the ball over a line
  4. Ball to a person in certain place
  - You may find other options
  - Remember that you may chose more than one option to score (multiple score options & multiple scoring system)

The following slides are a series of leading questions in which you need to answer in order to provide the full information of your game while making your playbook.
You may modify the order and include more information as you find it more appropriate.

If you chose to have a goal…

How are your goals (remember you may have more than one type of goal)?

- Size
- Shape
- Location
- Angle
- Number



What is your "object"

- What object are you going to use to score?
- Ball – all various types
  - Soccer ball, basketball, foam ball, rubber ball, etc
- Puck
- Flag
- Sock
- Bean-bag
- Disc
- Person only (no object)
- Other option

Peteca

Progression & Possession

How can you progress up the court or field?

- Pass
- Throw
- Run
- Push
- Strike
- Dribble
- Kick
- Ride, swim, etc

Progression & Possession

Will you use implements?

- Scoop to carry the ball

- Stick to hit the ball

Progression & Possession

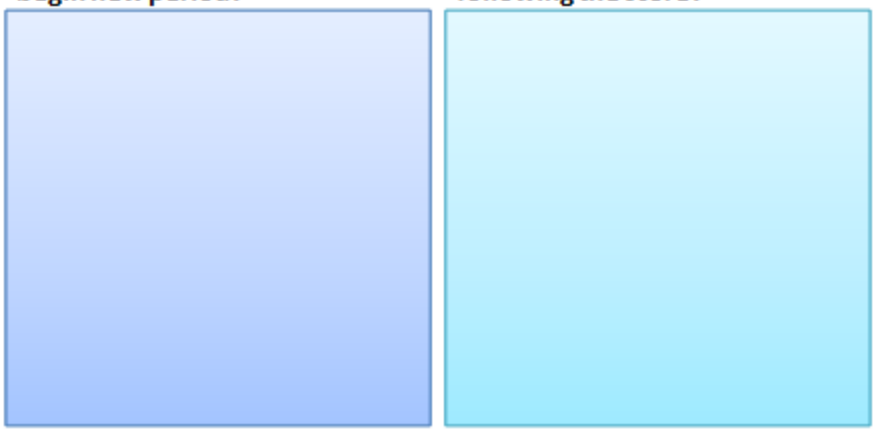
How do you get possession?

- After a score
- Interception
- Tackle or tag
- Fumble or strip
- Rebound
- Violation
- Out of play
- Opposing has no more turns

Rules & important details

How do you start the game or begin new period?

How do you resume play following the score?



Rules & important details

- What are the consequences of rules violations?

Rules & important details

- What are the boundaries?

Include details about your court/ field set up and measures

Review your answers and create a playbook

- Your playbook may have whatever media you chose:
- A PowerPoint – as it is, slide share, with audio
- A video
- A story format – pictures with caption
- A audio description
- A word document with the rules
- See the "Down the drain" PowerPoint as an example

Appendix F

IRB Forms and Letters

DEPARTMENT OF
KINESIOLOGY

AUBURN UNIVERSITY
COLLEGE OF EDUCATION

(NOTE: DO NOT SIGN THIS DOCUMENT UNLESS AN IRB APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

PARENTAL PERMISSION/CONSENT
for a Research Study entitled
"technology integration impact in student-designed games"

Student-designed games physical education class

Your child is invited to participate in a research study to examine the impact on using technology integration when designing his/hers own games for physical education classes. The study is being conducted by Mauro André, doctoral student of the Auburn University Department of Kinesiology. Since your child is age 19 or younger we must have your permission to include him/her in the study.

What will be involved if your child participates? If you decide to allow your child to participate in this research study, your child will (1) participate in a 15 minute interview that will cover questions related to their experience in creating games for physical education class, (2) s/he will wear a pedometer in the classes conducted for the research, (3) the researcher will record notes while observing the students' actions in class. The study will last from 4 to 7 weeks and should be completed before the Thanksgiving break. I am asking for your permission to record the interview/observation and later transcribe it. After the interview/observation is transcribed, the voice record will be erased. No identifying information will be collected other than voice, and I will be the only person who has access to the recordings. Further, if any of the actual transcript is ever used in a presentation or publication, I will use a pseudonym for your child's name.

Are there any benefits to your child or others? This will probably be a new experience for your child – s/he will have a chance to design the game that s/he and others will be playing in physical education. This will be a novel and enriching experience for the participants. In addition, if your child participates in this study, they will help contribute to developing quality physical education programs and better teaching practices for all physical educators.

Parent/Guardian Initials_____

2050 Memorial Coliseum, Auburn, AL 36849-5323; Telephone: 334-844-4483; Fax: 334-844-1467

www.auburn.edu

DEPARTMENT OF
KINESIOLOGY

AUBURN UNIVERSITY
COLLEGE OF EDUCATION

If you (or your child) change your mind about your child's participation, your child can be withdrawn from the study at any time. Your child's participation is completely voluntary. If you choose to withdraw your child, your child's data can also be withdrawn. Your decision about whether or not to allow your child to participate or to stop participating will not jeopardize you or your child's future relations with Auburn University, the Department of Kinesiology.

Your child's privacy will be protected. Any information obtained in connection with this study will remain anonymous. The data collected will be protected by Mauro André. Information obtained through your child's participation may be used to be published in a doctoral dissertation, professional journal or presented at a professional meeting.

If you (or your child) have questions about this study, *please ask them now or* contact Mauro André at 334-444-1823. A copy of this document will be given to you to keep.

If you have questions about your child's rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH FOR YOUR CHILD TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO ALLOW YOUR CHILD TO PARTICIPATE.

Assent from your child will be obtained at the time of interview and they will be free to say "no".

Parent/Guardian Signature	Investigator obtaining consent Date
Printed Name	Printed Name
Date	

The Auburn University Institutional Review Board has approved this document for use from 9/11/12 to 9/10/13 Protocol # 12-290 EP1209

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Learn more about Edmodo on the back of these pages (parental permission/consent). On the back of both pages of these parental permission there are details explaining about Edmodo.

Are there any benefits to your child or others? This will probably be a new experience for your child – s/he will have a chance to design the game that s/he and others will be playing in physical education. This will be a novel and enriching experience for the participants. In addition, if your child participates in this study, they will help contribute to developing quality physical education programs and better teaching practices for all physical educators.

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Your child's privacy will be protected. Any information obtained in connection with this study will remain anonymous. The data collected will be protected by Mauro André. Information obtained through your child's participation may be used to be published in a doctoral dissertation, professional journal or presented at a professional meeting.

If you (or your child) have questions about this study, *please ask them now or* contact Mauro André at 334-444-1823. A copy of this document will be given to you to keep.

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Date	

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In order to use technology and design their games online, student will be using Edmodo.

So, what is Edmodo?

- Edmodo could be thought as a " Facebook for educators". By this we mean that it allows teachers to create a virtual classroom for his or hers students
- In Edmodo, students can upload files and share conversations.
- Students are able to choose to whom they write: for the entire class, for specific students for the students in his/hers group.
- The teacher can make comments about students' progress.
- Although Edmodo may look like Facebook, here are some important differences:
    - Only students invited by the teacher will have access.
    - Only the students from the class will be able to see what is being written on the Edmodo wall of that classroom.
    - The principal, the physical education teacher, and the school's technology specialist will also have access.
    - Each student can create their own pseudonym.

See over for an explanatory diagram

A screen shot of an Edmodo page is shown in order to explain each feature

1. Post – Each participant is able to write a post, link files and select to whom they wish to send the post (regardless to whom they send, the teacher will always be able to see the post – that is how the website is designed).
2. Teacher will send the participating students a group code for them to join Edmodo. No one without that code is able to enter in the virtual classroom. The teacher is also able to manage who is part of the virtual classroom (including and excluding) and creating smaller groups.
3. Students will be able to create a profile with pseudonyms – ensuring their anonymity while posting online.
4. This is where students reply comments – the interface is very user-friendly.
5. The website allows the teacher to create smaller groups. As a result, students will be able to work on their game without being monitored by other classmates. Whenever the group feels comfortable, they will be able to share their game while posting to the entire section.
6. This is a photo of the classroom teacher, students will not be required to upload a photo.