Facilitating 21st Century Skills and Increasing Active Learning Environment of Students by Games and Simulations

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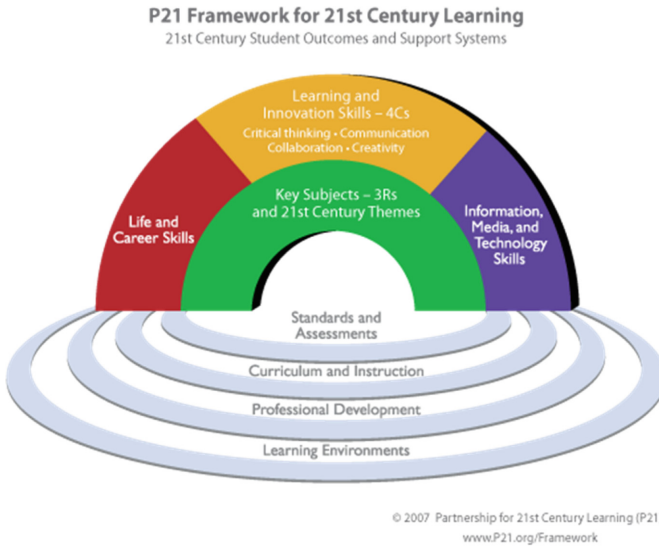{Nophawan-y,urairat-y}@thonburi-u.ac.th

Abstract. This paper presents teachers training to design, develop, and apply educational games and simulations in their class. The development of training teachers to design, develop, and apply educational games and simulations in their class in the era of 21st century and educational reform during 2006–2016 are discussed. Pedagogical knowledge and application as well as techniques of design, development, and application of educational games are offered. Benefit of games and simulations from teachers' products is revealed. The development and application of educational games and simulations may be one of efficient tools in the 21st Century where teachers need to integrate language, culture, innovation and information technology for their teaching.

1 Introduction

In the era of 21st century, globally, many young learners have difficulties in using their high order thinking skills, collaborating with others, or creating new ideas or products. These learners need to be trained in such skills, so they can survive and live happily. This calls for educational reform, and learning and teaching methods and techniques need to be change in accordance with the complexity of society, economics, and technology. A new approach such as active learning is introduced by educators to increase quality of learners. In this approach, one technique to enhance active learning is to employ games and simulations.

21st Century Skills
Students need to be prepared very well for living in the era of 21st century. Students must be equipped with three core skills, including learning and innovation skills, information, media and technology skills, and life and career skills in order to succeed in their work, life, and citizenship [1]. See Fig. 1. These skills need to be integrated across a curriculum and instructions through standards such as ASEAN University Network-Quality Assurance (AUN-QA) and assessments such as the Common European Framework of Reference for Languages (CEF or CEFR).

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However, mostly, the current curriculums are not designed to produce students for embedding such 21st century skills in tomorrow's world [2]. This is because Internet and computer technology are under constant development. Charles Fadel, from Global Lead, Education Cisco Systems, Inc [3] stated that "The Internet is changing the way we work, live, play, and learn" (p. 21). All students must be trained to use high order thinking skills such as critical thinking and problem solving skills as well as life and career skills. At the same time, students must be equipped with innovation and creativity skills, information, media and technology skills [3]. See Table 1.

Table 1. What's new about 21st century skills?

New understanding of coverage	New areas of emphasis
Critical thinking and problem solving skills for EVERYONE	Innovation and creativity skills
Life and career skills for EVERYONE	Information, media and technology skills

Presently, learning and innovation skills include 7C and 3R. See Table 2.

What approach and teaching techniques should we use to build up those various skills for our students? How will we train them? We chose active learning and games and simulations.

Active Learning
Whenever experiences stimulate *mental activities that lead to meaningful learning,* this is *active learning* [5]."Active learning involves providing opportunities for students to

Table 2. 7C and 3R in learning and innovation skills

7C	3 R
• Critical Thinking & Problem Solving	• Reflectiveness
• Communication	• Resilience
• Collaboration	• Risk Taking
• Creativity & Innovation	
• Curiosity & Inquiry	
• Cultural Understanding	
• Care for our self, others, and the planet	

Source: [4] http://www.banb7.sa.edu.au/docs/capabilities_dispositions.pdf

meaningfully talk and listen, write, read, and reflect on the content, ideas, issues, and concerns of an academic subject" [6] (p. 6). Active learning characterizes as follows: Students are involved in more than listening. Less emphasis is placed on transmitting information and more on extending students' skills and ideas. Students are involved in higher-order thinking (analysis, synthesis, and evaluation). Students are engaged in activities (e.g., reading, discussion, and writing). Greater emphasis is placed on students' exploration of their own attitudes, values, and prior experiences [7].

Techniques of applying active learning to class included active listening, active writing, visual-based active learning, brainstorming, collaborative learning, peer teaching, problem-based learning, case studies, class discussions, questioning sessions, role playing, drama, and simulations [8].

Games and Simulations

Kapp and O'Driscoll [9] *state that games and simulations are very useful for learning.* Students collaborate, share their vision, work together to achieve a common goal, have fun and excitement, and put high levels of energy when they play games *and simulations* with their friends. Computer games especially online games enhance the cognitive advantages of learning because of repetition. Students as players play games again and again when games are over and over for getting a higher score, to beat a colleague, or to reach the next higher level. This motivates players to play more and more. Games also provide a goal and an immediate feedback for players, so they have direction and learn while they play games. In *simulations, students have chances to act as in a real situation, so their* cognitive elements are transferable.

Classically, simulation games include 6 elements [10]. *Roles*: What roles are involved in situations? What is the status? How are persons in each role affected by the problem situation? *Goals*: What are the goals of individuals and groups in the situation? Goals in simulation games which involve conflict or problem solving should not be the same for every group. *Alternatives*: What alternatives do individuals or groups have in trying to achieve their goals? Do they make decisions and use high order thinking skills? *"Chance" element:* Do students as players can anticipate in some situations and cannot in others? *Focus on interaction*: Do students have interaction within or between their groups while they are playing games in order to achieve the goals? There is no need to have "winner" or "loser" in simulation games when games

are ended. Finally, *debriefing*: Do students talk about and examine what happen during the games including feeling, actions, and reactions? Do students demonstrate creativity and innovation of products or learning after playing games?

To conclude, educational games and simulations or simulation games need to be designed and developed based on both global and local environment. Students actively learn through games and simulations, and teachers should design their simulation games which include roles, goals, alternatives, "chance" element, focus on interaction, and debriefing elements.

2 How We Train Our Students

In this section, we shared our experiences of training our student teachers to design and develop their games and simulations.

2.1 Course and Purposes

The 93001: Language, Culture, Innovation and Information Technology in Education course is offered for student teachers. The main purposes of the course are to train students: (1) to use both native and target languages academically and efficiently, (2) to apply teaching theories, technology, culture to create new tools and new teaching materials. We, then, discussed what strategies we should use. We decided to use games and simulations as a tool and product for this course. The reasons are the following. Kids like to play games, pupils have chances to simulate what they will do in their real life, culture can be integrated while playing games and simulations, teacher-students can design and create their games suit to their pupils and contexts in a limited of time. Moreover, teacher-students use 4 language skills because they are trained and assigned to design, develop and implement their games and simulations systematically and scientifically by using research methodology, explain and demonstrate their games and simulations in teacher-students' class before implementing in their own class. Write up their games and simulations as a paper and present in a conference.

2.2 Target Group

The target group is teacher-students who study a teacher certificate program during 2006–2015 at *Thonburi University*, Thailand. There are about 110–120 teacher-students in each year and 30 are put into classes based on their level of teaching, viz., kindergarten, primary, secondary, and vocational. Most of them are young teachers, but a few are old. All have graduate bachelor degrees, and most are subject matter experts in their fields. However, none have a professional teacher license. In this paper, this group is called students; whereas, pupils is used for a group of students who are taught by these teacher-students. I refer to the first author, and we refer to all three authors.
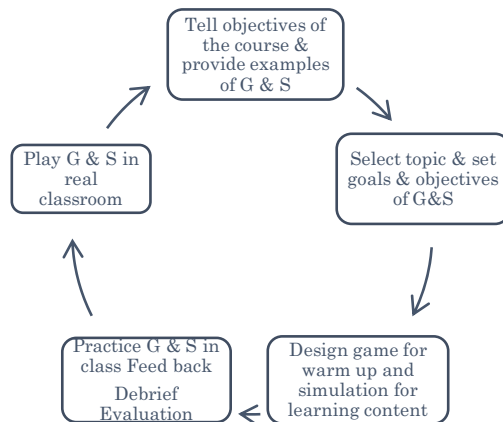
2.3   Training

We use active learning approach to train our students to design, develop, and apply educational games and simulations in their class. This is because our students have chances to use their high order thinking skills, involve in creating and using their products, and get their feedback from us and their peers after they finish playing their games and simulations.

2.3.1 Pre-training

We plan to integrate games and simulations (G & S) development into the course: *Language, Culture, Innovation, and Information Technology in Education* (2-2-5), so one hour is allocated for this activity in each week. Then in the next semester, students bring their games and simulations to experiment in their class, write their paper, and present their experiments in the ThaiSim national conference. We plan to introduce examples, the concept, process of game and simulation development, and debriefing little by little. Students have chances to think, create, design, develop, use, and evaluate their games and simulations. We play as a helper and supporter.

2.3.2 Training

The process of this training activity is shown in Fig. 1.

Fig. 1. A process of training game and simulation development for teachers

Introduction of objectives of the course and provide examples of G & S

I describe the objectives of the course and the major activity which students will have to do. Students need to learn language, culture, innovation, and information technology in education. These four elements must be integrated into their own games and simulations. They will design and develop their own games and simulations. By doing these, they use information technology (IT) techniques and skills to search, read, and evaluate what information they find from the Internet. They have to summarize information and have conversation within their group. Then they write information in their own words and present to class. While searching and reading information,

students learn culture of Thai or other countries. Microsoft Word, PowerPoint, Google drive and form, Facebook, LINE, Skype, and SPSS are introduced via learning by doing, so students embed necessary IT skills. By the end of the course, I hope students will produce their own games and simulations which are considered as innovation for their teaching.

I divide students into 4 groups according to the level of teaching: kindergarten, primary, secondary, and vocational and ask two students to work together to create their game and simulation as a core activity of this course. One example of games and simulations of each level is introduced for students, and they play for the purpose of learning and experience, before they develop their own games and simulations.

Selection of Topic and Contents

Students know well their learning and teaching situation, so I ask them to discuss with their partners to choose the topic from their courses and prepare their contents according to the topic they choose to develop their games and simulations. The criteria are set for choosing their topic: the topic is difficult to understand or complicated, it acts as a background for the next one, and students will use it in their real life. Students search for and study theories of learning, games, and simulations. Then they select one or two theories which are relevant to the topic they choose and suitable for teaching technique they will use.

Setting up Goals and Objectives of Learning

A direction is very crucial; as a result, I ask students to set up goals and objectives of learning for this topic. Goals of games are broader; while, objectives for the contents are more specific. My students and I discuss goals and objectives of learning in order to make clear and have mutual understanding. Then they note down these goals and objectives of learning. I remind them that when they design their games and simulations, they have to look at their goals and objectives of learning so they will not get lost.

Design Educational Games and Simulations

Six elements of designing educational games and simulations [10] are explicitly explained, and students need to apply these elements in their games and simulations.

Roles: Each pair of students identifies a learning situation: level, age, numbers, and characteristics of students, subject taught, times and duration of teaching, and equipment. Games and simulations must be designed appropriate to their students' group. Games are encouraged to use as an input of a lesson; while, simulations are employed for students to act, react, and interact as in a real situation. For example, in a class of graphic design, students do matching tools of Adobe Photoshop before doing simulations with their graphic team to design name cards and sale in Facebook. Each group has to try hard to attract their customers. Members of each group function differently such as a manger, 3 graphic designers, a marketing and sale person, and a secretary.

Goals: Students set up the goals and objectives of their games and simulations. Goals are broader; while, objectives are narrower. Goals are focus on learning from playing games, and objectives are emphasized on content knowledge. For examples, goals of

this game are: (1) to enhance team work and co-operation and (2) to encourage students to use high order thinking skills. Objectives of this game: After students finish playing this game, they will be able to: (1) indicate the names of functions of the industry tools correctly and (2) select appropriate tools for using in each situation.

Alternatives: Students have to create their own games, so they have chances to make decisions and use high order thinking skills. At the same time, they have to design their games which encourage their pupils to think and make decisions while playing the games too.

"Chance" Element: Students design games and simulations and apply them in class within 6 months and all are manual games, so as players, they can anticipate what will happen in some situations and what will not happen in other situations.

Focus on Interaction: Small games which serve as input of the lesson have less interaction than simulations. After students' attention is attracted to focus on their lesson, they do the simulation. Students should design this simulation to provide for students to have interaction within and between groups. Though no need to have "winner" or "loser" in simulation games when games are ended, most students design their game for competition.

Debriefing: All groups need to *debrief* after they finish their games and simulations. Students prepare four to five open-ended questions to ask their pupils. The examples of questions are:-

(a) How do you feel after playing games and simulations?
(b) What did you learn from playing games and simulations?
(c) What should be done to improve playing games and simulations?
(d) Can you use what you learnt from playing games and simulations to your real life or daily life and study? How? Please explain.

At this point, all students compile their devices for using in as well as write their manual of their games and simulations.

Trial out
Students have to trial out 2 times at least. I ask my students to test their games and simulations in my class. Their friends pretend to be pupils. Two students check devices as stated on the manual and examine the objectives, a process of running simulations in their own classes, and debriefing of games and simulations. Two students act as observers and one serves to a time keeper. After each group finished its games and simulations, both my students and I provide comments and suggestions. Students take comments and suggestions to improve their games and simulations. They play their games and simulations one more time before applying games and simulations in their own class rooms.

Apply
Students run their games and simulations in their own classes. Pictures and video are taken during the games with two purposes: to review and improve and to be evidences.

Evaluation

Students report their results of running games and simulations in their real classrooms. How is the climate of their class? Do their pupils like and willing to learn more? What did their pupils say about playing games and simulations? To increase reliability of games and simulations, two students of each pair run their games and simulations in their respective schools to see that (1) pupils like games and simulations and (2) the mean scores before and after playing games and simulations of each group increase or not.

2.3.3 Post-training

Students improve their games and simulations, and they prepare to present and run their games and simulations in conferences. The purposes of this activity are to have experts evaluate these games and encourage students to share and experience an activity at the national level.

3   Reflection of Actual Practice

Training games and simulations for teacher-students enhance their 21st Century Skills and active learning as follows.

21st Century Skills

Designing and developing games and simulations provide opportunities for students to use high order of thinking which are *critical thinking and problem solving*. Students have to analyze their pupils and learning environment before setting the goals and objectives of games, simulations, and learning. Then they have to select the most suitable topic, design, develop, test, and apply in their classroom which students must complete this process in limited time. Students need to study existing games and simulations before starting to think of developing their own games and simulations, so they have to search, read, compare, and make their games and simulations different from the previous ones so they *inquire* new information and knowledge. Thus, students are asked to create new games and simulations which are considered as their *creativity and innovation*. Students work in pairs, in a small group, and in the whole class while they design and develop their games and simulations. They have to *communicate and collaborate* with their partners and friends.

All students and pupils are Thai, so *cultural understanding* is not a problem or concern. About 2–3 pairs teach Thai dance or Thai language, so they integrate Thai culture into their games. Those students who teach kindergarten have to carefully design their games and simulations to avoid any accidents from running or competing.

Students practice their games and simulations in class and do debrief at the end of games and simulations, and have chances to *reflect* their feeling, knowledge, and experiences. Two students brought one game and simulation which created by two of them to experiment in each of their class. Each pairs of students mostly teach in different schools. Thus, students have to be flexible and adjust more or less, so their games and simulations are suitable for running in the two real classes. Students are required to present their games and simulations in a conference which there are 4–5 senior teachers act as evaluators to evaluate their games and simulations. Most students

are young and have never had experience to make any presentation. They have to *take risk*, but they did, courageously, by practicing before presenting their games and simulations in the conference.

Active Learning

Training students to design, develop, and employ games and simulations in classrooms can be considerate as embedded *active learning* to this group. The process of training game and simulation development for teachers (Fig. 1) facilitates active learning. Students have to talk and discuss the learning situation of their class, and then analyze the situation before synthesis their situation and knowledge of their subject contents with games and simulations. The ultimate goal of this activity is to produce games and simulations which are new and suitable for their pupils. This idea and process is congruent with Rusbult [5] which students create games and simulations leading to meaningful learning. The process also co-responds to Meyers and Jones [6] because it provides students to have meaningfully conversation and communications of four skills. Students reflect their learning and experience with their peer while they practice and with their pupils while they run their games and simulations in the debrief session. To conclude, games and simulations create active learning as Bonnell and Eison [7] stated because students use their high order thinking skills, they engage in games and simulations, and they explore their attitudes and experiences after playing games.

Consequence

After integration games and simulations into one course: *Language, Culture, Innovation, and Information Technology in Education* 3 credits (2-2-5) for 6 years, the program developed a new course *Simulations and Games for Learning* 2 credits (2-0-4) for the teacher certificate program.

4   Limitation

Time is limited, so only one topic or lesson is used for developing a game and a simulation to experiment in only 1–3 hours according to the level of pupils. This contrasts with the learning idea which is an accumulating process little by little. We as teachers encourage them to continue design and develop their games and simulations for their class because the results from their experiments reveal that pupils are alert and active. They have fun and learn while playing games and simulations.

Levels of students: There were 4 levels of students in this program: kindergarten, primary, secondary, and vocational level. Moreover, there is one more group which works under informal education section in this program. They were mixed with different levels for the first six years because students were put into class according to 'first come, first serve' basis. Then students were put into each level of their teaching in the last two years. The reasons are that the purpose, design, process, motivation, and care and management of each level are quite different. When they work in groups, either pairs, small groups, or the whole class, they feel they have more mutual understanding because they have the same background.

Games and Simulations Design: In the early period of training, all students designed only manual games and worked in groups of 4–5 members. From our observation, only 2 students worked; while, the other two sat and watched. Thus, we decided to make the group smaller by pairing them. We encouraged students who taught or had knowledge and skills in computer or information technology to apply their knowledge and skills to develop their computer games. This is still embryo because limited of time, knowledge, and experience, so mostly, students used PowerPoint to present or run their games and simulations.

5   Conclusion

In the 21st Century where teachers need to integrate language, culture, innovation and information technology for their teaching, one of efficient tools may be development and application of educational games and simulations. The learning situation should be analyzed first, and the element of games and simulations need to be considered and included in the process of games and simulations design and development.

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