

Using simulations and game-based learning for information skills training

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Abstract. Information literacy (IL) is increasingly perceived as one of the determinant for students' academic survival; it is perceived as a vital competence to increase career prospects, partly due to the revolution of Information and Communication Technologies (ICT). Most libraries in higher education institutions have the responsibility of equipping students with IL, and strive to develop innovative approaches for the delivery of IL. On the one hand, although the impact of these novel approaches is noticeable, librarians are still facing challenges to bridge the language barrier and ease geographical constraints faced by students, to engage students in learning activities, and enable them to learn at their own pace. On the other hand, the great potential of video game for educational purpose, to engage learners, effectively deliver training, and dramatically reduce training cost, has been witnessed during the past decades by several researchers. As a result, this paper presents the initial stage of an 18-month experimental research project which aims to investigate the impact of simulation game for IL training in Waterford Institute of Technology. A literature review was conducted to identify current practices involving the use of simulation and games to improve IL training. The review was focused on characteristics of information skills-related learning activities, game features for engaging learning and delivering learning content. It also analyses the impact of different learning styles in terms of constructivist learning theories, instructional design theories. The review looks at the principles that support the design of educational games, for more engaged, motivated, immersed learning activities. This paper will present a preliminary analysis of this review, and focus on the use of 3D virtual environments and gaming technologies to improve IL training. The authors address how constructivist learning theories can be harnessed in virtual worlds to deliver learning content in multiple ways, strike a balance between serious and fun elements, and enable learning by doing with *just-in-time* information to facilitate acquisition of both information literacy and skills.

1. Introduction

1.1. Rationales and background

Researchers have found that many students in third-level Irish education fail to attend library training (McGuinness, 2009), probably due to the format in which it is traditionally delivered. Similar phenomena were also observed in the United Kingdom. For example, researchers from Liverpool John Moores University found that students missed library training because of geographical constraints, lack of time, and language barriers (Tunde & Linda, 2004). Okolo et al. (2008) pointed out that, due to the gap between the traditional format of library orientation and the prevalence of information technologies in students' daily life, students tend to find traditional training uninteresting.

1.2. The importance of information skills

The term information skills, was defined by Reitz (2010), as the ability and skills in finding and evaluating information, and refers to the awareness of and familiarity with libraries' layouts, information resources, and common searching techniques. According to Reitz (2010), the level of mastery of information skills is to be reflected by the extent to which one is able to "critically evaluate information content", appropriately use it, and understand its "social, political and cultural context and impact".

Information skills are very important for academic success. Meyer et al. (2008) ascertained that information skills underpin lifelong learning, and that third-level students should be encouraged to build upon information skills which are part of the fundamental course of their first year. Due to the fact that students are encouraged to develop independent learning strategy in higher education since the mid-1990s, information skills have become a major factor in students' academic survival and success (Winship, 1995). Students tend to "rely more on independent learning and greater investigative library use" (Rhodes & Chelin, 2000). As a result, most of higher institutions place an increasing emphasis on information skills training, and this was observed by McGuinness (2009) who surveyed 77 third-level Irish librarians, and found that most of the librarians feel that they have an enduring responsibility to provide information skills training using different formats.

1.3 The role of library training section in campus

For years, third-level libraries bear the responsibility to deliver basic training on information literacy to new students, to disseminate information and to make effective use of their resources. To achieve these goals, academic libraries employ orientation as the primary means to familiarize students with library resources and services, teach them how to access and assess information, and understand the fundamentals of information literacy (Margam, 2010; Aida, 2001).

2. What contribute to successful learning

2.1. Motivated and immersed learning

Motivation and immersion can make learning more effective. For example, according to Garris et al. (2002), motivated learners are usually enthusiastic, focused, and more engaged in learning activities; they enjoy learning, strive, and persist to learn and they driven by “their own volition” rather than “external forces” (Garris et al. 2002). Motivation can be intrinsic or extrinsic (Garris et al. 2002). Intrinsic motivation is mainly affected by challenge, curiosity, and fantasy (e.g., learners find it interesting to learn by solving problems), whereas extrinsic motivation primarily refers to identified regulation (i.e. learners engage in the learning activities due to the importance or value of the outcomes).

Bangert-Drowns & Pyke (2001) described engagement as "the mobilisation of cognitive, affective and motivational strategies for interpretive transactions". Through their study, it was found that engaged learners tend to manage their learning more strategically, to be eager to learn, and to collaborate with their peers. Bangert-Drowns & Pyke (2001) also found that, in order to engage learners, educators usually employ challenges and authentic problems that encourage students' knowledge and mastery of particular topics. Since the level of engagement is related to learners' achievements, as highlighted by Finn et al. (1995), an increasing number of educational institutions are inclined to see engagement as an educational aim and a solution to students' improvement (Butler-Kisber & Portelli, 2003). Moreover, learners' engagement should also enhance their capacity for life-long learning and development (Kuh, 2003).

2.2. Learning styles

Another rationale for this research roots from the nature of learning. Tusting & Barton (2006, p. 45) ascertained that learning is

“characteristic of all real-life activities in which people take on different roles and participate in different ways. People learn by engaging in practice and their participation can be supported in new ways. Teachers can ‘scaffold’ these activities, enabling learners to develop new forms of expertise”.

Students from different backgrounds, including international students, returning students, second level transferred students, and third level continuing students, may have different learning styles, including “Learning by doing” which is crucial for and preferred by most active learners (Hegarty et al., 2009). Learning styles are associated with previous learning experience and personality (Julie, 1995). According to Julie (1995), learners can be categorized into four groups based on their learning preferences, such as active learners, reflective learners, theorist, and pragmatist.

Julie (1995) further describes each group of learners as follows:

Active learners are those who enjoy new experiences, exploration, and challenge. They are normally motivated, interested and enthusiastic about

actions that make things happen. Learning through role play, teamwork, games is preferred by such learners.

Reflective learners are as cautious, thoughtful and prefer to take action after all the information has been collected. These learners tend to make sense of new knowledge based on the prior experience, they prefer to learn in an observational manner.

Theorists mainly learn by investigating evidence and by following a set of logical steps in accordance with general rules. Learning activities which aim to understand the interrelationship between ideas, principles, and example of application are preferable to such group of learners.

Pragmatists learn by practicing their ideas regardless of general rules. The feedback and outcome of their action inform them whether the action is working or not. Knowledge is hence built from the practice. Such learners prefer to learn by working with real problems or computer simulation of real experience.

2.3. Instructional design

The origins of ID (Instructional Design) can be traced back to early 20th century, alongside with the development and sophistication of psychology and computer technology. ID evolved and tended to be more applicable to a variety of settings from the military, aerospace and business training to community colleges, and higher education (Leslie et. al., 1992). Leslie et. al. (1992) also emphasized that ID aims to “achieve effective, efficient, and relevant instruction” so as to improve learners’ experience. The importance of instructional design was also highlighted by McCombs & Whisler (1997) who believe that instructional design is especially appropriate in the information age to facilitate knowledge acquisition because learners in this era have become more active in their learning process, and expect the learning content to be more interesting and meet their knowledge needs. Learners necessitate ID, since ID is naturally learner-centered, and the process of ID is based on the learners’ characteristics and needs (Leslie, 1992).

2.4. Constructivist learning theories

According to Zaibon & Shiratuddin (2010) learning from a constructivist perspective is the active process of acquiring and constructing knowledge through meaningful ways. Knowledge is created and acquired through interactions and based on prior experience. Similarly, according to constructivist theories, learners establish connections and links to prior knowledge and experiences.

Good & Brophy (1997) also pointed out that there are normally four aspects of constructivist learning activities: (1) “Learners construct their own meaning”, (2) “New learning builds on prior knowledge”, (3) “Learning is enhanced by social interaction”, and (4) “Meaningful learning develops through ‘authentic’ tasks” which sequentially emphasized the importance of making sense of information, making connection between prior knowledge, comparing and sharing ideas with others, and practicing those knowledge in assignments that simulates real life situation.

3. Analysis of current training practice

3.1. Overview of information literacy training in Ireland

The awareness and mastery of services provided in libraries underpins learning activities and information literacy, which, to some extent, determine students' academic success (Tunde & Linda 2004). A nationwide survey on information skills training was conducted in Irish higher education by McGuinness (2009), and indicated that library services in higher education institutions were perceived as helpful by a majority of students. Nevertheless, only 50% of the respondents had attended the library orientation. These results were corroborated by Helen et al. (2006) who conducted a survey in WIT library and noticed that only 40% of the respondents had taken part in a formal library tour or orientation program; most of these attendants stated that the traditional face-to-face orientation training had been helpful. More recently, Hegarty et al. (2009) showed that the current structure of library training sessions in WIT had some limitations and drawbacks. For example, they explained that the training consists of two one-hour courses where the first hour is used to introduce the students to the library resources with an emphasis on print materials, and the second class section introduced the concepts of critical thinking and evaluation, applied to information sources. However, Hegarty et al. (2009) also explained that those who miss the first session will probably encounter library anxiety (i.e., students feel uncomfortable with using the library), which is a common problem faced by a large number of students in institutions which adopt such information training methods, and may prevent them from using the library (Tunde & Linda, 2004). This suggests that the media used for training may need to be more flexible and engaging

3.2. Innovative solutions for information literacy training and their limitation

The growing intake of international students and the adoption of modern information and communication technologies raise the necessity of employing innovative training strategies to meet students' needs (Margam, 2010; Tunde and Linda, 2004; Sultan, 2011). Various technologies have been adopted as supplements to traditional orientation to reduce language barriers and geographical constraints, engage students in learning activities, and encourage communication between librarians and multimedia-based library instruction was created to free the new entrants from geographical and time constraints, as well as to prevent library staffs from repeating the traditional orientation indefinitely at Delhi University in India (Margam, 2010). Similarly, Ingram library in University of West Georgia (USA) employed a web conferencing system to deliver library instruction, to encourage communication and interaction between students and librarians; as a result, the number of online and commuting students grew steadily (Anne and Andrea, 2011).

Those aforementioned technologies, as expected, turned out to be effective to improve students' experience. However, some unexpected problems also appeared. For examples, in order to ensure instant feedback and real-time communication for the web conferencing system, library training staff found it hard to accommodate the schedules of all students (Anne and Andrea, 2011). Similarly, although the media-based training program enabled students to avail of remote and self-pace information training, most students found that the format offered lacked interaction and instant feedback (Margam, 2010).

As a result, Margam (2010) suggested that current media-based technology may have limitations for training. For example, videos lack interaction, because users can only play or stop the animation but cannot perform actions the same way they would in the library. Also, in video-based training systems, students cannot obtain instant feedback. For these reasons, it is suggested that multi-sensory approaches, such as game-based learning and virtual reality, may be more suitable, to allow for a more interactive and engaging experience.

There have been several attempts to apply video game to library training in the last few years. For example, staff at the University of East London created a video game for library instruction to improve the effectiveness of library training for international students. This software aimed to minimize students' language barrier, and made the training more engaging (Okolo et. al., 2008). These experiments demonstrated how difficult it is to increase the adoption of this innovative approach and how the effectiveness of serious games highly relies on game design, and a good balance between entertaining and pedagogical elements (Okolo et. al., 2008).

4. Using GBL approach for information literacy training

Why use GBL and simulations for information literacy training

3D simulation games such as MMORPGs (Massive Multiplayer Online Role Playing Games), enable interaction and collaboration between participants, and facilitate learning through narratives and dialogs with NPCs (Non Player Characters). These games present concepts visually to users who may be in different geographical locations (Susaeta et al, 2010).

To some extent, gaming activities encompass most elements of information skills, and are consistent with the way people learn. This was investigated by Gumulak & Webber (2011) who revealed that information skills-related gaming activities include (1) "recognizing the information needed" (e.g., requiring information that explains how to make progress in this game), (2) "identifying the gap between what is known and what is needed" (e.g., reviewing those information in hand to identify what is still unknown and needed to finish the mission), (3) "constructing strategies for acquiring the needed information" (e.g., identifying the information source accessible such as web, experienced play among friends), (4) "locating and accessing information" (e.g., Google your problems or asking experienced player), (5) "evaluating information" (e.g.,

comparing newly gathered information from different sources and refine them), and (6) “using and communicating information” (e.g., solving the problems, finish the mission accordingly, and take into account the advice provided by fellow gamers in forums or blogs from).

Games engage and motivate players to learn. For examples, Prensky (2001) investigated the affective aspects of gaming behaviors, and explains that game elements could be attractive to players because they provide some degree of enjoyment, have obvious and significant goals, are interactive, provide feedback, include conflicts, challenges, and problem solving activities.

How to use GBL to improve information literacy training performance Constructivist learning environment

Efforts on refining design principles based on constructivism learning theory for building constructivism gaming environment have been made by Rosario (2009). He proposed 12 design principles which could be mapped to the aforementioned four elements of constructivism learning theory. In this section, the mapping process of those 12 principles and examples of how those principles could be implemented in game design will be presented.

According to Rosario (2009), design principles for constructivism gaming learning environment include:

1. Probing principle: player is encouraged to build and test hypotheses regarding solution to tasks. In this way, a learner can see for himself what does or does not work. For example, one scene in a Japanese culture game which is based on a 3D virtual environment, required player to gain access to a temple by putting on slipper, otherwise the player will be inform by guard that he has to collect the slipper from the reception desk first.
2. Distribute principle: players should find growth and knowledge in the interaction with other players and game objects. Most MMORPGs allow instant chat between players, this features enable them to gain help and advises to proceed or complete a task. Multiple routes principle—there should be more than one way for players to progress.
3. Multiple routes principle: there should be more than one way for players to progress, encouraging them to make decisions and solve problems. For instance, in a simulation game for library training, in order to find a book for a given topic, the players could either search through OPAC system, or go directly to the shelf if he is familiar with the order in which those books are arranged.
4. Practice principle: players should be able to spend a lot of time practicing throughout the entire game in an interesting environment. For instance, an FPS game-American Army provide a set of training sessions targeting for different skills. Players are able to practice in this section before go into really task.
5. Psychosocial moratorium principle—players should be able to take risks where there is a lower chance of real-world consequences for in-game

- activities. This principle mainly refers to the player should not physiological affected by any dangerous situation in game such as injury in a battle, or a traffic accident due to less attention on the instruction.
6. Regime of competence principle—players should be challenged by attainable tasks which require that the tasks should be the representative of players' experience and progress within the game. For instance, in an RTS game- league of legend, the system automatically select players with similar level based on profile of their account for the competition.
 7. Self-knowledge principle—players should obtain knowledge and skills from completing tasks, which in turn prepare them for more difficult tasks to gain more knowledge. This is a generic principle in MMORPGs which normally assign tasks based on the completion of the prior task, since the skills gain from prior task will help the players to complete current task. In the Rune of Magic , a typical MMORPG game, before proceeding to a task which requires the player to enter an dangerous zone to find an item, the players have finish an crafting task which aims to introduce the concept of how to improve the quality of your weapon and armor.
 8. Collective knowledge principle—players should be encouraged to learn from each other by building a repository of useful knowledge shared by all such as discussion forums. Similar as most e-learning system, most serious games have tailored forums or blog for knowledge sharing, such as the forum of train simulator or football manager where you can find valuable knowledge or hints that could be applied in real life.
 9. Engaging principle—the game should have a compelling theme that is attractive to players. The players should be able to play an exciting role what they may expect to experience in real life. For example, in a political game, the learners are playing the role of the major of New York city to make an finical plan.
 10. User interface ease of use principle—interface should be user friendly and the system should be easy to navigate,
 11. On-demand and just-in-time tutorial principles—game tutorial should aid players in learning game mechanics and user interface while they are playing, exploring or interacting with the environment.
 12. Achievement principle—players should be constantly an visibly rewarded in an exciting way at each level of game play and skill mastery so as to encourage keep them happy and wanting to play. The rewards include special items, prestige, new skills and abilities.
 13. This example illustrates how games can be used to support constructivist theories, and provide an interesting framework for both developers and practitioners.

The necessity of Instructional design

Generally, the term Instructional Design” as defined by Patricia & Tillman (1999), was used to describe a systematic and reflective process of integrating learning principles into a solution of arranging instructional materials, activities, information resources, and evaluation. The outcome solutions were expected to

be both functional and attractive to the end user. The entire process of instructional design usually includes the analysis of learning needs and goals, the development of a delivery strategy and system to meet those objectives, and evaluation of functionality of the outcome.

According to Gunter et al. (2006), there is a necessity to design serious game based on sophisticated and practical instructional or educational theories, to ensure that the educational goals will be met. Designing serious game without conducting instructional design can turn a serious game into a learning platform but without the engaging features (Nick & Terry, 2010).

Among a variety of instructional theories, Gagne's nine events of instruction was considered to the most in line with game design principles (Nick & Terry, 2010). The following section will briefly introduce Gagne's events of instruction, and an example of incorporating Gagne's instructional design theory with serious game design will be given.

Gagne's theory and game design

Gagne (1985) proposed a nine events instructional model to foster internal learning process as follows:

1. Gain Attention (e.g., sound or image)
2. Inform objectives (e.g., pointing out what knowledge or skills they are expected to gain after the course)
3. Stimulate recall of prior knowledge (e.g., remind learners the prior knowledge relevant to current topic)
4. Present stimulus material (e.g., auditory and pictorial information)
5. Provide learner guidance (e.g., provide learning hints separately)
6. Elicit performance (e.g., provide opportunity to practice)
7. Provide feedback (e.g., give comment on the finished task)
8. Assess performance (e.g., exams given at the end of the course)
9. Enhance retention and transfer (e.g., put learners in a transfer situation)

Such instructional theory was adopted by Zaibon & Shiratuddin (2010) in the development of mobile game for teaching the political issues of Malaysia. The following instructional strategies corresponding to each event of Gagne's instructional model will demonstrate how to integrate instructional theory into game design:

1. Gain attention: an attractive introduction screen with sound effects can work as stimuli to gain attention from players.
2. Inform learners of objectives: the instruction of game rules, and game objectives will be provided at the beginning.
3. Stimulate recall of prior learning: this objective can be achieved by adopting multiple game levels which require player to recall knowledge learn from previous level to finish the task of current level.
4. Present the content: game content should be organized in a meaningfully manner and presented via text, audio, and graphic.
5. Provide "learning guidance": players will be able to access user manual or tips anytime they want by clicking the help button from system

- manual.
6. Elicit performance: the players are required to practice the new skills to proceed. Repeatable tasks targeting for certain skills will be set up at each level.
 7. Provide feedback: feedback in a game should be provided in forms of score, graphics, animation, and audio.
 8. Assess performance: it is important to inform the players' level of performance at the end of each level.
 9. Enhance retention and transfer: this objective can be achieved by allowing players to accomplish task in their own strategies.

This shows that instructional design can successfully inform the design of game-based learning solutions.

5. Conclusion

This paper aimed to identify the current difficulties faced by librarians to provide engaged and effective IL training. The author also identified the difficulties faced by students in attending and successfully completing IL training programs. It also shows that these issues might be due to different reasons such as geographical constrains, lack of time, language barriers, and lack of motivation on the part of students. The authors have explained that these issues can be addressed using games and simulations technology. They have also demonstrated that how learning theories can be successfully combined to game design to provide engaging and educational training.

This literature review is the first part of a project which aims to design and assess library training based on games and simulations. The author intended to design and develop a library training based on simulation and game technology. Further study will focus on assessing the impacts of this software in terms of learning and engagement.

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