Please cite this article in press as: M.N. Giannakos, L. Jaccheri, From players to makers: An empirical examination of factors that affect creative game development, International Journal of Child-Computer Interaction (2018), https://doi.org/10.1016/j.ijcci.2018.06.002

From Players to Makers: An Empirical Examination of Factors that Affect Creative Game Development

ABSTRACT

The recent incremental growth of tangible and programming technologies has made it possible for teenagers to engage in creative game development activities. The aim of this work is to increase knowledge on the factors that characterize these activities and to increase understanding about *what motivates young students to participate in such activities*. In our empirical evaluation, a group of researchers and artists designed, implemented and evaluated workshop programs with 78 students aged 12 and 17 years. For the first study, we collected qualitative data from 11 interviews and subjected this data content analysis. For the second study, we designed a survey grounded in motivational factors for technology and collected 49 responses. The results show that (a) creative development activities raise awareness of technology (especially in female students), intensify the experience and invite students to explore boundaries, increase collaboration and exchange views and ideas, and (b) participants' effort expectancy and performance expectancy significantly affect their intention to participate.

Keywords

Creative activities; Game development; Digital artifacts; Students' motivations; Empirical examination; Gender.

1. INTRODUCTION

Digital artifacts that enable people to exchange, create and distribute information have, in recent decades, profoundly reshaped the way we work and live (Lovell and Buechley, 2011; Roque et al., 2012). The creative production of digital games and artifacts in learning activities has been linked to teaching new computer and design literacy skills (Buechley et al., 2008; Iversen et al., 2016). The philosophy behind the creative production of digital games and artifacts in learning is not new, given that Seymour Papert's constructionism and "learning-by-making" principles have been available for more than 25 years (Papert and Harel, 1991). However, the contemporary technical, infrastructural and social developments, such as the appearance of various making spaces (e.g., FabLabs, Makerspaces), tools with diverse making affordances (e.g., 3D printing, microprocessors) and the acute need to ensure that future citizens and workers will be fully prepared for a global economy and master twenty-first-century skills (e.g., critical thinking, innovation skills) posit digital games and artifact development as a very promising research area to support learning processes, especially in terms of acquiring twenty-first-century learning competences. Today's educational programs focus less on recall and reproduction and more on developing problem solving, creative thinking and decision-making abilities. In recent years, a variety of environments have been developed to introduce creativity and making principles to young students, and different organizations, such as Creative Skillset[1] and TIGA[2] accreditation, encourage this movement.

Creative production of artifacts, making, modding, digital fabrication, hacking, and other relevant activities are now supported in a number of global communities, including groups of innovators, designers, artists and hackers to mention a few. Research in the area is growing tremendously, with numerous initiatives such as a recent special issue of the International Journal of Child-Computer Interaction on digital fabrication in education (Iversen et al., 2016), the incremental establishment of and experimentation in spaces such as Makerspaces and FabLabs (Blikstein, 2013) and the growing FabLearn community, among others. Digital games are an integral part of this research community; they have the potential to make the symbolic and abstract manipulations involved in creative procedures more concrete

[1] http://creativeskillset.org/

[2] http://www.tiga.org/education/tiga-accreditation

and manageable (Cassell, 2008). For example, digital games and artifacts allow students to learn by iteratively testing and rebuilding their designs. The interactions between students and games in a creative learning activity are vital, since student-game interaction captures the most salient features of gameplay as it relates to complex problem-solving and motivation (Eseryel et al., 2014). A better understanding of multiple aspects from young students' perspectives could be valuable in designing effective creative development activities. From the current research, it is difficult to tell which aspects of these activities can have a positive impact in young students' engagement and learning. The purpose of the research presented in this paper is to build an understanding of the main interactions between young students and the processes in creative development activities and to consider improvements on the current processes.

An important issue related to the success of creative game development activities is their adoption by students. A number of models and theories have been used to address students' adoption of computer-based activities (Giannakos and Vlamos, 2013). The unified theory of acceptance and use of technology (UTAUT) is one of the most widely and successfully used (Venkatesh et al., 2003). Other researchers have empirically explained (using UTAUT or its initial form, Technology Acceptance Model (TAM)) a number of issues regarding students' attitudes (Shih, 2008). We aim to measure and investigate students' motivations because successful activities largely depend on them (Csikszentmihalyi, 1990). In this light, we chose technology acceptance variables related to students' motivation and applied them to a creative development context. We then conducted an analysis to identify which motivators would lead students to participate in the creative development activity.

This empirical study explores students' view about creative game development activities (referred to as creative activities) (i.e., evaluation phase 1) and then examines any potential effects of students' motivations and intentions to participate in similar events in the future (i.e., evaluation phase 2). Therefore, in our study, we measure and assess students' beliefs regarding creative activities in order to address the following question:

- *What factors affect students in their intention to participate in creative game development?*

Answering this question is expected to contribute to improving creative activity design through understanding students' intentions to pursue creative activities in the future.

The paper is structured as follows: the next section presents related work in this field. In Section 3, we present theories underlying the key variables studied in the paper and our research approach and hypotheses. Sections 4 and 5 describe the creative development activities and the two empirical evaluation phases. The final section of the paper raises the key theoretical and practical implications of this research and discusses a number of ideas on further research in the area.

2. RELATED WORK

2.1. Construction-based learning activities

Beyond desktops, ubiquitous technologies not only allow for more active, physical engagement but also provide the opportunity for novel and creative interactions. Physical and digital enhancement also make it possible to convey experiences in ways that are not possible in the physical world; for example, turning our thoughts into reality (e.g., through 3D printers; Eisenberg, 2013). In turn, this construction-based learning can provide opportunities to encourage or even enhance further exploration, discovery, reflection and collaboration (Price and Rogers, 2004).

Initiatives such as those for design thinking in K-12 education by d.school[3], for digital fabrication in education by FabLearn Labs[4], as well as grassroots education initiatives such as the Design for Change

[3] http://www.k12lab.org

[4] https://tltl.stanford.edu/project/fablearn-labs

global movement[5] provide environments for invention, creation, discovery, and sharing. The contemporary movement for Makerspaces, Hackerspaces, and FabLabs, as well as initiatives pertaining to the world's most prominent research infrastructures (e.g., CERN's IdeaSquare[6]), bring people together to generate new ideas and work on conceptual prototypes in an open environment, towards socially and globally relevant new product ideas and innovation. Thus, today's learning is gradually transformed utilizing construction-based activities - so people could discover knowledge, rather than receiving it passively.

2.2. Creativity-enhanced learning activities

Although creativity is difficult to define and widely debated, researchers and theorists tend to define it as the process of sensing problems or gaps in information, forming hypotheses, testing and modifying these hypotheses and communicating the results (Torrance, 1976)—although the concept becomes more of a comprehensive belief in creativity than the definition above may imply (Clark, 2008). For example, Vygotsky (1967) stated, "Any human act that gives rise to something new is referred to as a creative act, regardless of whether what is created is a physical object or some mental or emotional construct that lives within the person who created it and is known only to him" (p. 7). It is widely accepted (Torrance, 1976) that students need to experience creative learning opportunities. According to Aljughaiman and Mowrer-Reynolds (2005), one of the most important challenges for creative opportunities is "to establish an environment that promotes the children's interests" (p. 17).

This evolving definition of creativity results in the incremental growth of the research focus on creative activities and their underlying cognitive processes (Aragon and Williams 2011). There is also an extensive

[5] http://www.dfcworld.com

[6] http://ideasquare.web.cern.ch

body of work on the importance of an individual's attitude in the process of creative activity (Shernoff and Vandel, 2007). Creativity is one of the core resources for problem solving (Hsiao et al., 2006), and most problems need creative thinking in order to be solved; thus, students must be motivated to participate in creative activities.

Today, the current drive in many countries to teach design and technology competences to all has the potential to empower and support creative learning activities to support problem-solving concept (Papavlasopoulou et al., 2017). Creative learning activities to support problem-solving, coding, and design have become an integral part of K-12 curriculum, as the Common Core Standards, the Computer Science Teachers Association (CSTA), and the International Society for Technology in Education (ISTE) standards have been widely applied[7]. Nowadays, more and more governments are seeking to teach 21st-century skills to all and support young students in creative and problem-solving tasks[8]. Although there is a growing body of research in the area (Papavlasopoulou et al., 2017; Earp, 2015), there is still limited evidence on how to design, scaffold, support, and integrate creative activities in order to achieve rich learning experiences. There is therefore a need to provide insights on how creative activities can help us to advance current learning practices.

2.3. Creative game development

Recent developments in the intersection of technology and physical fabrication have led to an improvement in humans' ability to create interesting and creative environments. For example, digital fabrication devices such as laser cutters, 3D printers and computer-controlled knitting machines are allowing for quick and mass customization, enabling people to design and build their own objects

[7] http://csta.acm.org/Curriculum/sub/CurrFiles/CompThinkingFlyer.pdf

[8] Framework for 21st century learning: http://www.p21.org/our-work/p21-framework

(Gershenfeld, 2005). Growing communities of people are sharing know-how to build real-world objects, from clothes and sensors to robots and food, on sites such as Instructables[9]. Open source software and hardware communities promote the creation of technologies to support this movement, concrete examples are tools such as Chumby, Arduino and Scratch. Due to these developments, today we are witnessing a paradigmatic shift toward constructionist gaming (Kafai & Burke, 2015) that is reinforced by several developments, including the initiative to promote computational thinking (Grover & Pea, 2013), a need to broaden participation in computing, and a wider emergence of a do-it-yourself culture among today's youth (Honey & Kanter, 2013).

Computer technologies for producing game-based creative outcomes are also abundantly visible. Graphics and music software and word processors are used pervasively in production. Many tools to support creativity and idea or narration generation have also been developed (Buechley et al., 2008; Roque et al., 2012). In our study, we chose open source software called Scratch for Arduino[10] (S4A) to illustrate both collaborative and creative learning. S4A is a media-rich programming language that allows youth to design and share programs in the form of stories and games. They use building block command structures, and programmed objects can be any imported two-dimensional graphic image, whether digitally or physically made. This makes S4A particularly agreeable to an array of young creative students who want to build their own stories and games and engage in the participatory culture (Buechley et al., 2008). With more than 10 million registered members and over 17 million projects shared to date, the Scratch website is one of the most vibrant online communities, and Scratch may also be used in small-group formats (e.g., pair programming).

[9] http://www.instructables.com/

[10] http://seaside.citilab.eu/scratch/arduino

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Computer game design and development, modding and computational textiles/fabrication are some of the most successfully applied practices to help students to engage with creative game development (Papavlasopoulou et al., 2017). During such learning tasks a successful construction involves a complex process that fosters skills like: problem-solving on multiple levels, confront "failures", strategies to explore and decide possible solutions, structure thoughts and actions (Bers et al., 2014). Many tools, such as Cricket, Braitenberg Blocks, and Arduino technologies, can be a great opportunity to support fruitful and creative learning experiences (Bilkstein, 2013), while digital fabrication can provide Bildung (i.e. deep and sustained learning) (Iversen et al., 2015).

Game development - and coding in general - is not (or at least should not be) a male activity, notable differences in terms of choosing career in computing appear, as low number of female students prefer to enter in this field of study. Previous studies in game development (Robertson, 2013) indicate that girls do not enjoy game development as much as boys, and that in fact, game development activities may make pupils less inclined to study computing in the future (Robertson, 2013). On the other hand, studies indicate that girls' developed games score more highly compared to boys (Robertson, 2012); in addition girls feel much more competent when interacting with tangible interfaces during the game development process (Berta et al., 2017). Thus, it is interesting to investigate the effect of creative game development utilized with tangible artifacts in girls.

3. Our Research Approach and Hypotheses

The challenge of how to motivate students to engage in creative development activities is still unresolved. In particular, our research is intended to fill this gap by conducting an empirical investigation that will enable scholars and educators to efficiently design and develop creative activities at the intersection of software and hardware development. In our research, we organized creative game development activities of the "programming games" genre (Wolf, 2002). Wolf (2002) set out to classify 42 game genres along the lines developed by the Library of Congress Moving Imagery Genre-Form Guide (Apperley, 2006). The programming games genre (Wolf, 2002) has been recognized as one in which “players write short programs that control characters”; these characters then react to situations based on that programming. In our case, the students were becoming game players but most importantly game makers, using recycled materials to build their physical characters and then writing short programs (using the visual programming tool Scratch) to control their characters and put them into imaginary situations.

Our research follows a two-phase process (Figure 1). In the two consecutive phases, we explore the impact of creative activities on students through a qualitative approach (Phase 1). Afterward, we measure and quantitatively validate the activity based on the students’ experiences (Phase 2).

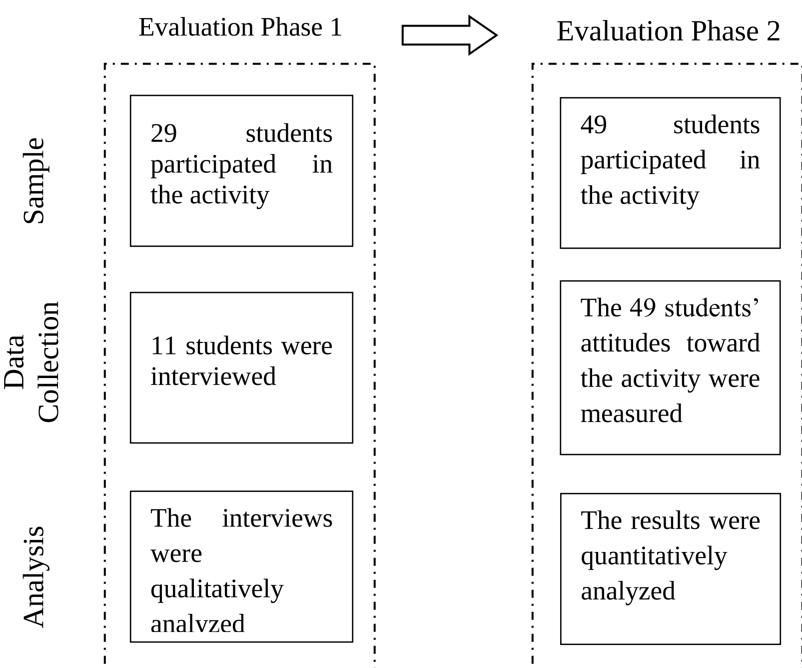

Figure 1. Phases of our research process

3.1. Qualitative Approach

Price and Rogers (2004) propose six aspects of understanding how young students make sense of and integrate digital encounters. They suggest that one of the key aspects of interacting in digital environments is to increase students' awareness of what they are doing when they interact with these environments. Another feature is the anticipation that is triggered when a person experiences couplings between highly familiar physical actions and unfamiliar effects. The degree of authenticity of the experience and the amount of collaboration that results can also be greater, and both are considered in the literature to be important aspects of active development (Price and Rogers, 2004). Although we did not employ deductive reasoning in our study (i.e. theory to confirmation approach), Price and Rogers categories were found to be very relevant for the aim of this study and were read and discussed between the coders before applying the inductive in nature (i.e. observation to theory approach) grounded theory approach. As such, through the lens of prior research on digital creative development in the qualitative phase of our study, *we attempt to probe different benefits of game development activity in depth.*

3.2.Quantitative Approach

Students' motivations are considered important determinants of their future decisions and learning success (Buechley et al., 2008); however, school activities might not always be as motivational as needed (Wang & Eccles, 2013). Both intrinsic (i.e., for enjoyment) and extrinsic (i.e., for a specific purpose) forms of motivation decrease across the school transition (Otis et al., 2005). Creative activities are highly beneficial for young students because they facilitate and improve problem solving, adaptability and self-expression (Hsiao et al., 2006). Creative development activities are highly affected by students' motivations (Sarsani, 2008). Young students still prefer to play games that other people have developed, rather than creating their own. This gap implies a need for further research to understand, more comprehensively, how students could be motivated to become game creators rather than game consumers.

A number of models and theories have been applied to address students' attitudes and motivations and to identify the effects of different factors on their adopting activities for learning. Self-determination theory (SDT) is a well-established theory of motivation that has been widely adopted to investigate why a particular human behavior occurs; the nature and quality of motivation are determined by satisfying three basic needs: autonomy, competence, and relatedness (Ryan & Deci, 2000). Technology acceptance and user experience models differ substantially although they deal with the same component in HCI (Hornbæk & Hertzum, 2017). Hence, in this study we tried to employ constructs that cover both the technology acceptance and user experience views. The UTAUT (or its prior form, the TAM) (Venkatesh et al., 2003) and social cognitive theory (Bandura, 1986) are some of the most widely applied theories in the context of human behavior. The main limitation of these models in HCI research is their general prediction nature (i.e., they are used to generalize experiences) which undermines the accurate measurement of experiences (Hornbæk & Hertzum, 2017). Thus, in this study we employed the most influential technology acceptance constructs, performance expectancy (PE) and effort expectancy (EE) based on the UTAUT, along with enjoyment (ENJ) and satisfaction (STF) based on entertainment theory (Vorderer et al., 2004); tied with a particular experience/specific use episode. Those constructs are among the most commonly used motivation factors in students' intentions to participate in a particular activity (e.g., Shih, 2008; Lin et al., 2005). There is, however, a lack of empirical evaluations of students' motivations and their effects on students' intentions to participate in creative development activities (Cover, 2006).

Despite the apparent growing body of research in the area of creative development activities for children (Papavlasopoulou et al., 2017), it is still difficult to say which are the main differences of the various age groups. For example, we have seen systems and practices utilizing different affordances to support different age groups (i.e. Scratch and Scratch Junior); but still the research on how the differences between the various age groups is in its infancy.

In light of the above, *we aim to measure students' motivations and age, and examine their effects on their intentions to participate in creative development activities*. We then aim to measure these factors and to identify potential effect effects of these factors on students' intentions to participate in similar events in the future. Thus, the study's set of hypotheses is formulated as follows:

H1. Enjoyment has a positive effect on intention to participate.

H2. Satisfaction has a positive effect on intention to participate.

H3. Performance expectancy has a positive effect on intention to participate.

H4. Effort expectancy has a positive effect on intention to participate.

H5. Age has a positive effect on intention to participate.

4. EVALUATION PHASE 1: QUALITATIVE EXPLORATION OF CREATIVE ACTIVITIES

4.1. Participants

Two classes from two different schools participated in the first creative game development program; the workshops took place at a ReMida center, which collects and offers a variety of materials for use in creative and educational projects. The centers are cooperative arrangements between the municipality, the education project Reggio Children, the municipal waste company (recycling), and the local business community. ReMida centers work according to Reggio Emilia education principles (Edwards et al., 1993), in which the main idea is that the initiative for creative actions should spring from the child him-/herself. ReMida centers are creative places where students start to work—with many appealing objects—without being activated by adults; adults act only as assistants.

The first phase of the evaluation was composed of two workshops with 29 participants; the participants were students with no Scratch or any other programming experience. The workshop was an elective activity; however, the classes were randomly selected, and all the students in the classes agreed to participate. Hence, our participant selection can be characterized as random with no "methodologically intended” preconceptions or beliefs. Of the 29 students in the first phase, 15 participated in the first workshop and 14 in the second; all participating students were 12 years old, and in each workshop, we had three randomly assigned groups (composed of four to five children). Each group had two computers.

4.2.Game Development Procedures

Instructors asked the students to produce games that told a story about a theme that was important to them; for example, some groups focused on pets or television shows. Students had to make their games interactive and include tangible interactive experiences such as sensors, motors and actuators; research has found that providing students with guidelines can improve the quality of their outcomes (Cohen et al., 2002). The task of programming a game is an archetypical example of complex problem solving (Werner et al., 2014).

The students who participated in the workshops were instructed and assisted by an artist game developer, the leader of the ReMida center, five students with experience in game development (a PhD student and four master’s students), a senior researcher and a project manager. The artist game developer led the introduction to the workshop, following the schedule shown in Figure 2; the rest of the instructors assisted students whenever they asked for help. For the first phase, the children completed and published a total of six interactive games. Their activities were documented with photographs, interviews and observation reports and used as data in this research.

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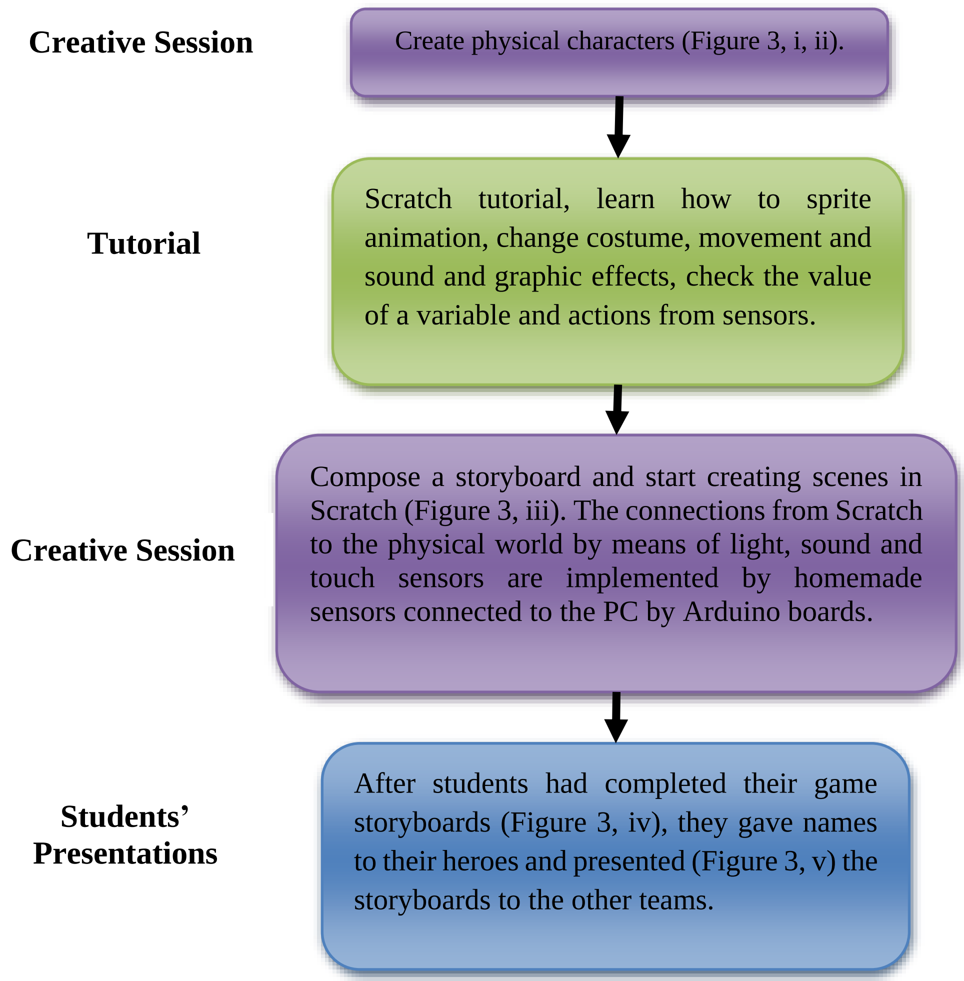

Figure 2. Schedule of the Workshop

In some parts of the game industry is believed that students have to follow very strict and concrete development processes; however a strict process would not be compatible with the constructionist educational philosophy (Papert, 1980) upon which Scratch and our creative game development activity were based. This philosophy expands the constructivist learning theory by adding the need for an external concrete construction in learning processes to support mental construction. One of the main principles of constructionism is learning-by-making. Our approach was as follows: We developed a specific workshop model that provided everything we expected the students to learn, although we did not expect that our workshop model would be followed precisely as scheduled; we were fully aware that students would want to build projects in various ways, and we considered this a positive phenomenon that encouraged creativity.

Programming concepts were introduced as needed for the progress of the programming game. For example, we did not introduce and explain all possible loop constructs, but instead introduced each one as and when it was needed (i.e. just-in-time information). Students experienced problems, but we did not record signs of frustration; the problems that occurred did not exasperate the students because we had introduced them to the needed concepts. The activity was designed to be, and ultimately flowed as, a game development project. Each of the sessions was based on a specific concept, such as sprite animation, costume changes, movement or sound and graphic effects. For each session, a set of tasks was presented to the students: make the sprite open and close its mouth, make the sprite move, enable the user to control the direction in which the sprite moves, connect sensor input with character movements, etc. By building programs to implement the tasks one after another, the students ended up constructing and participating in a programming game while being taught game development concepts.

The workshop program was based on the open source software Scratch. In particular, it consisted of tutorials, creative sessions and a final student presentation (see Figures 2 and 3 for more details).

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Figure 3. Workshop flow: Create physical characters and digitalize them (i) and (ii); Animate the physical characters with S4A and Arduino boards (iii) and (iv); Present the developed games (v)

As an illustrated example of the outcomes of this activity, we present an exemplar program made by students. As you can see from the provided short video,[11] the proposed game is in alignment with Wolf's (2002) definition of the programming game genre. In particular, the game players/makers wrote short programs that controlled characters, and these characters then reacted to situations based on the game's development; the players were also able to interact with their characters using the built-in to the game sensors.

4.3.Data Collection and Analysis

In the first, explorative, phase of our evaluation, the data collected were mostly from interviews with the students, which we conducted using a semi-structured interview guide (see Appendix A); the interview

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[11] http://youtu.be/B-qFl7XHAak

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questions were designed to probe different aspects of motivation and creativity. We used convenience sampling, meaning we asked for volunteers rather than selecting specific students; however, because we interviewed more than one third of the total sample (five students at one school and six at the other), we can assume that due to the qualitative nature of this phase and the intensity of the interviews (each interview lasted approximately twenty to thirty minutes), our sample was sufficient. The interviews were conducted from a researcher with a master degree in science, media, communication and information technology and following a one-on-one schema. We wanted to offer a comfortable environment where children had enough time to reflect upon the questions (see Appendix A).

After we completed the interviews and transcribed and evaluated the material, it became clear that we had reached the point of saturation: interviewing more informants was not expected to provide radically different or more in-depth material. Ultimately, the text corpus covers of the interviews totaled 28 pages. Approximately half of the corpus reflected the interviews with boys, and the rest concerned the girls. After we collected the students' interviews, we proceeded with a content analysis. First, two researchers/coders (one with PhD in learning technologies and another with MSc in science, media and communication) read all responses, coding important keywords until categories emerged from similar codes. The two researchers were discussing and reaching consensus throughout the process, at the end both the researchers agreed on the final categories; following the method described by Glaser and Strauss (1967) but utilizing iterative consensus for issues seemed challenging for the coders. Due to this iterative consensus process, inter-coder reliability was exceptionally high (0.703), exceeding the recommended guideline (Cohen kappa > 0.60) and thus indicating high inter-coder reliability. High reliability is definitely positive sign, however according to Morse et al. (Morse et al., 2002), reliability has been subtly replaced by overall significance, relevance, impact, and utility of completed research. Thus, although we appreciate high reliability we also want to highlight that our research focuses primarily in the overall significance, relevance, impact, and utility aspects.

4.4.Results

The content analysis of the students' responses led us to the conclusion that the categories of awareness, experience, exploration and collaboration were highly important during the game development activity. Specifically, we can say that creative development activities

a) **Raise awareness:** By placing the software development in different settings, we enriched the students' awareness of both the software development and the capabilities of various settings (e.g. movies, games). To this end, the students created a richer basis regarding these aspects.

> *Deborah:* **I realized** there were lots of different ways of using the program [the software].
>
> *Nick:* **I found out, I did not really think** that you could make art with reused materials.
>
> *Emily:* **It kind of changes my mind**… But now **I found out** you can make movies and things for children, too.

b) **Embrace rich experiences (utilizing multimodal interactions)**: The experience of interacting with the digital environment during the activities through more varied modalities offered a greater diversity of information on which to reflect about the experience and the environment.

> *Paul*: I like to build. That we got to build it and not just make it on computer, but **we actually got to build it**—that was fun.
>
> *Janet*: When I have to make something, it is hard for me, but **if I then am just playing around with it, then it's easier**.
>
> *John*: I thought it was really fun to learn about the computer, how to make that, and it was fun to make our own character and **experience how it was creating something of our own**.

c) **Invite students to explore boundaries**: The activities encouraged high levels of exploration and discovery in the students. The rich environment enabled a number of different combinations of actions and interactions to experiment with, thereby encouraging the students' creative exploration.

> *Mike*: We came there, I thought "WOW" that was so cool. I went there and **I looked at everything and stuff, and I was, ohh maybe something**, every little corner has one thing on it.
>
> *Letizia*: [I] liked that there were, was **lots varieties to make your own** character.
>
> *Gaby*: **I like searching** for new music or [something] else…

d) **Increase collaboration and the exchange of views and ideas**: Based on the students' responses, we can easily say that the collaboration greatly improved the value of the activities. In particular, the students admitted that working in groups had helped them get ideas and learn from others, which made the activity more enjoyable and creative.

> *Mary*: It's much easier to **get ideas from others, and to learn from them.**
>
> *Sam*: It's **more enjoyable to do it with others** because you always have someone to talk to or... and you work maybe better with them.
>
> *Liz*: It is easier to relax and to **try new things when your friends are there**.

Most of the girls found the activity challenging and acquired new knowledge about programming based on the creative game development. From their discussions, we believe that many of the girls became curious about game development and gained some new perspectives with regard to what game development can be:

> *Monica:* I always thought **that programming was really hard and something that I would not be able to do myself**, but ehm, it's… **it was something that I could do myself**…

> *Maria:* I like to build, that **we got to build and not just play with it** on the computer, **but we actually got to build it**!
>
> *Valentina:* Actually I didn't find it like it was a programming thing. **I thought it was more about creativity and art because we buil[t] these real [from the materials] animations**.

Our notes include a number of observations of student discussions that show how the girls developed a vocabulary with specific development terms.

5. EVALUATION PHASE 2: QUANTITATIVE INVESTIGATION OF STUDENTS' INTENTIONS TO PARTICIPATE IN CREATIVE ACTIVITIES

5.1. Participants and Procedures

The second phase of our study was composed of four workshops. A total of 49 participants (38 females and 11 males) were recruited from schools for the trial. A total of 12, 10, 15 and 12 students, respectively, participated in the sessions. The participants were 12 years old for the first two and 17 years old for the last two workshops, respectively. Our sample consists of Norwegian students, all the students who participated in the study enrolled in public schools in Trondheim, Norway, and have followed the same syllabus. Students participated voluntary after legal guardians have agreed and signed the respective consent (following the approval from the national authority). Education in Norway is mandatory for all children aged 6–16 (see an overview of the Norwegian educational system[12]).

5.2. Materials

A wide range of data were collected to address our research questions including surveys, photos and observations. During most of the sessions, one of the organizers was present to assist and observe the

[12] http://www.nokut.no/en/Facts-and-statistics/The-Norwegian-Educational-System/education-in-norway/

students; in the second phase, the main emphasis was on the quantitative data; to this end, we administered a survey based on the literature review. Participants took the survey two days after each workshop so that we could evaluate the factors (a) intention to participate (ItP), (b) ENJ, (c) STF, (d) PE and (e) EE.

Appendix B lists the survey items used to measure each factor and the related source from the literature review. In all cases, seven-point Likert scales were used to measure the variables.

5.3.Procedures

The workshops followed the same game development procedure as in phase one (described in detail in section 4.2). In all workshops, the creative game development philosophy played a central role.

5.4.Data Analysis

The statistical analyses in this section include examining the descriptive statistics of the measurement items and assessing the measures' reliability and validity. Regarding the reliability of the scales, we applied Cronbach alpha, and for the validity of the scales, we performed factorial analysis with principal components and varimax rotation for the items for each variable. In the next stage, we evaluated the unidimensionality of the scales by conducting the factorial analysis. The existence of unidimensionality is very important because it allows for calculating the average of the indicators that compose each construct. Consequently, it is possible to use a sole factor to represent each theoretical construct.

Afterward, in order to examine possible predictors of students' intention to participate in the activity, a series of multiple regression equations were calculated using scores on the five identified factors and the students' ages.

6. RESULTS

A Cronbach's alpha test was conducted to examine the reliability, and the results showed acceptable indices of internal consistency in the six scales considered: ItP (0.87), ENJ (0.88), STF (0.83), PE (0.87) and EE (0.71).

Consequently, factorial analysis with principal components and varimax rotation was carried out to test the unidimensionality and validity of our five scales. As the table in Appendix B shows, all items exhibited factor loadings that were higher than 0.5, with no cross-construct loadings, indicating good discriminant validity. Consequently, it was possible to use a sole factor to represent each theoretical construct. The factor analysis identified five distinct factors: ItP, ENJ, STF, PE and EE; the descriptive statistics for each of the constructs built from the items are presented in Appendix B.

Based on the results of the regression analysis to predict students' intentions to participate in the activity, the overall model was significant ($F (5, 43) = 4.855$, $p<0.001$, $R^2 = .361$); the regression equations showed a differential pattern of factors motivating intention to participate to the activity (see Table 1). The explanatory power of the model is quite high, with performance expectancy (PE) of the creative development activity along with effort expectancy (EE) explained 36.1% of students' intentions to participate, and confirming PE and EE as predictors (H3 and H4 accepted). This means that students with high level PE and EE about the activity are more likely to participate in similar activities in the future. Contrarily, the sense of enjoyment of and satisfaction with the creative activity, and students' age, were not found to predict intention to participate in the activity (H1, H2 and H5 rejected). This means that students enjoyment and satisfaction is not a predictor of their intention to participate, while students 12 and 17 years old did not exhibit significant difference in their intention to participate. These findings are particularly interesting because they provide solid evidence that although creative activities' success is based on students' increased levels of motivation, engagement, enthusiasm, enjoyment, concentration, attention and focus (Davies et al., 2013), their intention to participate in these activities is heavily reply on activities' ease and usefulness (PE and EE).

Table 1. Predicting students' intention to participate in the activity

Variable	β	t	Sig.
Enjoyment	0.054	0.391	0.698
Satisfaction	0.184	1.134	0.263
Performance Expectancy	0.476	3.230	**0.002**
Effort Expectancy	0.306	2.099	**0.042**
Age	0.159	1.241	0.221

7. DISCUSSION

In this paper, we presented results from the design, implementation and evaluation of a series of creative game development activities. Students engaged in the programming language Scratch and the programmable hardware platform Arduino, which enabled them to engage in the world of creativity with digital game development.

Our empirical study consisted of two phases, an explorative-qualitative portion and a quantitative one. In the first phase, we collected data from 11 interviews and subjected it to content analysis. The results showed that the creative development activities: (a) raised awareness of technology, (b) embraced rich experiences (by utilizing multimodal interactions), (c) invited students to explore boundaries and (d) increased collaboration and the exchange of views and ideas. For the second phase, we designed a survey grounded in motivational factors for technology and collected and analyzed 49 survey responses. The results from the second phase demonstrated that the key variables (ItP, ENJ, STF, PE and EE) exhibited a high degree of convergent validity in the context of the creative development activities. Finally, the results demonstrated that the activity's EE and PE significantly affected students' intentions to participate.

EE refers to the degree to which students believe that participating in creative development activity is easy and free of effort. When an activity is considered easy by students, it means that it requires less cognitive effort, thus allowing them to concentrate on the learning and other cognitive issues, rather than the process itself (Saade & Bahli, 2005). Thus, an easy to follow activity, not only significantly affects students' intentions to participate, but also allow them to dedicate the appropriate cognitive load on issues found from the qualitative study and associated with ideas exchange, collaboration, exploration, and rich interactions and experiences.

PE in our context refers to the degree to which students believe that participating in a creative development activity will enhance their performance, and is a critical factor influencing students' attitudes and further decisions (Lee, 2010). This means that students need to understand the reason behind the participation in the activity in order to feel positively towards it, and the easiness (i.e. EE) is not considered important as a reason for using it (i.e., usefulness). Thus, an activity perceived as useful, not only significantly affects students' intentions to participate, but also make them feel positively about it.

The study has a number of implications for theory and practice. The results verified that EE and PE are important and influential factors in determining students' intentions to participate in a creative game development activity. Scholars, educators and practitioners should focus on increasing students' PE and EE during these activities because the predictive effect on adoption is significant. As such, the activities must be made more useful with the use of rewards for students' efforts and successes. In addition, creative activities should be detailed with clear steps (in order to increase EE) and connected with tangible results (in order to increase PE). Past research (Song et al., 2004) has also shown that strategies such as providing overviews of the tools used in a course, holding hands-on workshops with technology and providing immediate technical service are effective means of promoting users' perceptions of the EE and PE. Activity designers and practitioners should strive to increase participants' intrinsic motivations, such as social norms and influences, and provide home-like environments. For example, the creative development activities should follow some standard steps adopted from familiar school activities to make the students feel like experts, this recommendation is also in alignment with previous studies in CCI (Moser, 2012).

Moreover, instructors can treat activities as objectives for the students to achieve learning targets. When students participate and achieve learning targets, they increase their perception that the outcome of their work could be improved through participation. With this in mind, they recognize the value of these activities in their lives. These findings can help schools and institutions to understand the take-up intention rates for creative development activities and perhaps call attention to further exploring the reasons why many students are not openly willing to participate.

One of the most important and interesting outcomes, which was supported by the researchers' observations and notes, is that the creativity aspects of the activity had a particularly positive effect on girls; it offered them new perspectives on what programming and development are and clarified that the field is not limited to boys, giving the girls more confidence to cultivate an interest in the topic.

Thus, we can say that, overall, the activity was positively received from both female and male participants. In addition, qualitative evidence indicates that the activity was particularly positive for female participants. This is very important because girls traditionally show less interest in computer science topics (Tai et al., 2006); however, this can likely be attributed to the fact that we combined game development with creative activities that interested the girls (making physical characters) because we attempted to take advantage of the social structures and patterns of interest that already existed (creativity, physical making) in order to promote game development (Buechley et al., 2008).

Although these findings provide meaningful outcomes for understanding the creative development activities from students' perspectives, this study has certain limitations. As in all empirical studies, the sample of the participants (e.g., gender, educational level) may have had a contingent effect on the results, which might have limited the extent of generalizability of the findings to other populations. Our main interest, though, lies in school students, especially girls, because of the lack of interest and enjoyment (compared to boys) in game development (Robertson, 2013). By analyzing the responses from 12- and 17 year olds, we established that the distributions of the responses were the same with no significant differences for any item. This also leads us to conclude that there is no reason to distinguish the responses.

Finally, the findings are based on self-reported data collected from the students in the form of interviews and surveys. Future studies may combine self-reported data with actual data from students' interactions, as well as triangulate them with more qualitative data from video recording and observations. The collected data are from a limited number of students, from a specific country in a specific context and following a specific workshop and methodology. Thus, further research is needed, collecting longitudinal evidence, and even focusing on other important aspects like group-dynamics (Van Mechelen et al., 2014), other user experience factors in HCI (e.g., user engagement (O'Brien and Toms, 2008)) or following a participatory / co-design approach. This will allow us to enhance our current understanding about the creative development activities and design aspects of the various making and coding activities, as well as, to move from specific case studies/instances, to intermediate-level knowledge/strong concepts and providing a comprehensive framework and guidelines.

8. CONCLUSIONS

These two complementary studies on the motivations and experiences of young students examined the factors that affected their participation in a creative game development activity. Evidence continues to mount that creative game development can be greatly beneficial for young students, not just in terms of a pleasurable and sociable activity but as a pathway to positive education outcomes. In particular, creative game development increases awareness of technology's capabilities (especially with female students); the "physical" part intensifies the experience, invites students to explore boundaries and increases collaboration and the exchange of different views and ideas. Based on the students' participation in our activity, our study revealed that participants' EE and PE predicted their intentions to participate. That is, students' participation in creative game development activities is greatly based on the activities' ease and usefulness (PE and EE) and not on the students' positive feelings during the activity (enjoyment and satisfaction), or their age (based on our comparison between ages 12 and 17 years).

As this study documents with regard to female participation, creative game development activities are particularly rewarding because they allow young girls to refute current stereotypes by participating in them. More research is required to not only document, but also possibly intensify, this stereotype refutation.

Acknowledgments. This work was supported by the Research Council of Norway under the project FUTURE LEARNING (number: 255129/H20) by the GEMINI Center in Technology Enhanced Lifelong Learning (http://www.tell-gemini.org/) and the Department of Computer Science of the Norwegian University of Science and Technology. We would also like to thank all the students for volunteering their time, and P. Bøyesen, A. Eriksen, I. Leftheriotis and R. Proto for providing useful assistance during the activities. The project has been registered with NSD - Norwegian Centre for Research Data. All information treated with confidentiality following NSD's recommendations (http://www.nsd.uib.no/nsd/english/). Informed consents were received from the legal guardians and all the dialogs in this paper used pseudonyms.

REFERENCES

Aljughaiman, A., and Mowrer-Reynolds, M. (2005). Teachers' conceptions of creativity and creative students. Journal of Creative Behavior, 39(1), 17–34.

Apperley, T. H. (2006). Genre and game studies: Toward a critical approach to video game genres. Simulation & Gaming, 37(1), 6–23.

Aragon, C. R., and Williams, A. (2011). Collaborative creativity: a complex systems model with distributed affect. In Proc. of the 2011 annual conference on Human factors in computing systems, (CHI '11), 1875–1884.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory: Prentice-Hall, Inc.

Bers, M. U., Flannery, L., Kazakoff, E. R., & Sullivan, A. (2014). Computational thinking and tinkering: Exploration of an early childhood robotics curriculum. Computers & Education, 72, 145-157.

Berta, R., Bellotti, F., van der Spek, E., & Winkler, T. (2017). A tangible serious game approach to science, technology, engineering, and mathematics (STEM) education. In Handbook of Digital Games and Entertainment Technologies (pp. 571-592). Springer Singapore.

Blikstein, P. (2013). Digital fabrication and "making" in education: The democratization of invention. FabLabs: Of machines, makers and inventors, 1–21.

Buechley, L., Eisenberg, M., Catchen, J. and Crockett, A. (2008). The LilyPad Arduino: Using computational textiles to investigate engagement, aesthetics, and diversity in computer science education. In Proc. of CHI 2008, ACM Press.

Cassell, J. (2004). Towards a model of technology and literacy development: Story listening systems." Journal of Applied Developmental Psychology, 25(1): 75–105.

Please cite this article in press as: M.N. Giannakos, L. Jaccheri, From players to makers: An empirical examination of factors that affect creative game development, International Journal of Child-Computer Interaction (2018), https://doi.org/10.1016/j.ijcci.2018.06.002

Chu, S. L., Quek, F., Bhangaonkar, S., Ging, A. B., & Sridharamurthy, K. (2015). Making the Maker: A Means-to-an-Ends approach to nurturing the Maker mindset in elementary-aged children. International Journal of Child-Computer Interaction, 5, 11-19.

Cover, R. (2006). Audience inter/active: Interactive media, narrative control and reconceiving audience history. New Media & Society, 8(1), 139–158.

Clark, B. (2008). Growing up gifted: Developing the potential of children at home and at school (7th ed.). Columbus, OH: Merrill

Csikszentmihalyi, M. (1990). Flow: The psychology of optimal experience. New York, NY: Harper and Row.

Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education—A systematic literature review. Thinking Skills and Creativity, 8, 80-91.

Earp, J. (2015). Game making for learning: A systematic review of the research literature. In Proceedings of 8th International Conference of Education, Research and Innovation, 6426-6435.

Edwards, C., Gandini, L. and Forman, G. (1993). The Hundred Languages of Children: The Reggio Emilia Approach to Early Childhood Education, Norwood, NJ: Ablex.

Eisenberg, M. (2013). 3D printing for children: What to build next? International Journal of Child–Computer Interaction, 1(1), 7–13.

Eseryel, D., Law, V., Ifenthaler, D., Ge, X., & Miller, R. (2014). An investigation of the interrelationships between motivation, engagement, and complex problem solving in game-based learning. Educational technology & society, 17(1), 42-53.

Gershenfeld, N. (2005). Fab: The Coming Revolution on your Desktop—From personal computers to personal fabrication. Basic Books, New York, NY.

Giannakos, M. N., and Jaccheri, L. (2013). What motivates children to become creators of digital enriched artifacts? In Proceedings of the 9th ACM Conference on Creativity and Cognition (pp. 104–113). ACM.

Giannakos, M. N., and Vlamos, P. (2013). Educational webcasts' acceptance: Empirical examination and the role of experience. British Journal of Educational Technology, 44(1), 125–143.

Glaser, B. and Strauss, A. (1967). The Discovery of Grounded Theory: Strategies for qualitative research. Chicago: Al-dine.

Grover, S., & Pea, R. (2013). Computational thinking in K–12: A review of the state of the field. Educational Researcher, 42, 38–43.

Honey, M. & Kanter, D. (2013). (Eds.). Design, make, play: Growing the next generation of STEM innovators. New York, NY: Routledge.

Hornbæk, K., & Hertzum, M. (2017). Technology acceptance and user experience: a review of the experiential component in HCI. ACM Transactions on Computer-Human Interaction (TOCHI), 24(5), 33.

Hsiao, H. S., Wong, K. H., Wang, M. J., Yu, K. C., Chang, K. E., & Sung, Y. T. (2006). Using cognitive affective interaction model to construct on-line game for creativity. In Technologies for E-Learning and Digital Entertainment (pp. 409-418). Springer Berlin Heidelberg.

Iversen, O. S., Smith, R. C., Blikstein, P., Katterfeldt, E. S., and Read, J. C. (2016). Digital fabrication in education: Expanding the research towards design and reflective practices. International Journal of Child–Computer Interaction, 5, 1–2.

Kafai, Y. B., & Burke, Q. (2015). Constructionist gaming: Understanding the benefits of making games for learning. Educational psychologist, 50(4), 313-334.

Lee, M.-C. (2010). Explaining and predicting users' continuance intention toward e-learning: Anextension of the expectation–confirmation model.Computers and Education, 54(2), 506–516

Lin, C. S., Wu, S. and Tsai, R. J. (2005). Integrated perceived playfulness into expectation–confirmation model for web portal context. Information and Management, 42(5), 683–693.

Lovell, E., and Buechley, L. (2011). LilyPond: an online community for sharing e-textile projects. In Proceedings of the 8th ACM conference on Creativity and cognition (C&C '11). New York, NY: ACM, 365–366.

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. International journal of qualitative methods, 1(2), 13-22.

Moser, C. (2013). Child-centered game development (CCGD): developing games with children at school. Personal and ubiquitous computing, 17(8), 1647-1661.

Otis, N., Grouzet, F. M. E., and Pelletier, L. G. (2005). Latent motivational change in an academic setting: A 3-year longitudinal study. Journal of Educational Psychology, 97, 170–183.

O'Brien, H. L., & Toms, E. G. (2008). What is user engagement? A conceptual framework for defining user engagement with technology. Journal of the Association for Information Science and Technology, 59(6), 938-955.

Papavlasopoulou, S., Giannakos, M. N., & Jaccheri, L. (2017). Empirical studies on the Maker Movement, a promising approach to learning: A literature review. Entertainment Computing, 18, 57-78.

Papert, S. (1980). Mindstorms: Children, Computers, and Powerful Ideas. Basic Books New York, NY.

Price, S. and Rogers, Y. (2004). Lets get physical: The learning benefits of interacting in digitally-augmented physical spaces. Computers & Education 15(2), 169–185.

Ryan, R., & Deci, E. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68-78.

Robertson, J. (2013). The influence of a game-making project on male and female learners' attitudes to computing. Computer Science Education, 23(1), 58-83.

Robertson, J. (2012). Making games in the classroom: Benefits and gender concerns. Computers & Education, 59(2), 385-398.

Roque, R., Kafai, Y., and Fields. D. (2012). From tools to communities: designs to support online creative collaboration in scratch. In Proceedings of the 11th International Conference on Interaction Design and Children (IDC '12). New York, NY: ACM, 220–223.

Saade, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: An extension of the technology acceptance model. Information and Management, 42(2), 317–327.

Sanchez-Franco, M., J. (2010). WebCT – The quasimoderating effect of perceived affective quality on an extending technology ance model. Computers & Education, 54(1), 37–46.

Sarsani, M.R. (2008). Do high and low creative children differ in their cognition and motivation? Creativity Research Journal, 20(2), 155–170.

Shernoff, D. J., and Vandell, D. L. (2007). Engagement in afterschool program activities: Quality of experience from the perspective of participants. Journal of Youth and Adolescence, 36, 891–903.

Shih, H. (2008). Using a cognitive–motivation–control view to assess the adoption intention for Web based learning. Computer & Education, 50, (1), 327–337.

Song, L., Singleton, E. S., Hill, J. R. and Koh, M. H. (2004). Improving online learning: student perceptions of useful and challenging characteristics. Internet and Higher Education, 7, 59–70.

Tai, R. et al. (2007). Planning early for careers in science. Science, 312, 1143–1144.

Torrance, E. P. (1976). Creativity in the classroom. Washington, DC: National Education Association.

Van Mechelen, M., Gielen, M., Laenen, A., & Zaman, B. (2014). Exploring challenging group dynamics in participatory design with children. In Proceedings of the 2014 conference on Interaction design and children (pp. 269-272). ACM.

Venkatesh, V., Morris, M. G., Davis, G. B. and Davis, F. D. (2003). User acceptance of information technology: toward a unified view. MIS Quarterly, 27(3), 425–478.

Vorderer, P., Klimmt, C., and Ritterfeld, U. (2004). Enjoyment: At the heart of media entertainment. Communication Theory, 14(4), 388–408.

Vygotsky, L.S. (1967/2004). Voobrazhenie i tvorchestvo v detskom vozraste (Imagination and creativity in childhood). Journal of Russian and East European Psychology, 42(1), 7–97.

Wang, M. T., & Eccles, J. S. (2013). School context, achievement motivation, and academic engagement: A longitudinal study of school engagement using a multidimensional perspective. *Learning and Instruction*, *28*, 12-23.

Werner, L., Denner, J., and Campe, S. (2014). Children programming games: A strategy for measuring computational learning. ACM Transactions on Computing Education (TOCE), 14(4), 24.

Wolf, M. J. (2002). Genre and the video game. The medium of the video game, 113–134.

Please cite this article in press as: M.N. Giannakos, L. Jaccheri, From players to makers: An empirical examination of factors that affect creative game development, International Journal of Child-Computer Interaction (2018), https://doi.org/10.1016/j.ijcci.2018.06.002

Appendix A: Semi-Structured Interview Guide

Capturing answers: Answers will be recorded via note taking and audio recording. Taking notes allows the interviewer to highlight key points to probe further and may also make producing and evaluating the final notes quicker because there is no need to wade through large files of transcripts.

Develop a rapport with the respondent: Obtaining meaningful information from a respondent will be easier if they are comfortable opening up to the interviewer. This can be done by asking non-probing questions such as how they are doing, etc.

Ask questions that lead to detailed answers: It is important that you phrase questions in a way that makes respondents provide detailed answers rather than simple “yes” or “no” responses.

Examples of questions include:

- How did you feel after doing the activity?
- What is your involvement in this learning project?
- What are the strengths and weaknesses of the activity?
- How has the project changed the way you study?
- What type of assistance would you like to have when you participate in the activity?
- What hurdles remain to your being able to fully engage in the activity?
- How would other students benefit from this activity?

It is good to have a set of questions at hand, but the interviewer needs to also be prepared to expand on or probe the predetermined questions as the need arises. This is the essence of qualitative interviews.

End the interview: When to end an interview can depend on a number of factors. For example, the interviewer may feel that they have exhausted their questions and that they are no longer getting new information, or the respondent may appear to be tired or may have other commitments to attend to. A good practice is for the interviewer to summarize the key points that they feel the respondent has provided because this gives the respondent a final chance to expand or clarify any points. Finally, it is important to thank the respondent for their time and provide them with the interviewer’s contact details. Depending on circumstances, it may also be worth letting the respondent know how they can obtain the project reports because this will provide them with a sense of ownership of the material that they shared.

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Appendix B: The measures and their definitions

Factors	Definition	Items (Questions)	Source Adopted
Intention to Participate	The degree of students' intention to participate in a similar activity	I intend to participate in similar activities in the future (ItP1)	Giannakos and Vlamos, 2012
		My general intention to participate in similar activities in the future is very high (ItP2)	
		I will regularly participate in similar activities in the future (ItP3)	
		I will think about participating in similar activities (ItP4)	
Enjoyment	The degree to which the activity is perceived to be personally enjoyable	Participating in the activity was enjoyable (ENJ1)	Venkatesh et al., 2002
		Participating in the activity was exciting (ENJ2)	
		I felt good during the activity (EN3J)	
Satisfaction	The degree to which a person feels positive about the activity	I was satisfied with the activity (STF1)	Lin et al., 2005
		I was pleased with the activity (STF2)	
		My decision to participate in the activity was a wise one	
Performance Expectancy	The degree to which an individual believes that attending the respective activity is useful for him/her	Participating in similar activities improves my performance in arts and technologies (USF1)	Venkatesh et al., 2002; Sanchez-Franco, 2010
		Participating in similar activities enhances my effectiveness in arts and technologies (USF2)	
		Participating in this kind of activity increases my capabilities in arts and technologies (USF3)	
Effort Expectancy	The degree to which an individual believes that attending the activity is easy for him/her	I found the activity to be flexible (EAS1)	Venkatesh et al., 2003
		The process of the activity was clear and understandable (EAS2)	
		It was easy for me to attain skills in the activity (EAS3)	

Appendix C: Summary of Measurement Scales

Factors	Items	Mean	Std. Deviation	Loading	Cronbach's α	AVE
Intention to Participate	ItP1	4.41	1.27	0.829	0.871	0.655
	ItP2	4.41	1.19	0.888		
	ItP3	3.78	1.50	0.833		
	ItP4	4.55	1.50	0.673		
Enjoyment	ENJ1	6.49	0.74	0.893	0.884	0.757
	ENJ2	6.18	1.09	0.880		
	ENJ3	5.98	0.92	0.837		
Satisfaction	STF1	5.67	0.85	0.920	0.830	0.651
	STF2	5.96	0.89	0.801		
	STF3	5.63	1.32	0.681		
Performance Expectancy	USF1	5.59	1.15	0.722	0.868	0.637
	USF2	5.08	1.20	0.817		
	USF3	5.51	1.16	0.849		
Effort Expectancy	EAS1	5.43	1.00	0.598	0.714	0.531
	EAS2	5.14	1.21	0.765		
	EAS3	5.31	1.23	0.806		