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Identifying Game Variables from Students' Surveys for Prototyping Games for Learning

N. Ismail, O. Thammajinda, U. Thongpanya

Abstract**—**Games-based learning (GBL) has become increasingly important in teaching and learning. This paper explains the first two phases (analysis and design) of a GBL development project, ending up with a prototype design based on students' and teachers' perceptions. The two phases are part of a full cycle GBL project aiming to help secondary school students in Thailand in their study of Comprehensive Sex Education (CSE). In the course of the study, we invited 1,152 students to complete questionnaires and interviewed 12 secondary school teachers in focus groups. This paper found that GBL can serve students in their learning about CSE, enabling them to gain understanding of their sexuality, develop skills, including critical thinking skills and interact with others (peers, teachers, etc.) in a safe environment. The objectives of this paper are to outline the development of GBL variables from the research question(s) into the developers' flow chart, to be responsive to the GBL beneficiaries' preferences and expectations, and to help in answering the research questions. This paper details the steps applied to generate GBL variables that can feed into a game flow chart to develop a GBL prototype. In our approach, we detailed two models: (1) Game Elements Model (GEM) and (2) Game Object Model (GOM). There are three outcomes of this research – first, to achieve the objectives and benefits of GBL in learning, game design has to start with the research question(s) and the challenges to be resolved as research outcomes. Second, aligning the educational aims with engaging GBL end users (students) within the data collection phase to inform the game prototype with the game variables is essential to address the answer/solution to the research question(s). Third, for efficient GBL to bridge the gap between pedagogy and technology and in order to answer the research questions via technology (i.e. GBL) and to minimise the isolation between the pedagogists "P" and technologist "T", several meetings and discussions need to take place within the team.

Keywords**—**Games-based learning, design, engagement, pedagogy, preferences, prototype, variables.

I. Introduction

IN Thailand, the CSE syllabus discusses sex-related topics such as dating, pregnancy, relationships and the social impact of these relationships on family planning. Also, the syllabus extends to cover related health issues and sexually transmitted diseases (STD). The government considers the importance of sex education and its influence on youth health; so, research, seminars, workshops and authority opinions have provided information that enriches our knowledge about sex-related topics and youth practices in Thailand [7]. However, extended new knowledge and further research to improve understanding and further develop of CSE in Thailand are needed. Digital games are user-centred; they can promote challenges, co-operation, engagement and the development of problem-solving strategies. Web 2.0 is a technology that describes a second generation of the World Wide Web that focuses on the ability for web users to collaborate and share information. In learning, Web 2.0 has paved the way for an informal education approach through collaboration and by placing students at the centre of their learning to construct their knowledge through sharing and exchanging [14]. GBL is an innovative educational paradigm that utilises games as a mode for transferring learning [29]. Educational games are considered to have the potential to deeply and engage learners with any topic, allowing active participation in the learning process [35]. Reference [6] stated that educational games, like any educational tool, must be able to show that necessary learning has occurred. It is therefore crucial to systematically evaluate them to affirm their impact [20]. According to [10], GBL has divers characteristics (i.e. quiz, role play, adventure, etc.). From an educational view, there is a diverse range of educational goals (i.e. engagement, problem solving, etc.). Consequently, [11] highlights the concern of the difficulty of evaluating the GBL module referring to this diversity of characteristics and features. Reference [13] explains that constructing a GBL design framework can facilitate its evaluation. Therefore, in this study, we address different frameworks that we edited GEM and GOM that can be used as a method for evaluating GBL, which we consider as a contribution of this study to help in GBL design and evaluation. Reference [13] has identified that games need to:

- Encourage active learning;
- Challenge the learner to take risks, students are confident that they can do no harm, are not embarrassed by their early failures and are positive in their evaluation of their learning.
- Encourage collaboration in order to solve a problem;
- Encourage intrinsic learning because, compared to traditional methods, games are more engaging and more interesting;
- Use fun and challenge to make the learning experience more memorable; and,
- -Let the learner learn with sound, interaction, images and text; not just words.

In summary, the major components can be identified as competition, engagement and immediate rewards. In a

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comparison between traditional learning and games-based e-learning, it was found that GBL has higher merits in terms of students' engagement, knowledge transfer to real-world environments, immediate feedback in response to mistakes and a learning pace tailored to individuals.

This paper starts by explaining the study's background and research problem. Data collection tools tailored in order to respond to these research questions are then outlined. We subsequently detailed the steps undertaken to specify the game variables to design the game prototype: (1) GEM and (2) GOM. Finally, we illustrated screenshots of the game prototype. The following diagram summarises the steps followed in this paper (see Fig. 1).

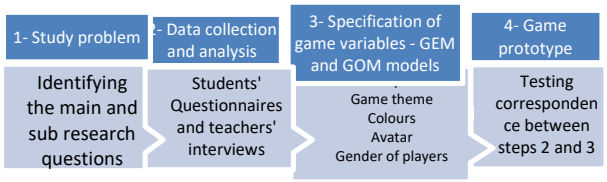

Fig. 1 Research design steps to develop game prototype

II. Study Problem

In Thailand, the teenage pregnancy rate is the highest in south-east Asia. Infection rates for STD are rising, while the age of first sexual intercourse has decreased [23]. In terms of health and social concerns, in 2014, 316 adolescent mothers (aged 10–19 years) gave birth every day. Whilst this was a decrease from the 362 deliveries a day in 2011, the repeat birth rate increased from 11.3% in 2010 to 12.8% in 2014 [7]. The main consequences of adolescent pregnancy and parenthood are economic and social in nature, as adolescent parents face increased barriers to educational achievement and social stigma in their public and private lives.

It is well-documented that sex education can have beneficial effects on young people's sexual behaviour [30]. However, many institutions teach about sexuality from a point of view that emphasises the negative consequences of sexual intercourse, and often do not explore the possibilities of CSE, such as offering a space for discussions and debates or promoting students' analytic and critical thinking skills related to sexuality. The Thai Ministry of Public Health and non-governmental organisations such as the PATH Thailand Foundation (previously Path2Health) are contributing to projects that aim to improve teaching about sexuality. The final recommendations of the TeenPATH project (which involved 12 secondary schools and students from Grade 7 to Grade 12) are that CSE needs to be designed and delivered through activity-based instruction methods and exchanges of opinions between students using activities that stimulate critical thinking and a dialogic approach to the topic.

The findings of a study by [30] indicate that many students lack understanding and awareness of contraception as well as necessary communication and negotiation skills in their sexual lives. In addition, the study finds a lack of classroom engagement and interaction in the teaching methods and a need to provide children and young people with critical thinking skills and to enable them to reconsider their negative sexual attitudes. An important recommendation is to create online learning materials such as games to provide alternative channels for learning about sexuality and related topics, both for students and for teacher training. Such online content can not only provide accurate and up-to-date information about sexuality but also help students change their attitudes to reduce misconceptions about sex and increase awareness of health and well-being related to their sexual lives. It has been suggested [25] that computer games can incorporate as many as 36 important learning principles. For example, they put learners in the role of decision-maker, pushing them through ever harder challenges, engaging the player in experimenting with different ways of learning and thinking [13]. Crucially for learning, computer games can provide instant feedback [25].

Researchers have therefore worked on developing a GBL module that is designed to balance the subject matter with gameplay and the ability of the player to retain and apply the subject matter to the real world. The main purpose of the game is to stimulate students' critical thinking and problem-solving and encourage a social dialogic approach. The researchers working on this project come from interdisciplinary backgrounds, including education, computer programming and health care. Common characteristics of the games are as follows: all require players, set out objectives, lay out procedures, state rules, provide resources, thrive on conflict, enforce boundaries and resolve outcomes. Researchers in this study are also from interdisciplinary backgrounds, including education, technology-enhanced learning, and computer science and development.

III. Theoretical Framework

References [13], [26] advise that GBL involves processes that differ to such an extent from learning in other forms (such as face-to-face classroom instruction) that they could be described as unique models or theories of learning. Squire's review of computer game research suggests several theoretical frameworks that could provide a social and cultural insight into learning and games, activity theory is one of these frameworks [27]. Activity-based theory is a multidisciplinary paradigm for comprehending the relationship between action and cognition, built upon cultural–historical activity [34]. It starts from the assumption that an activity is composed of a 'subject' and 'object' mediated by a 'tool, where human activity is always mediated by a tool. According to [24], the basic unit of analysis in activity theory includes; subject, object and tool (see Fig. 2). The subject (person or group) is motivated by an object or 'objective' to engage in some activity. This process involves mediation through certain tools, such as technologies, texts, cognitive schema, cultural symbols and modes of organising. Within this system, the person acting is referred to as the subject, their intention (or objective) is referred to as the object, and the mediating artefact is referred to as a tool. In our study, secondary school students (year 7) are the subject, the intention comprises

targeting CSE and the improvement of their understanding of developing skills within the syllabus, and the mediated tool is GBL (see Fig. 2 below).

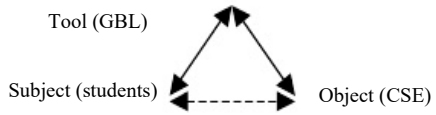

Fig. 1 Edited activity system (initial triad) [24]

As [27] has described, activity theory emerged from Vygotsky's psychological research into learning (and specifically from his discussion of the mediating role of artefacts in cognition). Activity theory is suitably situated in learning, with individual actions informed by a wider cultural and historical context (such as the selected discipline and topics in which tools are produced and individuals' actions are legitimated, how the flow is organised, and so on). For example, in the game used in this study, the selected questions in each challenge are derived from the CSE syllabus and the escalation of the problem-solving is structured using the study objectives.

Stemming from Vyotsky's socio-constructivism theory and the notion that learning is a social mediated environment, [17], [27] expanded the model of activity theory and added another layer to the system to represent the community within which the activity takes place. This is one of the bases of developing this game, as development of negotiations and dialogic approach with secondary school students is one of the main objectives of this study. The community here therefore includes the Community of Practice (CoP), a group of people who share a craft or a profession [31], students, teachers and families. Second, the rules that hold within that community represent the way in which the game is developed. For example, the compliance of the game content with the study syllabus has to be organised in order to achieve its objectives. In this scenario, the objectives are educational (such as academic attainment). This expanded system is illustrated in Fig. 3.

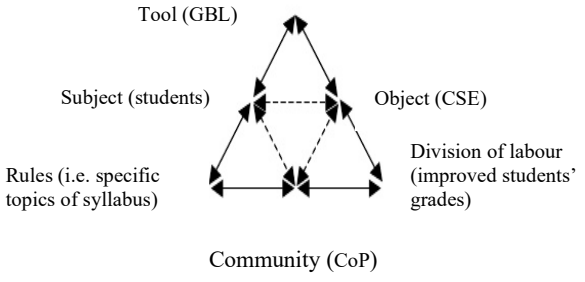

Fig. 2 Edited activity system (extended representation) [24]

Notably, there are multiple iterations of the game while playing it. Within these iterations, some relationships between elements of the system are implied – so, for example, the CoP is related to the students, only through the studied syllabus (CSE), and likewise is related to the CSE only through its division of labour, which is the achievement of the educational objectives.

There are two main issues with using activity theory as a theoretical framework for this study. The first is with the students and the second is with researchers.

First, according to [24], activity theoretic analysis does not directly suggest what to do to remedy the situation when describing problems. Solutions must be inferred from knowledge of the cultural–historical context. However, in the context of analysing learning, such solutions may well be left to the subject to develop. The confronted problem can therefore form the basis of discussions between students and teachers and among students themselves, and can thus represent a further point to read about and debate. Stimulating debate and discussion between students and teachers is thus one of the main objectives in developing GBL in this study.

Second, when using activity theory, as GBL focuses on descriptions of children's learning and play, according to [12], activity theory develops the idea of internal contradictions within the system (game platform) while playing the game. 'Contradictions' are inconsistencies in the system. For example, because of limited broadband, disagreement can occur between those who are involved in the activity. Also, for group play mode, confusion over who is responsible for a particular task or purpose (an object) can arise. Consequently, GBL can be incoherent or impractical for some players. Such contradictions suggest that the system is somehow inadequate and needs to be improved through some kind of transformation or development. This latest feedback is encouraging researchers and game developers to improve the game and identify areas of improvement.

IV. Data Collection

This research project is carried out through a two-phase cyclical procedure (Fig. 1). The outcome of cycle 1 is the game prototype which is the focus of this paper. Students will be given the prototype of GBL twice while learning about CSE. Prior to the dissemination of the prototype, team members in the research will have an induction session for the subject teachers/students to give all the information about the prototype that students might need while interacting with the application. The game has two cycles: cycle 1 (which is the focus of this paper) and cycle 2, which will take place after the end of round 2 data collection, and ends with the students' and teachers' feedback after trying the game (see Fig. 4).

Study Design

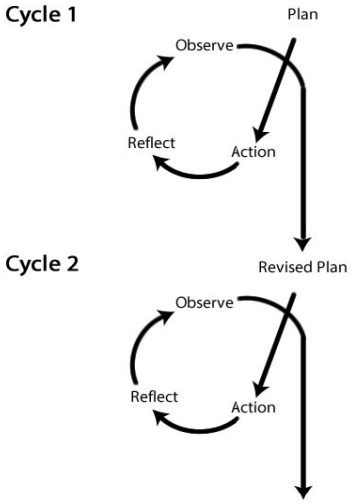

Fig. 3 Project two-phase cyclical procedure

Action-Based Research

An action-based approach was used in our research as a reflective process of progressive problem-solving led by individuals (teachers and students) working with others (researchers and developers) in teams or as part of a CoP to improve the way they address issues and solve problems. Action-based research emerged as a distinctive mode of social science theory and practice in the re-building era after World War II [18] and has continued to be relevant to bringing change by studying this change as it unfolds in a process of co-creation with research participants. It can be viewed as 'practical science' with a distinctive iterative cycle of problem identification, diagnosis, intervention, evaluation and problem re-statement [8], while offering the potential for a citizen participation policy in the construction of knowledge [28]. The reason for selecting this method of learning from experience is derived from Lewin's model of informal learning, which lies at the heart of our contemporary understanding of the action research method directed toward the solving of social problems [19]. The output of action-based research is 'actionable knowledge'–to the practitioner and academic communities [9].

Data Collection Process

The data collection process was initiated by obtaining the consent of the Institutional Review Board (IRB), where the methods proposed for this research were reviewed to ensure their ethical nature. The research team subsequently prepared a list of secondary schools in Chiang Mai and began to contact the head teachers of these schools by email and phone (if available) to select six secondary schools in the region to participate in the project. Prior to the research team's visit to the schools, teachers who showed an interest in the project were sent consent forms for themselves and for the students to read, sign and send back to the researchers to confirm that they were happy to take part in the project. The outcome of this final step of preparations was that we were able to initiate contact with CSE teachers in each school (PE and science) who showed an interest in the project and arrange a convenient time for them to be interviewed and for their students to answer the initial cycle 1 questionnaire. For this study, we invited 1,500 students to complete the questionnaire, with 1,152 responding (a 74% response rate). To supplement the students' data with rich qualitative information, two CSE teachers from each school were invited to participate in focus groups to add an additional layer of insight to the results. In total, 12 teachers accepted the invitation to take part in two focus groups (FG1 and FG2), each with six teachers. The time allocated for each focus group was approximately the same, between 60 and 75 minutes for each group.

The reason for including science teachers in the research is the overlap in topics between CSE and science subjects according to the CSE syllabus. As for including teachers at all, although this study focuses on the students themselves, [30] made clear that it was important to include the teachers' perspectives. From our viewpoint, understanding the teachers' experiences and their knowledge about their students, together with their understanding of the CSE content, could effectively inform the research and enable appreciation of the students' learning needs and perspectives. We therefore decided to include 12 CSE teachers in focus groups in our study.

Data Collection Tools (Questionnaire and Interview Questions)

The research questions aim to develop an online game focusing on enhancing critical thinking and problem-solving and encouraging a dialogic approach. In round 1 of the data collection, we divided the questions in the questionnaires into four sections to identify the students' individual needs and preferences when playing the game and in learning:

(1) Individual preferences where students have been asked about their frequency of playing games, preferred platforms (i.e. mobile) and game types (i.e. adventure); (2) Educational preferences – this section posed questions focused on games for the purpose of learning (i.e. preference for group play mode of GBL in relation to CSE). In this section, we focused on game elements that can demonstrate the three main aspects that we intend to develop and encourage students towards them. These aspects are critical thinking, problem-solving and social discussion; (3) Content (CSE) – the objective of this section is to identify time allocated to students to study CSE and their education need(s) in this subject.

V. Game Variables/Attributes

A tension exists between pedagogy and technology, which is created by a lack of ability to use constructivist pedagogies to teach online and a lack of technological capabilities to implement pedagogies that match the learning objectives [33]. The consequences of this tension include the fact that many tutors do not use technology in their teaching effectively [22]. Knowledge construction and meaning-making within a community of learners can help to integrate pedagogy and technology and bridge the gap between them [21]. For learners, pressing a button (stimulus) would make sense for them to interact and respond [21]. In this phase of the study,

the discussion is between all project researchers to select the appropriate pedagogy to fit their technology and to differentiate between game developers who have created their models of game design with particular attributes (i.e. game avatars) and other researchers who have created their models with game elements (i.e. game learning goals). More importantly, it is aimed to combine both models to end up with a game prototype that can bridge the aforementioned gap between pedagogy and technology. The following sections outline both models.

Game developers need to know variables, which are the stored information (text and background) to run the game, allowing the player to control some aspects of the game (such as scoring points and selected avatar). For example, for the study context, when students select the wrong choice, they will lose one of the trials. Also, developers need to know the preferred avatar choices of the prospective game participants. References [15] and [16] listed examples of the variables that developers need to know about for the game design plan (see Fig. 5 below). Notably, the terms 'variables' and 'attributes' have been used in the study interchangeably.

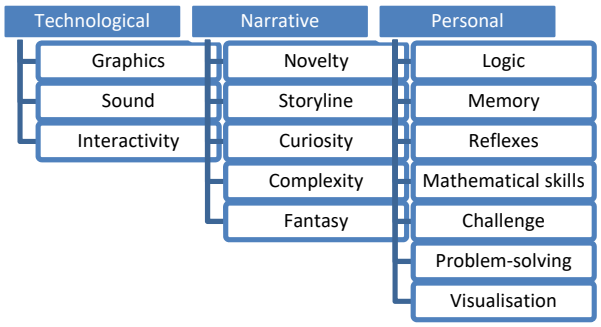

Fig. 4 GBL attributes [15], [16]

References [15], [16] incorporated classroom practices in the game prototype. Some of the practices are described below:

- Practice and drill: The participant is allowed to attempt practice tests related to the syllabus.
- Feedback: Participants are given immediate feedback, which is always positive even in the case of an incorrect answer. This can increase the motivation factor and bring a positive feeling, which is another practice [15].
- Incremental learning: A participant can learn about selected topics in levels (from the easier to the more challenging) step by step, moving from one item to another in a sequence. In our design, students are unable to move to game 2 before successfully completing game 1.

At this stage of the project, the game has not been tested by students or teachers. However, as researchers, we checked the game from two perspectives, educationally and technically using computing expertise. *Educationally*, the researchers analysed the collected data and placed the emergent themes in a model to feed into the developers' game flow chart. *Technically*, the primary function of game testing is the discovery and documentation of software defects (i.e. bugs), meta data analysis and running evaluation [4]. Other aspects that game developers consider include graphic design, user-friendly interfaces and the functionality of all buttons, menus and navigation panels.

The following section therefore considered two models – the GEM as step 1, undertaken by researchers using the results of data analysis. We edited the elements that make computer games engaging, adapted by [3] from [25] (see Table II). We then edited elements that make up computer games [32]. We called the resulting model the GEM (see Fig. 6).

Game Element Model (GEM)

In this section, we incorporated elements of motivation [5] and engagement by [3] in the game design. Reference [5] highlights features that contribute to motivation and is reproduced in accordance with aspects of games suitable for incorporation into educational software (see Table I).

TABLE I
FEATURES THAT CONTRIBUTE TO MOTIVATION IN PLAYING GAMES [5]

What indicates motivation?	Independent work Self-directed problem posing Persistence Pleasure in learning
What generates motivation?	Active participation Intrinsic and prompt feedback Challenging but achievable goals A mix of uncertainty and open-endedness
What can motivation collaborative interaction usefully support?	Peer scaffolding of learning Creative competition or cooperation Equal opportunities
What does a version of reality rely on?	Sustained motivation relevance to the user Recognisable and desirable roles for players
What are the problems with motivation?	Motivation may lead to obsession Motivation may cause transfer of fantasy into reality Motivation may induce egotism

For [5], GBL should incorporate or embody a sound educational philosophy and should have clearly stated educational objectives and content.

Reference [32] focused on different characteristics and elements of games to which game developers must pay attention when distributing games and simulations (e.g.

computer, mobile, 3D). These technical features can be challenges associated with the game design. They therefore designed a model (see Fig. 6) that can guide designers in developing a game. We edited this model and customised it using the collected data. Their model includes the same main elements that we include: game type, platform, technical characteristics, learning content and purpose. We also customised the sub-elements using the collected data and emergent themes.

TABLE II
THE ELEMENTS THAT MAKE COMPUTER GAMES ENGAGING, ADAPTED BY [3] FROM [25]

Characteristics of the computer game	Aspects of game players' engagement
Fun	Enjoyment and pleasure
Play	Intense and passionate involvement
Rules	Structure
Goals	Motivation
Interaction	Doing (i.e. the activity)
Outcomes and feedback	Learning
Adaptiveness	Flow
Winning	Ego gratification
Conflict/competition/challenge and opposition	Adrenaline
Problem-solving	Sparks of creativity
Interaction	Social groups
Representation and a story	Emotion

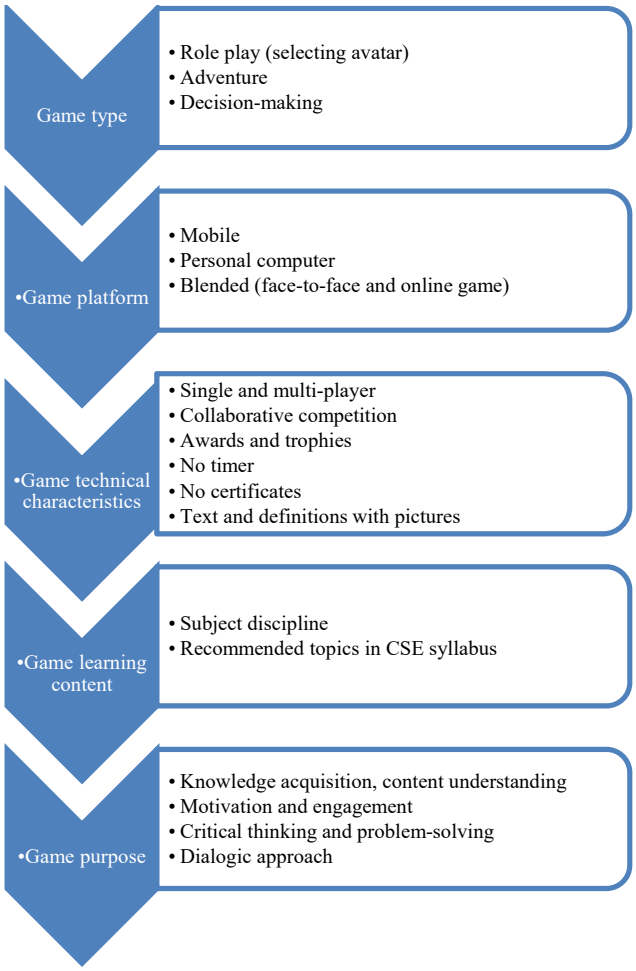

Fig. 5 Game Elements Model (GEM) – Edited elements that make up computer games [32]

Game Object Model (GOM)

To bridge the gap between education – the research questions and collected data – and technology – the game flow chart – we used GOM, which marries educational theory and game design [1]. This model is developed to better understand the relationships between *story*, *play* and *learning*. GOM combined the three to achieve the educational aims and answer the research problem, ultimately involving the game flow chart developing the game prototype. According to [22], bridging the gap between pedagogy (educational aims) and technology (i.e. online games) is pushing both beyond their comfort zones. In GBL, [2] explain the tension further as the dialectic between pedagogical dimensions and game elements and including components (represented by rounded squares) that promote educational objectives (abstract interfaces (black circles ●)) and the realisation of such objectives (concrete interfaces (white circles○)) contained within different spaces. *Components* accommodate abstract or concrete interfaces (represented by circles: abstract, black; concrete, white). Components can either be self-supporting or part of other components, in which case they inherit all the parent interfaces. *Inner components* contain concrete interfaces (○), while the outer ones are more abstract (●). Interfaces are also listed from the most to least important.

Fig. 7 shows that that the game design has four outcomes, which are (play, learn, challenge, and engagement). Within the main game space, "Knowledge Space" exists, where we created the three main parts of the GBL module that focus on critical thinking, problem solving and collaborative discussions, which are the study problems as explained in the introduction. The inner model "Visualisation Space" component includes two domain spaces; "Elements Space" such as awards, avatars and animation, and "Problem Space", as this exercise is educational, we focus on the pedagogical objectives that are behind the creation of this game. In the "Problem Space", we address; (1) experiential learning to link between the game elements and daily life practices. (2) Understanding of concepts and definitions supported by diagrams, according to the results from collected data, is essential. (3) Social elements in the game that stimulate communication skills, such as dialogue and group play. It is important to note that, there are some repeated elements in

more than one space. For example, avatar has been repeated twice; once, as a visual actor in the element space, and another time it appears in the problem space as a tool to support social communication. While the GEM and GOM models presented here provide a framework for the conceptualisation, design and development of educational games, story development and play are not clearly described. The next section therefore illustrates screenshots of the game prototype, including the three selected games.

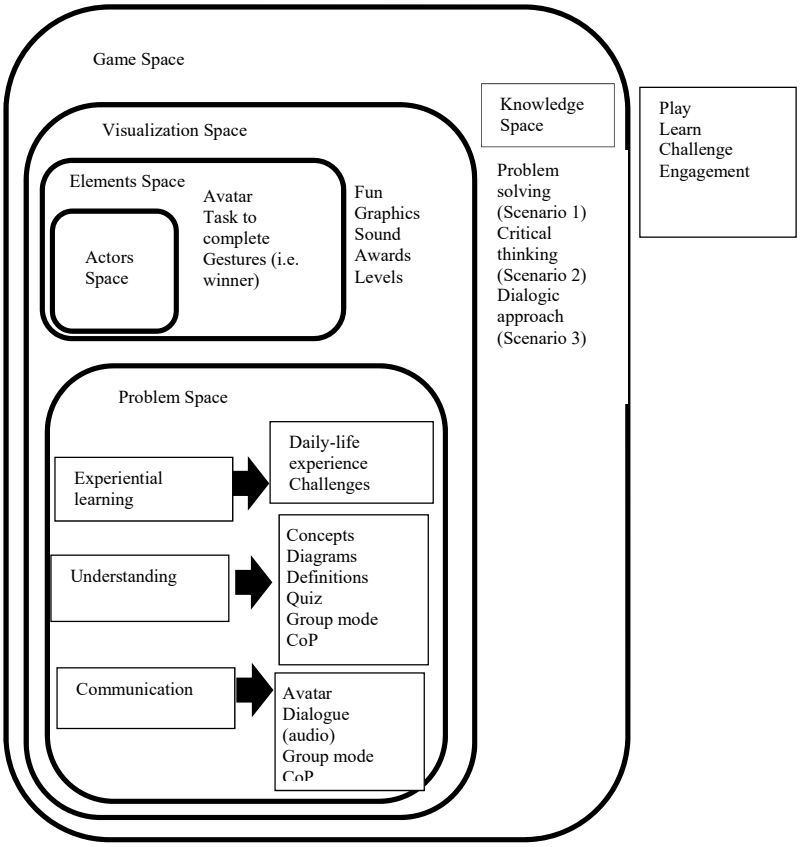

Fig. 7 Edited game object model (GOM) [2]

VI. Development of Game Prototype

Based on the selection of CSE tutors from the CSE syllabus, the game focuses on three main topics. Each topic focuses on one of the three main skills that we consider in this project (see Table II). It is worth noting that the game language is the students' and teachers' native spoken Thai.

TABLE III
CSE Topics and Associated Skills

Game number	CSE topic	Development of skills
1	Sexual harassment	Critical thinking
2	Sexual abuse	Decision-making
3	Social discussion	Dialogic approach

Fig. 8 Game home screen

Part 1 – Making Robot (Topic: Sexual Harassment)

In this game scenario, each player needs to construct a robot out of eight different parts.

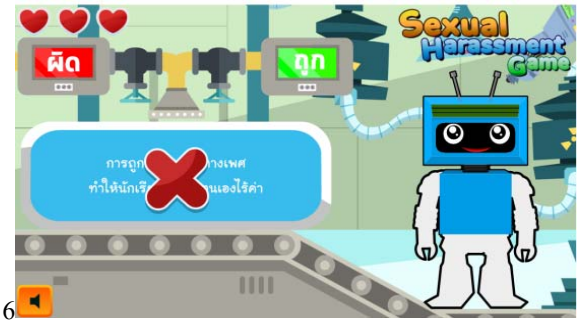

Fig. 9 Game 1 – Making Robot (topic: sexual harassment)

Game Instructions

To collect the parts, a statement which may be right or wrong will be flagged and the student needs to think and decide whether this statement is 'correct' or 'wrong'. If the statement selected by the student is 'correct', it will build one part of the robot. If it is 'wrong', the student will lose one of the five red hearts above, and no parts will be added to the robot shape. The student has a maximum of five 'wrong' selections, and then the game will be over. The selected statements illustrate different real-life scenarios related to topics within the Grade 7 CSE syllabus. All statements challenge the student to think critically before making a decision. Some examples of statements are as follows:

Scenario: I am shy to report sexual harassment.

Option 1: I will keep silent, it may not happen again.

Option 2: Bad people get an emotional payoff from seeing others afraid and upset.

Students will complete the game if they build the whole robot without exceeding the five wrong answers.

Part 2 – Perfect Pair (Topic: Sexual Abuse)

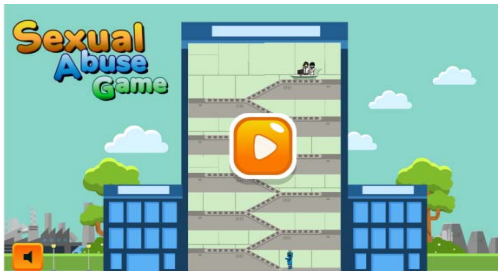

Fig. 10 Game 2 – Perfect Pair (topic: sexual abuse)

In contrast to the Making Robot game, the Perfect Pair game has awards and bonuses as well as levels, and, most importantly, the teacher allows it to be played in groups (as a group competition game). Each player tries to climb to the top of the building and conquer each level by answering one question. Other obstacles include bombs to penalise the players if they answer the questions wrongly. The winner is the one who reaches the top of the building first.

Game Instructions

- In floor 1, players select one question by pressing one of the boxes:
- If the answer is right, the player goes to the second level and gets a trophy.
- If the answer is wrong, the player goes down one floor, or uses one of the awarded trophies to avoid going down.
- There is a bonus level, represented by the heart symbol – the right answer will boost a player two levels up.
- There is a bomb level – here, the wrong answer takes players two levels down.
- The winner reaches the top level first.

Part 3 – Social Discussion

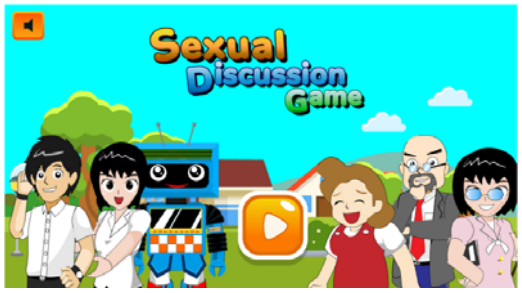

Fig. 6 Game 3 – Social Discussion (topic: dialogic approach)

Tutors agreed to select six scenarios related to the Grade 7 CSE syllabus. In each scenario, players are prompted by five avatars – father, mother, brother or sister, friend and teacher. Scenarios and avatar replies are pre-recorded audio.

Game Instructions

The player needs to choose one avatar to discuss the topic with.

The avatar gives advice.

The student selects to accept or reject the avatar's advice.

The student can write down his/her personal view about the situation including the scenario and the avatar's opinion.

Example of a scenario: Title "Leave Me Alone"

There is a new boy in your class. You think that he is really cute, and you make an effort to get to know him. After a while you realise that you do not have much in common. Now, however, he keeps asking you out. You say 'no', but he keeps asking and sometimes he gets angry with you. You feel kind of guilty because you made the first attempt at getting to know him better, but now his attitudes and behaviour are making you uncomfortable. What could you do to get him to leave you alone? Each avatar will give feedback and the student will select as explained above.

VII. Conclusion

Although commercial games have become a billion-dollar entertainment industry with new ideas continuously emerging about how they can be incorporated into learning, a conflict remains about how to merge pedagogy and game design technology effectively. Opponents of GBL advocate that it is not dependent on fancy 3D graphics and various elements of graphics. If so, the actual role of GBL in fostering the learning process is likely to be daunting. GBL needs to be a tool to engage students in the learning process and to enable them to develop skills such as critical thinking, self-discovery and problem-solving. The proposed solution is engaging GBL

beneficiaries within the data collection phase (interviews and questionnaires) to inform the GBL prototype design.

In conclusion, there is a purpose behind using GBL within teaching. The motivation for this could involve helping students to learn about certain topics, engaging and motivating them, helping them to get their heads around topics they struggle to grasp, or other reasons. For effective GBL that can achieve its purpose, GBL needs to be considered as a holistic process that all stakeholders of this game need to consider. Although students are considered the first beneficiaries, other beneficiaries need to support it, including teachers and game developers. Game developers who design GBL need to be aware of the game purpose and reasoning behind its use. Isolating these beneficiaries will be a hindrance for GBL and achievement of its purpose.

Another lesson learned from this study was that following the steps outlined, starting from the research questions and ending with the game prototype, helped the team to overcome the gap between pedagogy and technology by identifying the disparity between the two and reducing the gap. In the third step we edited two models, (1) the GEM, articulated by researchers for researchers and (2) the GOM, which needs to be designed and filled by game developers. We tried to bridge the gap between the two models. At this point, the group of researchers in education and computing had several meetings to discuss and reflect in order to associate between the two (game design and game flow chart) and, at the end of the meetings, both needed to answer the research question. We therefore recommend that (1) to bridge the gap between pedagogy and technology, (2) to answer the research questions via technology (i.e. GBL) and (3) to minimise the isolation between pedologists 'P' and technologist 'T', several meetings and discussions between team members need to take place. Each party, 'P' and 'T' may have separate ideologies and frameworks. However, both have the same research problems and need to solve these problems. Both frameworks therefore need to be linked, associated and filled consistently. For further work, we recommend that the two models discussed, the GEM and GOM, can be used as a diagnostic tool to identify lecturers' positions in relation to their pedagogy and use of technology, and as a developmental tool to show how they can be used towards a more integrated approach in online teaching, moving beyond their comfort zone. It must be acknowledged that the approach outlined in this paper represents a new development in examining this important area and, as such, needs to be further explored and examined.

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