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PREFACE

This volume contains the Doctoral Student Consortia Proceedings of the 20th International Conference on Computers in Education (ICCE 2012). For this year, the Doctoral Student Consortia (DSC) brings together PhD students working in the broad research areas of computers in education in the following seven sub-themes: (1) Artificial Intelligence in Education/Intelligent Tutoring Systems and Adaptive Learning (AIED/ITS/AL); (2) Computer-supported Collaborative Learning and Learning Sciences (CSCL/LS); (3) Advanced Learning Technologies, Open Contents, and Standards (ALT/OC/S); (4) Classroom, Ubiquitous, and Mobile Technologies Enhanced Learning (CUMTEL); (5) Digital Game and Digital Toy Enhanced Learning and Society (GTEL&S); (6) Technology Enhanced Language Learning (TELL); and (7) Technology, Pedagogy and Education (TPE).

The DSC aims to provide an opportunity for a selected number of PhD students to present, discuss and receive feedback on their dissertation work-in-progress from a panel of established researchers with expertise in the same research areas. The DSC is meant to help students to shape their research methodologies, and to develop analysis methodologies at the early stages of their PhD research using the guidance and feedback that they get from the invited mentors. Mentors can also provide insights into fruitful areas for future research. The DSC also hopes to nurture a supportive learning community and promote interactions among the young researchers who come from a number of different institutions and across different countries in the Asia-Pacific region and beyond. It also provides opportunities for theme-based forums to discuss evolving methodological and theoretical issues of central importance to the community. The DSC and the related social events are financially supported by the Asia-Pacific Society for Computers in Education (APSCE).

A group of senior PhD students (Kevin Kai-Wing CHAN, Chia-Jung CHANG, Jaime GALVEZ, Anita HUANG, Wai Ying KWOK, Rose Ru-Whui LEE, Tuck Leong LEE, Mengmeng LI, Larry Lei Chun LIN, Boon See TAN, Arit UYOUKO) who were highly recommended by the APSCE Special Interest Group Chairs (SIG) Chairs/Co-Chairs were invited to be the organizers of this prestigious event. This group of senior PhD students is guided by the DSC Chairs (Weiqin CHEN, Chen-Chung LIU, and Hiroaki OGATA). The DSC chairs helped oversee the whole process of organizing the DSC and provided guidance along the way. With a strong sense of responsibility and enthusiasm, this highly dynamic group has been successful in organizing the DSC for ICCE 2012. It is clear that by entrusting this group of senior PhD students with the responsibility of organizing this important event and editing the DSC Proceedings, they were able to form a vibrant and supportive research community within a short period of time; which is one of the main goals of the APSCE.

This year we received a total of 10 submissions, and 9 of these papers were selected and have been included in the Proceedings. Each selected paper went through a rigorous blind review by independent peer reviewers to ensure the work was of high quality. We hope that the papers in the proceedings on various research topics will stimulate additional research ideas and discussions among the young researchers.

We would like to thank all the invited mentors in making this year's DSC a highly successful event. Finally, we would like to take this opportunity to record our sincerest appreciation to the local organizers in Singapore for their valuable support and arrangement in organizing the DSC.

On behalf of DSC Co-Chairs
Weiqin CHEN
Hiroaki OGATA
Chen-Chung LIU

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Supporting Student Self-regulation in Unsupervised Learning Environments

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Abstract: Technology has made it convenient for students today to learn outside of the classroom. However, learning in this kind of setting introduces challenges such as proper time management, maintaining motivation and avoiding distractions. This research investigates how student learning progresses in this unsupervised learning environment and proposes an automated support mechanism that promotes self-regulation to help students learn. The proposed system is not bound to any domain and its methodology supports learning in naturalistic settings. Results gathered from students' use of a system prototype confirmed the problems students encounter when learning in this environment and their need for support. It also showed that helping students self-regulate made them aware of their learning behavior and helped them identify ways to improve their learning efficiency.

Keywords: learning, unsupervised learning environment, feedback, self-regulation

Introduction

Student learning is not bound to formal learning settings in classrooms. Students continue to learn on their own in the library, in their homes or with their peers. Technology has made it even easier for them to learn because it gives them easy access to information anytime and anywhere. However, informal learning settings introduce challenges such as the need to self-motivate, manage time and resist distractions to learn effectively.

In formal learning settings, students are discouraged from engaging in non-learning activities such as chatting with friends or playing games. Students are also required to use certain skills and solve problems within given time frames. However, informal learning settings give students more control over their time and goals. Students can engage in non-learning activities freely which may benefit them by helping them de-stress and disengage from feelings of frustration and helping them move into more positive emotional states which allow them to regain motivation and resume learning [5]. The duration, frequency and type of non-learning activity will have different effects on students thus there also has to be a certain configuration for non-learning activities to be helpful. Students know themselves best so they are also the best persons to identify what is most effective for them. Our goal is to improve students' learning efficiency as they learn in informal learning settings by helping them self-regulate.

1. Literature Review

Self-regulation is a systematic process for promoting the attainment of goals and is composed of the cyclic phases of *forethought*, *performance* and *self-reflection* [6]. Forethought involves the formulation of goals for the learning session which serve as guides

on what activity to do. Performance involves doing activities that will accomplish the previously defined goals and monitoring progress to identify if there is a need to adjust goals or strategies. Self-reflection involves the assessment of the learning session, attribution of the causes of unfavorable behavior during the learning session and the identification of possible strategies to increase learning efficiency in succeeding learning sessions.

Self-regulation facilitates good learning behavior and its benefits have not only spawned research in traditional classroom settings, but also in more modern settings such as in computer-based learning environments. Systems like MetaTutor [1] and Process Coordinator [4] allow students to keep track of the self-regulation strategies they use and also suggest strategies that can help them accomplish their goals as they learn in computer-based formal learning settings. However, these systems expect students to engage only in learning related activities during the session. Research has shown that students use and actually prefer learning activities outside of the classroom apart from classroom-based activities [2]. Students' preference for learning in this domain and the challenges they encounter highlight the need to support them.

2. Proposed Research and Preliminary Research Questions

This research investigates the interplay between students' learning and non-learning activities while learning in an informal learning setting and the support that can be given to help students self-regulate and increase learning efficiency. We limit our work to informal learning settings that involve the use of a computer because work done on or in front of a computer can be logged automatically and because computer systems can provide automated support to help students self-regulate.

We use the term *unsupervised learning environment* to refer to informal learning settings wherein students learn by using a computer without supervision from a teacher. In this environment they need to identify their own goals, manage their learning, avoid distractions and self-motivate to learn efficiently. We aim to accomplish the research's goals by answering the following general and specific questions:

How do we help students self-regulate in an unsupervised learning environment to improve learning efficiently?

1. How can we help students define and prioritize their learning goals?
2. How can we help students become more aware of their activities while learning and encourage them to change their behavior that is not helpful to learning?
3. How can we help students self-reflect and identify ways to improve their learning?
4. Does helping students self-regulate when they learn in an unsupervised learning environment improve their learning efficiency?

3. Architectural Framework

The framework we are using for this research consists of three cyclic phases with elements based on the three aforementioned self-regulation phases and is illustrated in Figure 1. In the *interaction phase*, students are asked to identify and input their goals at the beginning of a learning session. After which, students start the learning session wherein information about their actions such as applications used, timestamps and screenshots of the desktop and webcam are recorded and stored in an interaction database. The system provides timely feedback to help students keep track of their activities and progress and to help them identify if there is a need to adjust them. In the *annotation phase*, students review their learning session with the help of the desktop and webcam screenshots recorded. Students

then annotate their activities on the computer (e.g., browsed a web page, read a textbook), identify if it is related to their learning goals or not and indicate when they felt distracted from their learning goals. Students are also asked to comment on the system's feedback during the learning session and rate their learning efficiency for the session. In the *modeling phase*, a machine learner will be used to create a predictive model from the annotated data to identify which conditions cause students to become distracted. Another machine learner will be used to incrementally adjust a feedback model to fit the students' feedback preferences. Feedback adjustments result in changes in feedback type, frequency and conditions. The updated distraction and feedback models are used by the system in the next learning session to decide when and what type of feedback should be given to the student. Over time, the adjustments will result in better models of the students' behavior and feedback preference thus, improving the feedback mechanism.

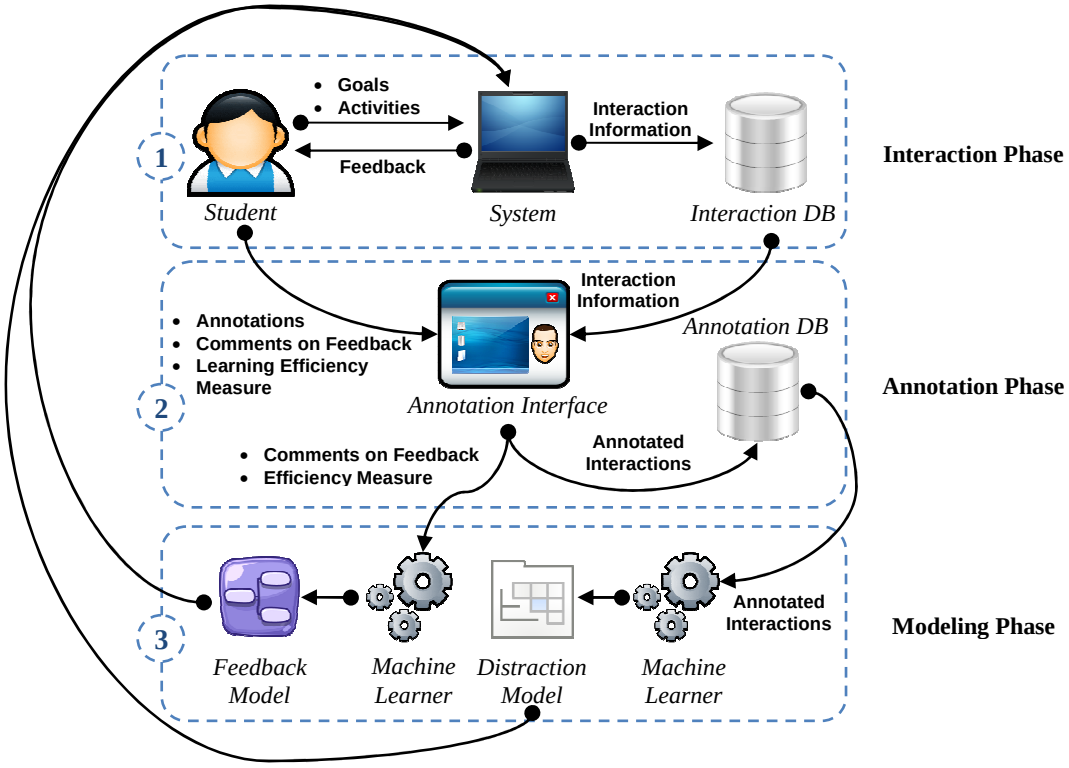

Figure 1. Architectural Framework of the Proposed System

4. Preliminary Results

An initial prototype of the system with both the interaction and annotation phases was created and tested on four students doing academic research [3]. The subjects were mostly graduate students working on different domains (i.e., computer science and physics) but were all required to do research and present results to their respective supervisors once a week. Academic research was considered an unsupervised learning environment because students did their work on a computer, managed their own learning and didn't receive direct guidance from their supervisor. Each student used the system for approximately two hours in one learning session per day over the period of five days resulting in 10 hours of data per student. After each learning session, students spent about an hour to annotate their data, which is around half of the learning session's duration. Surveys and informal interviews were also conducted to further verify and understand the students' learning behavior.

A transition likelihood metric was used on the annotated data to identify the likelihoods

of transitioning between states, wherein each state consisted of a student's emotion and intention (i.e., learning or non-learning). The results showed that students transitioned between feelings of engagement and confusion which were indicative of cognitive disequilibrium, a state commonly experienced by students when learning. Students were also constantly shifting to non-learning activities which may have served as distractions. However, students shifted back to learning which indicated that non-learning activities may also have served as rewards and de-stressors that helped motivate students to resume learning at a later time. Both effects of non-learning activities were also reported by students in the survey results collected. During the interview, we found out that students used varying measures for learning efficiency which included the number of completed learning goals, the amount of time spent in learning activities and the difference between what they learned from the session and their self-expectations. Furthermore, students said that they were able to identify what caused them to learn inefficiently and also what they could do to improve their learning behavior.

The next step in our research is to use our preliminary results to design and automate feedback provision based on the students' annotations, learning efficiency ratings and proposed solutions for improving their learning behavior. This feedback also needs to be verified if it translates to actual learning improvements through pretests and posttests.

5. Conclusion

This research investigated learning in an unsupervised learning environment and proposed a self-regulation based automated support mechanism to help students learn. The designed methodology allows students to learn in a naturalistic environment and helps them become more aware of how often, how long and which non-learning activities were helpful or harmful to their learning. The methodology also allows students to self-reflect and identify how they can improve their learning efficiency. The kind of support given by the system is not domain dependent so it is able to provide support for learning as long as it is done on or in front of a computer. Self-regulation is an important skill for life-long learning which the system promotes through honing students' self-regulation skills outside formal learning settings without the need of human supervision.

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Exploring Discourses: Third Culture Kids' digital lives

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Abstract: An important question for research is the ways in which children from globally mobile families negotiate the different Discourses they encounter through mass-media digital technologies, the home, and the classroom. The study reported on here took the form of a multiple case study, which was undertaken at a European International School over the course of a school year. This paper focuses on students' digital game play documented within the different contexts of classroom and out-of-classroom environments. It reports on the social dynamics and the productive outcomes made possible in spaces such as these, and the ways these children negotiated, appropriated or embraced the Discourses that they found as part of their ongoing work in establishing social identity.

Keywords: Identity, digital play, third culture kids, literacy education

Introduction

Issues of identity are of intense significance for the globally mobile child, and so too is digital play, as a forum for both pleasure and community. To inform contemporary pedagogy and curriculum in school, more information is needed about the ways in which issues of identity present themselves in on and offline contexts, and the ways in which children in turn negotiate them. To explore children's integration of digital games into their lives, for my Master's research study I held a series of after school computer clubs in the International School in which I was teaching. Through these clubs, I investigated the children's imaginative engagement with internet games [1] [2]. This research prompted more questions, particularly concerning identity and digital play, and the challenges these distinctive young people face in negotiating the worlds of the internet, home and school. For the last two years I have explored this topic as a full-time PhD student.

1. Related work with key references

My research draws on a wide selection of literatures, briefly summarised here in the following three topics:

1.1 Identity

Questions of identity and subjectivity are central to this research. So too is language use in both print and multimodal contexts for establishing these constructions of identity. Sociolinguists such as James Gee point to strong connections between language use, specifically how terms and concepts are framed and the everyday language used to speak about them, and the processes by which people perceive themselves and are positioned

within society. Gee calls on the notion of Discourse to explain key distinctions and operations here [3]. In his writings about identity, Gee uses a capital letter to distinguish between the familiar use of the word 'discourse' to mean a dialogue, and 'Discourse', by which he refers to a socially-formed grouping embedded with cultural practices. Gee theorises that we all have experience of a unique primary Discourse, our formative social communication learning from our parents, which is shaped by cultural influences such as national and religious Discourses, as well as a comprehensive range of secondary Discourses, our necessary ways of communicating differently in different situations, such as may be encountered within digital environments and school communities.

1.2 Third culture kids

The site of the research is an International School that prioritizes the children of intergovernmental organizations' employees. The majority of these children are expatriates, many of whom live a peripatetic life and thus live as outsiders from their home country, and to a large extent from the country where they currently reside. Consequently, these children have quite different formative experiences than children who have matured primarily within one culture. Such children have been labelled as "global nomads" [4] or "third culture kids" [5], and as Sears notes, these children can be seen as "exemplars" of an increasingly mobile world [6 p.79]. The growth of new digital technologies has presented a new range of options for the ways these children live their lives. Such changes consequently have important implications for the educational institutions that serve these children.

1.3 'New' Classroom Literacies

In 1996, the New London Group collaborated to produce a manifesto that seeks to broaden the scope of literacy pedagogy to accommodate both technological changes, and changes in the social landscape. Literacies occur within a broad social context, and within a wider range of spaces and Discourses than is dealt with by traditional classroom settings. Educational research therefore needs to move beyond classroom doors and into students' wider communities [7]. The research undertaken here adopts such a sociocultural approach, and is grounded in the idea that communicative production can best be understood within the social and cultural practices from whence it is formed.

2. Research Questions

The central research question in this study is 'how do third culture kids negotiate the Discourses of home, school and new media'. In researching this question, it is also necessary to identify some of the key Discourses these culturally diverse children encountered in the different intersecting spaces and places of digital culture, the classroom, and the home, and to explore the ways in which these children position themselves in relation to these Discourses. To refine the focus, this topic is being broken down into a number of specific directions.

One direction concerns the social dynamics established by the participants when playing or working in a group, both in school, and in out-of-school contexts. This includes group dynamics within virtual spaces. This focus works towards understanding the central research question as each student's differing Discourse backgrounds can be glimpsed within social interactions such as these. Questions being explored in this direction are:

- When the children play internet games in a room together, or work in collaborative learning situations utilizing digital technologies, what are the characteristics of the group dynamic that develops? And then:
- How do the individual children negotiate their relationships within these different places and/or within virtual group settings?

A second direction is concentrated on the need to know more about how game play, and other uses of digital technologies, factor in the performance of, and development of, these children's language and literacy skills. Students produce and share meaningful texts via internet games and social networking sites used at home, and games and other digital platforms used in the classroom. Exploring this production works towards understanding the broad topic as the research is grounded in a sociocultural position that language is central to identity; that identity is one and the same as its expression or performance through literate practices. Specific questions being explored in this direction are:

- What are the characteristics of the texts which children produce utilizing mass-media digital technologies in the home?
- How do they differ from texts produced in classroom situations when digital technologies are utilized?
- What evidence do these literate productions provide of the students' negotiation of the Discourses that surround them?

3. The contribution of the proposed research

Young people in the 8-13 year age group are at a stage of vital importance in how they see themselves, and in the development of their points of view and values, yet this age group remains under-investigated in most areas of educational research. This study specifically contributes to the literature due to the unique nature of its third culture kid participants, and aims to bring investigations of identity and the third culture kid into a digital-age focus. This broad research topic directly addresses Jackie Marsh's declaration of the "urgent need to map children's engagement with cultural texts in a global context" [8 p.12].

4. Research methodology

The research is guided by case study procedures. Over the course of the past school year, twenty International School students aged from 8 to 13 years kept a journal recording their at-home digital play. These journals were then used as an aide-memoire at weekly meetings where the students discussed their use of digital games and other media. The students were also observed in the classroom, focusing on the children's experiences with digitally enhanced learning. An opportunity to attend an after-school computer club during which students played on their own choice of internet games was also offered. Interviews were held at the beginning and the end of the school year with the students. Their teachers and parents were also interviewed.

The research employs qualitative research methods to ensure the authentic, "messy complexity of human experience" can be seen and contemplated [9 p.3]. The design encompasses two different kinds of triangulation to impart validity, a methodological triangulation and a data triangulation [10]. First, three methods have been employed to collect information from the child participants; taped interviews and discussions, observation notes, and journals. Secondly, three different data 'categories' have been engaged as interviewees: children, parents, and teachers.

Appadurai [11] maps contemporary global fluidity within a set of five different categories of flow: ethnoscapes, mediascapes, technoscapes, financescapes, and ideoscapes. These 'scapes' provide an illuminating framework for exploring the contemporary childhood of the globally mobile child. The data, which is now in the initial stages of analysis, is being initially codified according to these categories. This involves selecting representative sections of dialogue and image as the data is transcribed and collated. These selections highlight typical and atypical responses, as well as characteristic responses for different age and/or gender subgroups.

5. Preliminary results

The data is in the early stages of analysis and it is not yet possible to draw conclusions. Two papers utilizing early findings have been written and are currently under consideration for publication. One centres on the experiences of one family who had recently moved into the school community, and considers the complex and conflicting pressures, expectations and possibilities they encountered at home, at school, and in their online play, at this moment of cultural transition. The other reflects on the differing attitudes observed between the school community and the children's families, with respect to the role of digital play in children's lives, and suggests that schools need to understand parental positions around technology and digital culture, and reflect on these as they plan their digital futures.

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Inspiring Creativity through a Creativity Game of Players as Game Story Designers: A Metacognitive Approach

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Abstract: There have been tremendous ways of developing creativity, yet instead of traditionally formal instruction, games are the best media to spur creativity, as creativity can easily and spontaneously be evoked through games. On the other hand, metacognition is a good way to promote creative thinking, as metacognition which contains the abilities such as self-planning, self-monitoring, and self-evaluation can foster creative-relevant cognitive processes. Games are exactly the ideal platform that provides a playful context for metacognitive awareness prompting creative processes. Based on the advantages of games and that design is a creativity-relevant cognitive and constructive process, this research adopts the means of digital game-based learning (DGBL) to propose a metacognitive approach to inspiring creativity through a creativity game of players as game story designers.

Keywords: creativity assessment, game story design, game story creativity, creativity

Introduction

Creativity has been widely acknowledged as one of appreciated 3Cs today-*creativity, curiosity, and courtesy*. Many studies revealed that creativity is associated with and also facilitates divergent thinking, critical thinking, flexibility, and so forth, which are the vital elements to promote learning. However, is creativity inborn or acquired? Creativity, like other potentials, demands inspiration and practice to receive its whole-scale development. There have been tremendous ways of developing creativity, yet instead of traditionally formal instruction, games are the best media to spur creativity, as creativity can easily and spontaneously be evoked through games.

1. Purpose and Significance of the Proposed Research

Based on the advantages of games and that design is a creativity-relevant cognitive and constructive process, this research adopts the means of digital game-based learning (DGBL) to propose a metacognitive approach to inspiring creativity through a creativity game of players as game story designers. The purpose of this research contains three aspects. First of all, this research attempts to explore what kind of creativity assessment is appropriate for game story design. Second, this research investigates the effects of inspiring creativity through a game of players as game story designers. Third, this research tries to understand in which game story constructs were the students good at and short of creativity?

The significance of this research is that this research proposes an entertaining and metacognitive approach to inspiring creativity in replace of traditionally formal instruction of creativity. Besides, the devised creativity game can prompt players' creativity-awareness for distinctive game story constructs and creativity dimensions. This research provides valuable information for game design course instructors as well as game story design evaluators.

2. Literature Review

This research is based on the integrated rationales of game, creativity, and metacognition. Some selected literatures are briefly discussed as follows.

2.1 Game and Creativity

The literature has widely discussed the relationship between games and creativity. Some major advantages of games are described as follows. First of all, game play is a wonderful source of relaxation and stimulation for the brain and body-a sure and fun way to develop the ability of creativity [3]. Second, game play can arouse curiosity which leads to discovery and creativity [3]. Third, creativity can be activated by intrinsic motivation through games [5]. Fourth, games can stimulate divergent thinking which promotes creative learning [2].

Noticeably, game play as engagement fosters the cognitive and affective dimensions of the creative process, as well as the development of domain-relevant skills and creativity-relevant skills [5]. There are five creativity-relevant cognitive processes: problem framing, divergent thinking, mental transformations, practice with alternative solutions, and evaluative ability. Through game play, these creativity-relevant cognitive processes can be facilitated in learning. Evidently, games not only a brilliant means to mediate learning but also a fantastic catalyst to boost up creativity. Thus, games are the best approach to an enjoyable learning environment prompting creativity which in return inspires creative learning.

2.2 Game and Metacognition

The literature has extensively discussed over metacognition in the past decades. Metacognition refers to the ability or awareness of understand and monitor one's own thoughts [4]; simply put, thinking about one's thinking. Many studies have reported that metacognitive awareness can be fostered with proper instructional strategies. Likewise, the conditions that have been proven to foster metacognitive awareness through instructional strategies are similar to the conditions established in games [6]. Differently, games provides a context in which players can enjoy a playful activity. Using games to prompt metacognitive awareness can encourage motivation, promote engagement, and increase pleasure-an ideal means much better than formal instruction.

2.3 Metacognition and Creativity

Creativity involves f innovation, imagination, uniqueness, etc. Many studies have explored how to promote creativity through a variety of means and strategies. It has been demonstrated that metacognition is a good way to promote creative thinking, as metacognition which contains the abilities such as self-planning, self-monitoring, and self-evaluation can foster creative-relevant cognitive processes [1, 5].

3. Implementation of Game Story Players as Designers Approach

Grounded on the rationale of the triangular relationships of creativity, metacognition, and games, game story constructs and six types of creativity are presented in a metaphorical way in the devised creativity game, requiring players as game designers for inside-game- story players. Through designing, it stimulates players' metacognitive awareness that simultaneously prompts creativity awareness.

4. Method

4.1 Research Design

This research consists of three phases. In the first phrase, a creativity assessment rubric for game story design is developed and tested its validity and reliability. In the second phrase, a standard creativity test is selected and used to pretest and posttest a control group that is treated with a learning system containing selected instructional materials on creativity. For the experiment group, a questionnaire is used to pretest the participants' knowledge of creativity for game story design, and then the creativity game proposed by this research is conducted on the participants. In the third phase, the game story design projected done by the experiment group at the end of the semester will be assessed with the devised assessment rubric by three raters. Two groups will be compared in terms of different instructional treatments.

4.2 Preliminary Research Questions

Three research questions are formulated as follow: First, in which game story constructs are the students good at and short of creativity? Second, whether the proposed game treatment better promotes creativity? Third, how do the students view such a metacognitive approach to creativity inspiration?

5. Preliminary Research Work Achieved and Future Work

This proposed research has come to the phase of pilot study. An analytic rubric of game story creativity has been devised and the paper of rubric design has been accepted in the 2012 International Conference of Computers in Education. Based on the analytic rubric, initial ratings have been conducted and the validity and reliability of the analytic rubric are being examined. Besides, the game structure diagram of the creativity game as well as a questionnaire has been initially drawn. Future work will focus on the development of the creativity game and the evaluation of its effectiveness.

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Exploration of Signature Pedagogy Using ICT for English Grammar Learning in Elementary School Education

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Abstract: This research aims to explore a signature pedagogy that addresses the trends toward the pedagogical goals and the technological integration for English grammar learning in the twenty-first century. Based on a twofold literature review, a potential signature pedagogy with three variations in the use of two selected types of information and communication technology (ICT) resources has been designed for supporting English as Second Language (ESL) learners at the elementary school level to learn English grammatical knowledge. An empirical study which combines qualitative and quantitative methods is planned to evaluate the effectiveness of the designed signature pedagogy in a real classroom environment. Three classes of Grade 4 ESL learners will be invited to learn the target topic with the selected ICT resources during a one-month trial teaching, under three settings: inclining to form-focused approach; balancing form-focused approach and communicative approach; or inclining to communicative approach. The empirical study will conduct attainment tests, classroom observations, questionnaire surveys and semi-structured interviews to investigate the impact of the designed signature pedagogy on the achievements, processes and perceptions of students in the learning of elementary English grammar. This research will finally advise a signature pedagogy that fully exploits the use of the two selected types of ICT resources for supporting ESL learners to learn elementary English grammar.

Keywords: Elementary school education, English, grammar, ICT, signature pedagogy

1. Research Motivation

In many Asian cities such as Hong Kong where English language is not the native language of the majority of the population, this language is one of the major subjects that receive much attention in elementary school curriculum. There is a decade-long emphasis on the pedagogical integration of ICT into the delivery of elementary English language curriculum [1, 2]. In Hong Kong, in this curriculum, grammatical topics such as tense and agreement are considered to be the very important but most difficult component due to the inherent differences in the language systems between Chinese and English languages.

A signature pedagogy refers to a collection of discipline-specific teaching methods that focus on preparing learners to think like the experts in the target discipline for a skillful demonstration of discipline-specific knowledge for learning and daily pursuits [3]. Through the routinized approach to classroom teaching, a signature pedagogy could promote learners to habitually bridge abstract knowledge and regular practice for the deep learning of core knowledge in the target discipline. The implementation of signature pedagogy is regarded as important in the learning of rule-based topics. It is therefore good to implement

significant pedagogy in the teaching of English grammar, which is a topic comprised of language rules. This research is motivated to address the emergent need in the field of ESL education for more investigations into signature pedagogies which meaningfully use ICT resources for supporting English grammar learning in ESL classrooms.

2. Research Context

This research aims to explore a signature pedagogy that maximizes the potential of ICT resources for supporting ESL learners at the elementary school level to learn English grammar. This research is comprised of two stages for progressively designing, evaluating and then establishing a signature pedagogy that fully exploits the use of ICT resources for learning elementary English grammar.

2.1 The First Stage: Designing a Potential Signature Pedagogy Using ICT for English Grammar Learning

The first stage of this research focuses on a twofold literature review for designing a potential signature pedagogy that coordinates the pedagogical goals and the technological integration for English grammar learning in the twenty-first century. Based on an in-depth review of research literature on the pedagogical approaches for teaching elementary English grammar in the recent decade, ESL teachers over the world are found to mainly adopt two pedagogical approaches in English grammar lessons. The first approach is the form-focused approach, which focuses on inculcating learners with knowledge about variation forms and usage patterns of diverse types of linguistic units to generalize prescriptive grammar rules. The second approach is the communicative approach, which focuses on engaging learners in authentic learning tasks in the collaborative learning setting for applying grammatical knowledge in classroom interactions.

Based on an in-depth review of research literature on the use of ICT for learning and teaching English grammar system in the recent decade, ESL teachers over the world are found to mainly adopt two types of ICT resources in English grammar lessons. The first type is online learning websites specific for grammar learning. This type of ICT resources typically provides a set of static grammar notes, multimedia illustrative animations and dynamic multimedia simulations for rules explanation. The second type is online communication tools general for daily interaction. This type of ICT resources typically offers a range of written or oral communication software for interpersonal interaction in the synchronous or asynchronous mode.

The findings of the twofold literature review, concurred with the advocacy by established academics (such as [4]), suggest that a potential signature pedagogy for English grammar learning should make a strategic combination for leveraging the effect of the form-focused approach and the communicative approach. On the one hand, there should be inquiry learning activities under the form-focused approach, in which learners browse the selected online learning websites with topic-specific notes and worksheets to realize and conceptualize usage conditions of grammatical rules. On the other hand, there should be collaborative learning under the communicative approach, in which learners use the selected online communication tools to share and discuss target knowledge, and then to integrate and apply knowledge about grammatical rules. It should be noted that there is flexibility for varying the proportion of these two types of learning activities during English grammar lessons according to the learning needs of students.

2.2 The Second Stage: Evaluating the Designed Signature Pedagogy for English Grammar Learning

The second stage of this research will be an empirical study which focuses on evaluating the designed signature pedagogy in a real classroom environment. Three research questions are made for the empirical study:

(i) What are the achievements of elementary ESL learners toward English grammar learning under the designed signature pedagogy?
(ii) What are the processes of elementary ESL learners toward English grammar learning under the designed signature pedagogy?
(iii) What are the perceptions of elementary ESL learners toward English grammar learning under the designed signature pedagogy?

An elementary school that has rich experience in ICT in education will be purposefully sampled in Hong Kong as the partner school for the empirical study. A trial teaching in the form of one-month supplementary course, which amounts around 20 one-and-a-half-hour lessons, will be arranged in the partner school. Three classes of Grade 4 students, each consisting of around 30 students with similar learning ability, will be randomly selected and then assigned to one of the following three settings varying in the proportion of learning activities during lessons:

- Setting 1: The proportion of inquiry learning activities under the form-focused approach is higher than that of collaborative learning under the communicative approach.
- Setting 2: The proportion of inquiry learning activities under the form-focused approach is the same as that of collaborative learning under the communicative approach.
- Setting 3: The proportion of collaborative learning under the communicative approach is higher than that of inquiry learning activities under the form-focused approach.

The proportion of inquiry learning activities under the two approaches will be further delimited by taking the empirical findings of research on digital classrooms (such as [1] and [4]) and the current practice in ESL classrooms in Hong Kong into consideration. During the trial teaching period, students in each of the three settings will be grouped into pairs to learn English grammar, with the use of the two selected types of ICT resources and tailor-made learning worksheets. In each lesson, students will first be taught the target knowledge by the teacher and then, they will explore this topic with the assigned learning materials in pairs. The author will take charge of the classroom instruction for the one-month trial teaching.

Four methods will be adopted in the evaluation work to investigate the effect of the designed signature pedagogy. First, students in all the three settings will sit for identical pre-test and post-test [5] before and after the trial teaching, respectively. The test papers will include a series of questions that assesses knowledge of the students about key grammatical knowledge of English language, such as tense and agreement. Second, an interaction analysis [6] will be conducted to investigate the effect of the designed signature pedagogy on the learning process of students in each of the three settings. Two student groups will be randomly selected in each setting. The six selected student groups will be observed and videotaped in all lessons throughout the teaching period for collecting data on the learner-learner and learner-technology-learner interactions in the learning activities. A systematic analysis of the interactions for constructing target knowledge will follow to trace the learning process among students under the designed signature pedagogy.

Third, a questionnaire survey [5] will be conducted at the end of the trial teaching. All students will be asked to complete a self-administered questionnaire to indicate their perceptions of the implementation of the designed signature pedagogy for English grammar lessons. Fourth, one-fifth of the students in each of the three settings will be randomly selected for the semi-structured, individual interviews [5] to further investigate their perceptions of the implementation of the designed signature pedagogy. The selected students will be asked to describe the changes in their process, motivation and achievement in the learning of English grammar through the lessons that implement the designed signature pedagogy.

The empirical study is going to be conducted in a real classroom environment. The evaluation results obtained at this stage will contribute to the establishment of a signature pedagogy that uses ICT resources for maximizing the learning effectiveness among ESL learners in English grammar learning in elementary school education.

3. Research Contribution

In the Asian cities where English language is not the native language of the majority of the population, local ESL teachers in elementary school education, in general, lack sufficient evidence-based recommendations which support them to plan and implement effective and efficient methods for the pedagogical use of ICT in English grammar lessons. In addition, there is a lack of comprehensive research on technology-mediated signature pedagogy for the field of ESL education [4, 7].

This research contributes to the pedagogical advancement in the use of ICT in ESL education. It will not only help to enhance the learning of grammatical knowledge among ESL learners, but also help to cover the lack of comprehensive research in the field. The outcome of this research will be a potential signature pedagogy to maximize the effectiveness of ICT resources on the learning of elementary English grammar among ESL learners. This can provide ESL teachers with insights into the innovative design of technology-mediated pedagogies for the teaching of the target topic.

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Impact of Students' Perceptions of ICT-Supported Learning Environment on Approaches to Learning for Principles of Accounting in Secondary Schools

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Abstract: This research aims to study the impact of students' perceptions of ICT-supported Learning Environment and their personal characteristics on approaches to learning in the context of Malaysian accounting education at secondary school level. Students are facing the learning problem where they lack the opportunity to experience deep approaches to learning due to the teacher-centred teaching approach and immaturity of the curriculum and assessment design. In view of these problems, the Ministry of Education (MOE) has revised the curriculum and assessment from content-based to skilled-based with the aim to enable students to practise deep approach to learning with ICT. However, to what extent the new environment is able to stimulate deep approach to learning is the main issue underpinning by the present study which will be investigated through a correlational research design employing the Structural Equation Modeling (SEM) analysis method. Contributions and preliminary results of this study are discussed.

Keywords: Perceptions of ICT-supported learning environment, deep approach to learning, surface approach to learning, students' characteristics, Principles of Accounting

Introduction

A business or organisation communicates its results and position to its stakeholders through the use of financial statements. Given that financial statements are among the deliverables of an accounting task, accountancy is widely referred to as the "language of business". Basically, accounting is seen to involve the process of identifying, measuring, and communicating economic information to permit informed judgments and decisions by users of the information [1]. Fundamental to the identifying and measuring processes, is the application of the double-entry book-keeping system to record financial transactions which conducted under the procedures named as accounting cycle. It involves a set of steps in preparing the financial statements for a given period. All these steps are inter-linked and it requires students to employ deep approach to learning in order to master the whole set of accounts throughout the accounting cycle rather than fragmentally studying on each of the accounting procedures. The deep approach to learning represents a personal commitment to learning through seeking meaning of the contents, trying to relate parts to each other, associating new information with existing prior knowledge or to personal meaningful context. It is contrasted with surface approach to learning which is characterised by motivation to acquire only sufficient knowledge to complete the task or pass the subject through rote learning [2, 3, and 4].

In 2010, the Malaysian Ministry of Education (MOE) has committed an effort to transform the curriculum and assessment of the fundamental accounting subject in secondary schools, the Principles of Accounting, from content-based to skilled-based with the aims to enable students to practise deep approach to learning with ICT [5]. The effort undertaken is to overcome the learning problems which will be discussed in the next section. However, to what extent the effort is able to impact positive changes in students' learning is the main issue underpinning the present study.

1. Research Motivation

Unlike other disciplines, accounting is a technically-oriented subject and hence, the teaching of accounting was found to be dominated by the objective of training students to know facts and solve problems from a procedural perspective [6]. Thus, it was observed by few researchers that students always perceive that learning accounting is simply about learning a set of rules and evidences suggest that they tend to adopt a surface learning approach compared to other subjects [7, 8].

Similarly, in the Malaysian context, students' learning for the subject of Principles of Accounting has yet to achieve deep approach as it was found that most of the accounting teachers tended to use the teacher-centred teaching methods such as lecture, drill and practice and demonstration of problem solving by teachers [9]. Such methods could lead to surface learning where the lower-level procedural skills are acquired without processing information for meaning. This problem could be attributed to the former curriculum and assessment of Principles of Accounting (before year 2010) which were arranged in such a way that the process of accounting cycle was fragmented by its steps. Students learnt each part of the process through the method of drill and practice where they were exposed to exercises or problems which were related to that portion of process only. In other words, there were different sets of exercises or problems for each of the steps of accounting cycle e.g. exercises for journal-entry were unrelated to exercises in trial balance. The division of the book-keeping procedures negates the students' skills and knowledge to relate every aspect of accounting into a coherent whole [10]. Under this learning content structure, students were more oriented towards surface approach to learning as they treated parts of the subject as separate entities and failed to master the full set of accounts. Moreover, students lacked exposure and were not encouraged to engage in deep learning approach through technology [11]. It further proves that students are lacking ICT skills to handle a full set of accounts where these skills have long been heralded as a crucial element in both professional accountancy and accounting education [12].

The launch of the revised curriculum and assessment signifies the commitment of MOE to improve learning quality which enables students to have a coherent understanding of accounting through enhancing their competencies in preparing a full set of accounts with the assistance of ICT. The overarching question now is how effective is the ICT-supported learning environment as perceived by students in influencing their deep approaches to learning? What are the other factors which influence students' approaches to learning? Is the perceived ICT-supported learning environment a mediator factor between individual personal characteristics and approaches to learning? All these stand as the general motivation for the present research.

2. Research Questions

The research questions for the present study are suggested as below:

I. Do the students' perceptions of ICT-supported learning environment (in terms of Personal Growth, Assessment, and Relationship) influence their approaches to learning?
II. Do the students' characteristics (in terms of Prior Accounting Knowledge, Academic Ability, Preconceptions of Accounting, and ICT Proficiency) influence their approaches to learning?
III. Is the students' perceived ICT-supported learning environment a mediator between their characteristics and approaches to learning?

3. Contribution

This study adds to the body of accounting education and student learning literature by investigating students' approaches to learning in the ICT-Supported Learning Environment through examining their perceptions of the environment and personal characteristics. It was commented that the direct investigations of students' perceptions are scant, particularly in relation to technological innovation in the learning environments [13]. Thus, this study makes a prima facie contribution for accounting educators to obtain the captured reflective voice of students. Furthermore, the findings of the present study could provide important information for educators on which aspect of the learning-teaching context can be altered for the sake of improvements in teaching and learning, curriculum, and assessment that encourages deep learning approach.

4. Methodology

This research employs a correlational research design. It aims to establish the empirical relationships of students' perceptions of ICT-Supported Learning Environment, their personal characteristics, and aprroaches to learning through using of Structural Equation Modeling (SEM) analysis method. A closed-ended questionnaire will be distributed to secondary school students who have completed their school-based assessments of Principles of Accounting. The questionnaire will be adapted from the instruments of Learning Process Questionnaire (LPQ; reliabilities for the subscales: .58-.75)[14] for measuring approaches to learning; Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI; reliabilities for the subscales: .77-.95)[15] and Course Experience Questionnaire (CEQ; reliabilities for the subscales: .67-.88)[16] for assessing Perceptions of ICT-Supported Learning Environment; and Expectations of Learning Accounting Inventory (ELAcc; reliabilities for the subscales: .67-.92)[17] and ICT Skills Audit Scale [18] for appraising the individual student's characteristics.

5. Preliminary Results

To ensure the successful implementation of the revised curriculum by 2010, a "try-out" project was conducted in 150 technical and national secondary schools nationwide in Malaysia in 2007. Studies on students' receptiveness on the ICT-supported learning environment have been conducted in the "try-out" project which involved 1,322 respondents. The results revealed an overall positive tendency of all the dimensions of receptiveness (with mean values above 3.5 of a 5-point Likert scale) by students with the under-achievers demonstrating significantly higher receptiveness in terms of the dimensions of Skills Acquisition (M = 3.818, SD = 0.522), Teaching Competency (M =

3.755, *SD* = 0.707), and ICT Liking and Utility (*M* = 3.819, *SD* = 0.587) than the high-achievers (*M* = 3.714, *SD* = 0.768), *t* = 2.913, *p* = 0.002 (one-tailed); (*M* = 3.606, *SD* = 0.832), *t* = 3.464, *p* = 0.0005 (one-tailed); and (*M* = 3.618, *SD* = 0.776), *t* = 5.316, *p* = 0.0000 (one-tailed) [19].

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Scaffolding Teachers' Construction of a Learning Trajectory for Mathematics Supported by ICT

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Abstract: In this paper, we present preliminary results related to a developmental project where we explore how technology can be used to improve teachers' teaching practices and their students' learning of mathematics. We have adopted a teacher-centered, collaborative approach that challenges the participating researcher to develop strategies for finding different forms of scaffolding to support the teachers' participation in this project. So far, we have used the software GeoGebra to provide competence development for the teachers in terms of mathematical representations. This software will also have a central role when investigating how the teachers perceive and make use of different affordances provided by technologies when addressing a specific learning goal related to the teaching of algebra at a lower secondary school.

Keywords: Affordances, co-design, GeoGebra, Hypothetical Learning Trajectory (HLT)

Introduction

We are currently involved in a developmental project with two mathematics teachers at a lower secondary school in Sweden where we explore how to make use of ICT to improve the teachers' mathematical teaching practices and their students' learning of mathematics. Drawing inspiration from the methodology of co-design [8] our objective is to develop technology-enhanced mathematical learning activities. Co-design provides a user-centered, collaborative approach to design research, suitable when requiring expertise from different areas, in our case mathematics, pedagogy and technology.

Involving different stakeholders and especially teachers in the design process is a key factor for an innovative learning activity to find its way to teachers' everyday practice [10]. The teachers' role in the co-design process should be regarded as dynamic and their influence should be increased in latter design iterations [10] with particular focus on refining the interplay among various forms of scaffolding required when implementing the activity in order to provide favorable conditions for its integration in the regular curriculum [11]. This methodological approach puts increasing demands on the teachers as the design process progresses and challenges the researchers to identify and provide appropriate theoretical and methodological underpinnings to support the teachers in the continued design process.

1. The Hypothetical Learning Trajectory

Within the iterative process of design research different phases of preliminary design, teaching experiment and retrospective analysis can be identified [2]. The preliminary design includes the development of a Hypothetical Learning Trajectory (HLT) which can be described as "the consideration of the learning goal, the learning activities, and the thinking and learning in which students might engage" [9, p. 133]. Although the notion of HTL has a constructivist origin [9] it has been used from other perspectives. Gravemeijer, Bowers, and Stephan have for example used the instructional theory Realistic Mathematics Education (RME) to guide the formulation of a HLT to develop classrooms activities that reflect the view of mathematics as a human activity and learning as a process within a social context [4]. For our objectives, this property makes the notion of HLT a highly adaptable and flexible tool suitable when discussing different aspects of teaching and learning within the co-design group.

The effects of integrating technologies in educational settings, are not necessary transparent. Even if technologies can be used to address some problems related to teaching, there is a possibility that they introduce new unexpected problems [5] [6]. Lindwall and Ivarsson claim that a common problem is that students tend to "exclusively focus on the operational aspects of the task without actually approaching the subject matter content" [6, p. 376]. This suggests that even if the intention of a learning activity is to afford students to work towards a predetermined learning goal, students might still focus on other aspects and other affordances. Another challenge for the designer of a HLT is that, each tool, although seemingly similar in many aspects, can have divergent effects on how students interact in an activity [6]. The result could be unexpected forms of interaction in conflict with the intentions of the HLT.

Formulating a HLT that integrates technologies requires knowledge about the affordances provided by the tool and also knowledge of how these affordances are perceived and used by teachers and students in a learning activity [1] [6]. Addressing these kinds of issues with a collaborative approach challenges the researcher to create conditions for the teachers to discuss and consider different affordances provided by technology as well as create awareness among the teachers on how digital tools might affect their educational settings [1] [5].

2. Key Idea

Our goal is to develop a HTL that is grounded in theory and attuned to the various prerequisites imposed by different stakeholders, including the possibilities and constraints that may rise when using technologies in mathematics instruction. The collaborative approach challenges the researcher to create appropriate conditions for the teachers to be able to make informed decisions. Therefore, we also seek to explore how to develop, provide and evaluate different forms of scaffold for teachers' participation in the design process. Our strategy is to monitor and qualitatively analyze the outcomes from the discussions held with the teachers and, based on the analyses, provide support for enhancing the teachers' knowledge base. So far, our efforts include two meetings with the teachers.

3. Preliminary Results

Two teachers from the current school volunteered to participate and the purpose of the first meeting was to discuss the goals of the project. At this meeting, the teachers brought forward that they were interested in addressing some of the difficulties their students had concerning algebra, e.g. the students' inability to make sense of the distributive law. The

analysis of the discussions rendered the following research question: “What mathematical knowledge requirements does a teacher need in order to participate in the co-design of a mathematical learning activity supported by ICT?”

A synthesis of two complementary models was used suggest that “teachers’ mathematical knowledge requirement would be to consider and be able to judge and compare the didactical value of various mathematical representations” [7]. This requirement includes also the use of technologies in the sense that technologies provide affordances for multiple and multi-modal representations, simulations, manipulation of data, and conversions of representations [5]. Furthermore, the analysis of the discussion indicated that there was a need for competence development among the teachers regarding mathematical representations. For this purpose a second meeting was held where the teachers where shown some activities, implemented in GeoGebra, where numerical expressions are connected with their corresponding geometrical representations (Figure 1).

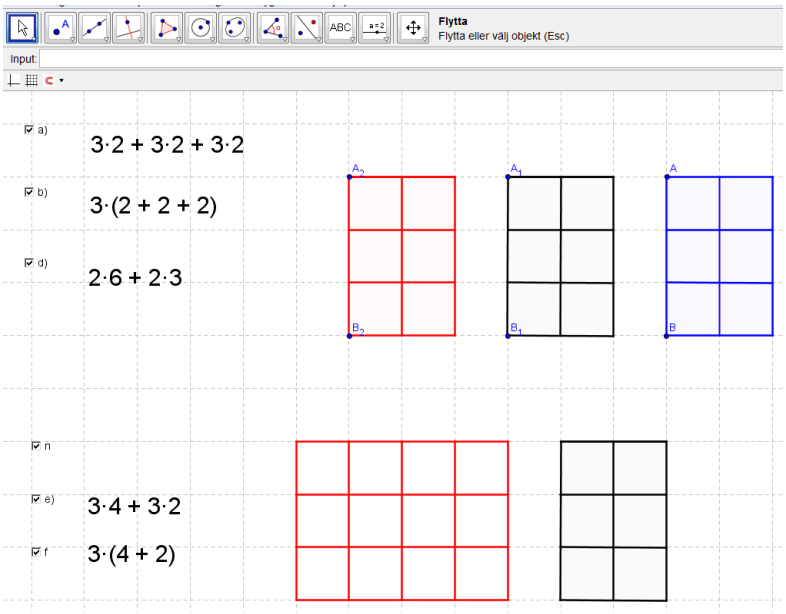

Figure 1: The activities implemented in GeoGebra

The dynamics of GeoGebra provides possibilities to move and rearrange geometrical figures with ease. This affordance is used in the activities to illustrate how algebraic treatments of a numerical expression can be interpreted and represented geometrically. The possibility to display and hide text and figures in Geogebra is used to create freedom of choice to display the two different mathematical representations either simultaneously or one at a time. Although figures and expressions are organized in a determined order in the activities, the teacher still needs to consider how the different representations should interact within the activities. The activities are designed to address students’ conceptions of the distributive law by affording transformations of representations which can be regarded as a characteristic of mathematical proficiency [3]. The activities are also designed to provide affordances for different forms of interaction between the teacher, the students and the activities.

4. Reflections on the Outcomes of the Meetings

The teachers had never used GeoGebra before the second meeting and they became interested in the features of this software and in the activities presented. Furthermore, they

wanted immediately access to the activities in order to use them with their students. During this meeting the teachers adopted the mathematical ideas presented in the activities and they came to realize the didactical potential in interpreting and representing algebraic laws geometrically. This was clearly a new insight for them and they recognized the limitations of alternative explanations that they normally used that where exclusively based on instructions on how to manipulate different variables.

The teachers were encouraged to use the activities with their students but they were not provided any details on how to create conditions for using the activities in instruction. Instead they were invited to modify and use the activities in GeoGebra in any preferable way and thereby challenging the teachers to create their own HLT. This last meeting has not yet been followed up and the outcome of these efforts has therefore not been analyzed yet.

5. Future Work

The next step is to discuss with the teachers how they have used the activities and also attend lessons where the teachers have implemented the activities as part of their daily work. The analysis of these sessions has two objectives. First we are interested in understanding and discussing how the teachers coordinate the different parts of the hypothetical learning trajectory when using GeoGebra. Secondly, we are interested in evaluating our efforts of providing competence development in terms of mathematical representation. We want to see if and how the teachers perceive and make use of affordances for representation and communication provided in the specific activities implemented in GeoGebra.

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Towards Improving Reading Comprehension Skills in Third Graders with a Serious Game

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Abstract: The results of different evaluations about reading comprehension in Mexico are not positive. Different methods or techniques have been implemented to counteract such numbers, and the support of information technologies (IT) in reading comprehension, is one of them. During the last years, video games demand increased in Mexico, which indicates that they are already part of the culture, and consequently, those must be harness to obtain better results. The purpose of this research is to improve reading comprehension skills of third graders through a serious game.

Keywords: Reading comprehension, serious games, third graders

Introduction

Reading is a process that each person does by themselves and it allows to examine the content of what is being read, analyze each of its parts to stress the essential and compare already existing knowledge with the one that has been just acquired [1]. A wide range of reading skills, including digital reading, are essential for an individual's personal and social fulfillment. In essence, acquiring the ability to read and understand well is a basic requirement for the social and economic demands in the society. Proficiency in reading literacy is not only one of the principal goals of schooling, but is also one of the principal means of learning [2].

A report made by Entertainment Software Association [3] explains that many children, teenagers and young people, spend part of their free time playing video games, which suggests that most of such groups enjoy using and interacting with such technologies [4]. New generations show the impact of growing inside this digital wave; technologies are an integrated aspect in their lives [5]. Students in this group use technologies to learn, and to communicate in new ways.

1. Theoretical Background

1.1 Reading Comprehension

Reading comprehension evolves due to the social, cultural and economic changes that society experiences day by day. Reading comprehension is not just the mere decoding of meanings of a text, but the construction of meanings that result from the interaction of the reader with the text [6]. Reading competence is defined as the ability of a person to understand, use, reflect and gain interest in texts written with the purpose to achieve their own goals, develop their knowledge and their personal potential, and participate in the society [7]. However, according to Nation, Cocksey, Taylor, and Bishop [8], students at

young age need to be competent in two specific abilities in order for them to become good readers. They need to learn how to recognize and decipher words from a piece of writing, and also understand the message that each word transmits. Reading comprehension is an act that takes time to develop, it is impossible to demonstrate a lack of reading comprehension in children who have not yet learned to read with enough precision and fluency. Therefore, researches with greater load in reading comprehension report that children at the age of 8 and older are the ones that start suffering the lack of such activity.

1.2 Serious Games

One of the ways to support the development of reading and to encourage the reading in general, is through IT. Some authors [4] think that video games help to solve problems as the ones mentioned before, partly, because of the stories of success in the use of video games in the business and military training in some countries. The results of research studies show that video games encourage the acquisition of certain cognitive skills and improve the comprehension of students in the subjects presented [4]. According to Zapušek, Cerar, and Rugelj [9] serious games are video games used for training, publicity, simulation or education and they are designed to be executed in computers. They allow student to simulate and experiment with situations that are impossible or difficult in the real word for different reasons, such as security, cost or time. Results presented about learning show a positive impact in the development of new knowledge. Similarly, serious games are receiving interest from the researchers and the industry because of the advantages that education and formation present [10]. Besides, some pedagogues consider these types of games motivating and attractive, when the characteristics that make them convincing are incorporated, of quality and even addictive sometimes [11].

1.3 Video Games and Education

Brown [12] explains that as the adoption of video games by the military as devices of training and recruiting, the appearance of video games in classrooms represents an important institutional credit to the new media. Second Life, for example, a multiuser virtual environment, is used by many universities and institutions (e.g. Texas University, Hong Kong Polytechnic University, Harvard Law School, among others) as a virtual classroom or virtual campus, where professors and students interact online. Squire [13] states that video games encourage a way of learning that goes beyond the traditional disciplinary limits and emphasize the problem solving. For Brown and Squire, video games encourage achievements that are attained through the competence, cooperation and teamwork. Nowadays, there are new researches like Guillén-Nieto and Aleson-Carbonell [14] that explain advantages of the use of video game as an educational tool.

2. Problem Statement

Currently, there is a huge problem regarding reading comprehension in Mexico. It is been known that people do not have a reading habit, conclusions that emerged based on results which were obtained in the first survey about reading [15], in which it is revealed that the Mexican's reading average is 2.9 books per year. According to report [16], Mexico is in the 48th place among the 66 countries of the Organisation for Economic Co-operation and Development (OECD) in reading comprehension and analysis. This report places Mexico in Level 2 where there is a minimum and insufficient competence for the execution of complex cognitive activities. Meanwhile, in Spanish language in reading comprehension and

reflection on language at a national level, one of every four third graders is on the *"Under basic"* level, while the 56% is on the *Basic* level (See figure 1-A).

3. Niche Opportunities

The video game industry in Mexico had an average annual growth of 18.7% during 2007-2010 [17]. In 2010, the Mexican market was worth $757 million, placing the country among the top 15 markets worldwide video game being the first in Latin America (See figure 1-B). So, taking into consideration all this to think about the impact that video games will have in the field of reading comprehension, as proved by several studies on how they have been applied for education in different branches [4].

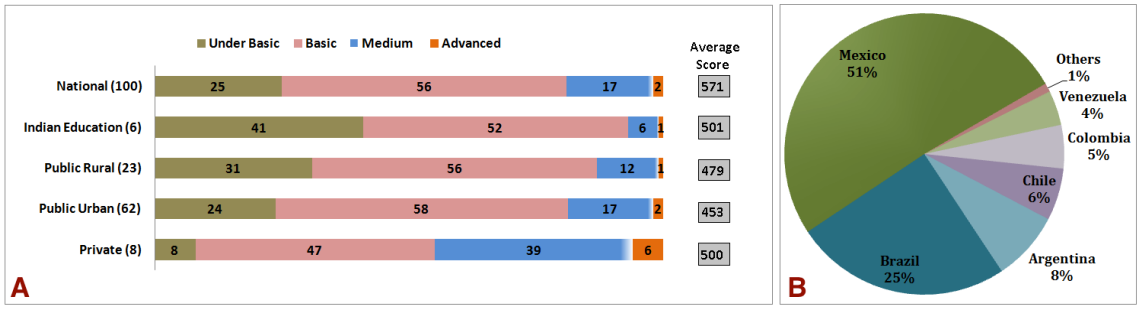

Figure 1. The first graphic (A) shows the percentage of students by level of educational achievement and school stratum in Spanish/Reading Comprehension and Reflection on laguange [16]. The second graphic (B) shows the distribution of the video game market in Latin America 2009-2013 [17].

Also, it is known that there is correlational evidence that students who read more have higher achievement [18]. An example of this is the correlation between the reading of elementary school students and their score on the Excale test. Excale are tests that measure the school achievement of students from preschool education, primary education and secondary education in different fields. In Gaytán-Lugo and Hernández-Gallardo [19] the results of their study shows that the number of books that an student of elementary school read is directly proportional to the score of Spanish in Excale, inasmuch as the correlation coefficient (*r*) was 0.608.

Based on the above, two research questions are generated: How to design and implement a methodology in a serious game to raise the level of third graders in reading comprehension? How a serious game promotes reading comprehension of third graders?

4. Method

We are going to use thinking aloud mixed with Solomon experiment. We have to design four groups. Two groups are going to be experimental samples and two groups are going to experience no experiment manipulation. Two groups are going to receive a pretest and posttest, and the other two are going to receive a posttest. This is because the control of the effects of the pretest [20]. In order to collect information and evidence about the progress of reading comprehension that third graders have at a specific moment, during the year they have to play with the serious game, every week we are going to go with the students to apply thinking aloud. This method allows students to speak about what they think and feel at the same time that, in this case, they play with the serious game.

5. Current Progress

Right now we are working in the story that will be fantasy genre as [11] recommended. At the same time, we are looking for techniques that improve reading comprehension. These ones have to be in the script and in the challenges of the serious game in an implicit way.

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Development of Number Sense in Third Grade of Elementary School Using Serious Game

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Abstract: This research focuses on instrumentation of information technologies that become psychological tools, designed to develop number sense of third graders. The theoretical background is supported by the Cultural-Historical approach, and considers that, using a serious game; emphasize the student's attention and perception for constructing mathematical concepts. A preliminary outcome identifies numerical relationships and counting, as a field of opportunity to increase math skills associated with number sense.

Keywords: Number sense, serious game, artifact

Introduction

In early years at school is perceived the difficulty of students to build mathematical concepts and it is reflected in numeric skills. Different components of cognitive processes have been associated to a poor performance on that field. The aim of research is to identify new standards that foster cognitive processes of higher psychological functions of attention and perception, as a strategy to develop number sense in the third graders. To achieve this goal, we propose designing a serious game as psychological tool, that enables students relate the abstract operations of numerical entities with concrete objects, and navigate through different training paths, according student' cognitive level. It is hoped, from these mathematical learning experiences, that students develop their number sense.

1. Literature Review

1.1 Number Sense

The study of number sense is documented in several studies, which analyze the concepts and components of the skill needed to build mathematical concepts [1, 2, 3, 4, 5, 6]. Malofeeva et al. [3], establish that number sense is the ability to understand the meaning of numbers, relations between them and the ability to perform mental calculation, numerical estimation, and quantitative reasoning; furthermore, includes conceptual understanding of numbers, knowledge of place value, number relationships, counting and sequencing, understanding and meaning of addition, subtraction, multiplication and division.

1.2 Serious Games and Mathematics

Serious games (SGs), according Ling, Xiaoqiang and Dandan [7], are a category of video and computer games to train or educate users while giving them an enjoyable experience. SGs provides a simulated environment with experiential learning activities [8]. SGs can be

used as tools in schools to improve students' efficiency to learn [9], moreover, emphasize the student' attention and perception, to overcome the limits of their sensory field by doing a voluntary effort. The imaginary context of the game teaches the child to guide their conduct by the perception, situations that affect him, and the meaning of the situation. As result children learn to do, consciously, an activity, and acquire a development. Researches evidence the potential positive impacts of using games and serious games, with respect to learning, skills enhancement [10], therefore the advantages of use them in mathematics [11].

1.3 Artifacts as Psychological Tools

The Cultural-Historical approach of mediations, centered on the use of cultural artifacts, is widely used in mathematics learning [12, 13, 14, 15]. According to Vygotsky [12], the artifacts are cultural mediations, transformed as psychological tools, by the use of signs as language. The use of psychological tools promotes development of higher psychological processes as perception and attention, which are the source of a specifically human behavior [12, 16], necessaries to construct mathematical concepts [17]. The use of information technologies allow to exploit the potential of artifacts [14]. With SGs, the child could perceive its environment, and language help him to perceive objects immersed in it and the relationships between them. Through SGs and language, the child reorganizes its spatial and visual field, and creates a temporary field, which is real and perceptible for him. He captures changes and reconstructs the separate activities, therefore he develops his attention. These processes are necessary to construct mathematical concepts, and enables students relate the abstract operations of numerical entities with concrete objects [17].

2. Problem Statement

By the logical character and level of abstraction necessary to construct mathematical concepts, the students demonstrate cognitive difficulties, which are perceived by indicators of educative achievement [18, 19, 20]. In México, the problem is accentuated in third graders, whom must develop mathematical skills associated with number sense. However, statistics shows a score of 419 in math, when Organisation for Economic Co-operation and Development (OECD) countries has an average of 496 [20]; 52% of students are at levels considered unsatisfactory and show difficulty identifying numerical relationships, recognition of magnitudes and simple operations with numbers [19].

3. Contribution of the Proposed Research

Identifying new benchmarks in the transformation of higher psychological processes, for develop number sense, will be the major contribution of the proposed research. The incorporation of dynamic assessment and learning gradients, into a serious game, will be the second contribution. From these approaches it is expected to contribute to developing of skills of counting and numerical relationships as components of the number sense.

4. Proposed Research Methodology

4.1 Objective

To design a serious game that develops number sense, through transforming of psychological processes of perception and attention in mathematical contexts, looking to improve the skills of counting and numerical relationships in third graders.

4.2 Research Questions

The research will address these questions: How to enhance the development of the psychological processes of perception and attention by an instrumental approach? How a serious game develops number sense skills of third graders?

4.3 Hypothesis

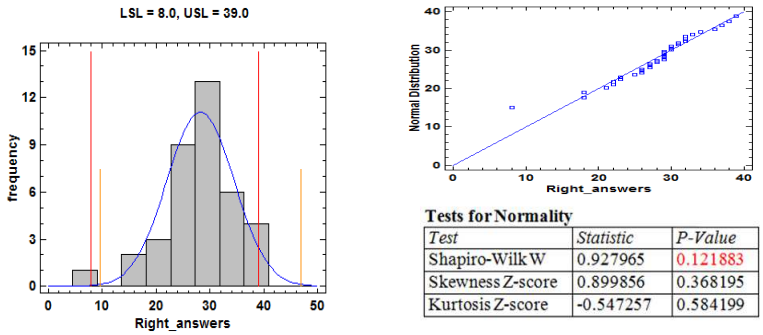
The use of serious game transforms perception and attention, and develops the skills of counting and numerical relationships of number sense, in third graders.

4.4 Research design

The research will adopt a combination of qualitative and quantitative methods to explore the development of number sense. At the first stage, the transformation of the psychological functions of perception and attention will be studied by the Genetic method of Vytgotksy [12], whose function is to study these processes in its functionality. At the second stage, two classes of third grade, will be randomly selected and assigned to the experimental and control groups. Students of both the experimental and control groups will sit for identical pre-test [21]. For six months, control group will use the SGs designed. After that, both the experimental and control groups will be subject to post-test, to measure development of the skills of counting and numerical relationships [21].

5. Preliminary Outcomes

A pilot study was conducted to identify mathematical abilities of third graders. During first part of the study, a test was designed on the basis of number sense concept, and the Mexican curriculum. After applying test, Coefficient alpha was measure (α=0.8) and the test's structure was reviewed to improve internal consistency. The figure 1 shows results of the study. In the second part of the study (See Figure 2), same test was applied to different students, and they expressed difficulty in properly resolving the items associated with numerical relationships (36%), counting (38%) and exercises for applying basic concepts of arithmetic operations (46%). These findings allow to identify areas of opportunity associated to number sense's elements. This can lead to design of strategies to exercising these specific skills, to develop number sense, looking for increase mathematics learning in third graders.



Tests for Normality

Test	*Statistic*	*P-Value*
Shapiro-Wilk W	0.927965	0.121883
Skewness Z-score	0.899856	0.368195
Kurtosis Z-score	-0.547257	0.584199

Figure 1. Analysis of internal consistency, of the number sense test.

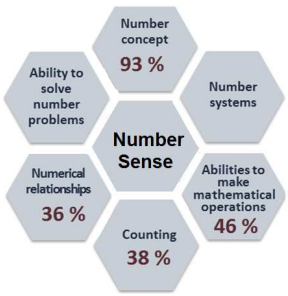


Figure 2. Results of the number sense assessment.

6. Conclusion and Future Work

Currently, we have been identifying areas of opportunity to improve mathematical skills, related with number sense. This allows designing strategies, for instance a serious game, to develop number sense. As future work of this study, the author is planning the following:

- Instructional design for SGs based on numerical relationships, counting and arithmetic operations, as categories of the number sense.
- Implementing a SGs with math problematizations, according student' cognitive level.
- Pre-test and post-test to measure skills of counting and numerical relationships.

From these processes it is expected to contribute to development of skills of counting and numerical relationships as components of the number sense of third graders.

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