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Integrating a Social Network Group with a 3D Collaborative Learning Environment

A Case Study: Open Wonderland and Facebook

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Abstract— **Although extensive research has been carried out on virtual learning environments and the role of groups and communities in social networks, few studies exist which adequately cover the relationship between these two domains. In this paper, the authors demonstrate the effectiveness of integrating these two environments by creating a novel prototype and conducting a preliminary pilot evaluation session. For the prototype system, a Facebook Group was utilised as a repository for learning content and the Open Wonderland platform was selected as a mixed reality intelligent environment for 3D virtual collaborative activities. Since tacit knowledge can be gained via collaborative group-based activities and discussions, a new Wonderland module was developed to integrate this platform with the Facebook group. Similarly, explicit knowledge can be learned directly via the prepared materials which are provided within the group repository. We hope to demonstrate that this approach can provide greater accessibility to the learning content since it can be accessed from both the 3D world and the 2D Facebook Group. In other words, this system can support both synchronous interaction as well as asynchronous data retrieval. Finally, the prototype system was evaluated by means of a two-hour task-based assessment and user-satisfaction questionnaire. We present the key findings from this pilot study (which were very encouraging), and propose further ideas for the future refinement of the concepts presented in this paper.**

Keywords-Social Network; 3D Virtual Collaborative learning Environment; Human-Computer Interaction;

I. INTRODUCTION

Nowadays, Web 2.0 applications are part of many people's lives. Online Social Networks for communication purposes such as Facebook, Twitter, Google+ or knowledge-sharing Wikis such as Wikipedia are well-known examples of Web 2.0 technology. At the heart of understanding Web 2.0 technology is the concept of *Interactions*. In other word, the gap which had been found between the users and Sir Tim Berners-Lee's invention [1], Web 1.0, was filled with this technology. Web 2.0 applications have come to emphasise the users as new content of the system. One of the well-known slogans in computer science supporting this idea is "The user is the content". The other supporting evidence for the abovementioned recommendation was shown by The New York Times when they selected *'YOU'* as the person of the year in 2006 [2]. Furthermore, Web 2.0 applications caused a rapid transmission of the messages among its users. Therefore, it can be seen how Web 2.0 applications can be widely used tools for the distribution of information and knowledge. The transfer of knowledge is organised into two major categories: the *explicit knowledge* and *tacit knowledge*. The former is based on a straight process of learning from available content; however, the latter is gained from the conclusion of a discussion. These two types of knowledge transfer can be supported by different applications in Web 2.0.

Additionally, Web 2.0 has affected online learning systems. E-learning 2.0 is derived from the combination of Web 2.0, legacy learning system and human factors [1]. Stephen Downes was apparently the first to use the term e-learning 2.0 [3]. He stated, Web 2.0 technology is more than a technology since it is a social revolution. Jafari et al.'s investigation illustrated e-learning 2.0 is much smarter than the previous system since it works similar to the MashUp technology [4]. They argued that the ultimate goal of e-learning 2.0 is to combine the *social factors* and a *learning environment* in order to have a unified learning framework. Therefore, one of the most significant discussions in learning systems involves the design of a web-based collaborative learning environment to support learners' needs. Many kinds of these systems have been implemented and assessed by users in terms of usability and effectiveness. In this paper, the authors aim to propose a model of collaborative learning system to support both aspects of knowledge transfer. The proposed model is composed of a 3D collaborative learning environment and a Social Network.

A. 3D Collaborative Learning Environment

On the one hand is a 3D collaborative learning environment which has been widely investigated by the researchers. The term collaborative learning is used by Apostolos to refer to an educational exercise which is based on the real-time cognitive and mental effort of diverse students who have common

objectives and are equally liable for their achievements [5]. However, Johnson & Johnson's definition focused on the level of learning. The CL[1] for them has been applied to situations where students work within small groups and collaborate with other group members to maximise their academic performance [6]. The other discussion, raised by Weiss [7], is related to Lack of Interaction, which is known as a failure point for collaborative tasks such as learning. He believed that more interactions caused more motivation among the learners. Furthermore, John-Steiner defined CL with regard to social interaction [8], since the basic principles of CL argued by Vygotsky and Piaget [9-11] are based on this factor.

A 3D collaborative learning environment is generally known as an intelligent game-based environment with academic goals. Dafoulas stated that students who play video games can navigate in most virtual environments [12]. The Federation of American Scientists argued that some skills can be gained through the gaming environment [13]. For instance, there are many games that require strategic thinking as well as problem solving abilities, or maybe they need convincing interpretative analysis. Liarokapis et al. suggested a game-based learning model for e-learning systems, however, they proposed a classroom-based learning system which was dependent upon the video games [14]. Bronack et al. criticised the model that Liarokapis et al. had suggested from their findings [15]. They believed that the 3D virtual learning environment is not comparable to the traditional class-based learning system because it can make more opportunities for learners to explore the virtual world and likewise allows them to choose their own path through the 3D space. Furthermore, the architecture, design and implementation of this kind of system has been investigated by many researchers, such as Bouras and Tsiatsos in [16], who investigated on the multimedia virtual system and Tegos et al. in [17], who focused on the multi-user functionality and X3D technology for the representation of the virtual learning systems.

Since collaborative virtual learning systems strongly support user interaction, the idea of using this method as an experiential learning environment was offered by Jarmon et al. in [18]. In his study, Second Life was considered as an instance of a virtual learning environment. Bedford et al. suggested Second Life as a virtual learning platform in which real-time interaction is possible and they identified three groups based on real-time interaction: experiential activities, project-based activities and community-based activities [19]. Moreover, the recent study of the relationship between collaborative behaviours and team performances heightened the importance of using a collaborative virtual environment in group-based tasks to enhance performance [20].

In summary, the 3D collaborative learning environment with its special features such as voice chat and avatar can be a good choice for the learning system since it provides some opportunities for interaction among its users.

B. Role of Social Networks in Education

On the other hand is Social Networking, which is known as one of the most important applications of Web 2.0. In recent years, there has been an increasing interest in this field and a considerable amount of literature has been published on this subject. Liccardi et al defined Social Networks as a social construction of nodes which have isolated and organizational characteristics and there are some relationships among them in the specified domain [21]. A Social Network Service is an online community which specifically represents the structure of nodes and their connections [22]. Throughout this paper, the term Social Network will be used to refer to the Social Network Service.

So far, however there has been some discussions about the effect of Social Networking on students' lives, a few individual investigations have been found in the integration of a content-based community in a Social Network with a 3D collaborative learning environment, which is recognised as the most interactive environment for learners. This paper seeks to address the gap between explicit and tacit knowledge in the 3D collaborative learning environment by introducing the abovementioned integrated system. Breslin described some functionalities of Social Networks such as: network of friends, profile, sending a private/public message, forums, managing events, writing a blog and sharing media [23] which are required to have a comprehensive learning system. Rodrigues et al. proposed a model, shown in figure 1, for illustrating the interaction between a learning system and Social Network [24].

Figure 1. Interaction between the Learning Environment with Social Networks [24]

The primary goal of this study is to evaluate the features and effectiveness of a Social Networking community within a 3D collaborative learning environment to discover the role of community-based activities in the learning process. For this purpose, the authors have chosen a Facebook group with academic members as an example of Social Networking communities, and the Open Wonderland platform as an instance of 3D collaborative environment. Learners can discuss the Facebook posts, add their comments via the 3D environment and also talk with each other through this environment. A Facebook group is used as a repository of the content, since all of the comments should be automatically added to the corresponding post in a group. Furthermore, the more advanced proposed system has the ability to record voices and text conversations and save them to the Facebook as a file. The significant advantage of this system is the availability of content in a well-known Social Network as well as the use of a 3D collaborative learning system. Therefore, it can increase the pace of accessibility, which is defined as the amount of time a user spends finding the available contents. Moreover, it allows users to gain tacit knowledge, since it provides real-time communication in different ways, as well as explicit knowledge since it records the interactions and enables non-real-time interaction.

[1] Collaborative Learning

To summarise the discussion, it is concluded that Social Networks are applications for communication that can be used in the education system. A strong relationship between Social Networks and the Collaborative Learning Environment has been reported in the literature. Since Social Networks is identified as the most widely-used application on the Web, and Facebook is known as the most popular Social Network, it seems that using this platform can spark more enthusiasm among the students in the learning process. To have a more comprehensive learning environment it can be argued that integrating a 3D collaborative learning environment with a well-known 2D application might be accepted by a broader range of users.

The remainder of this paper is organised as follows. The identified gap within the literatures led authors to create a prototype of the proposed system. Therefore, section 2 will suggest a hypothesis and a methodology. Section 3 will outline the requirements of the proposed system and illustrate the system use case diagram. The methodologies, procedures, tasks, and remarks of the evaluation will be presented in the Section 4. The final Section will offer the conclusion and suggestions for future work. Moreover, the fully-dressed scenario of use cases and a questionnaire will be provided in a supplementary section.

II. Research Approach

This section begins by laying out the theoretical dimensions of the research, and addresses the gap between 3D Collaborative Learning Environment and social network communities. The section starts with a hypothesis. It will then go on to describe the methodology used for this research.

A. Research Hypothesis

First, in reviewing the literature, a little investigation was identified in the association between a social network and an intelligent virtual learning environment. However, a strong relationship between these two has been reported.

Social Networks were defined as online platforms illustrating the relationship between their members introduced as one the most important applications of the Web 2.0 technology.

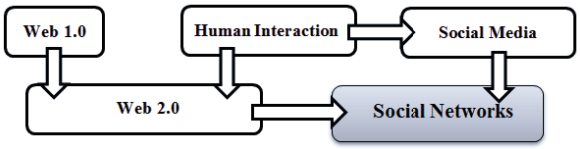

Figure 2. The Social Network's Factors

In the other side, Web 2.0 technology causes a huge improvement in learning systems. The lack of interaction issue was solved with the first version of web-based learning [25]. However, this system suffered from some serious limitations resulting from ignorance of human factors. Therefore, the second version of e-learning was introduced to consider the human factors as one of the most significant aspects of such systems.

In addition, video games were presented as one of the most widely used tools for the students. Surprisingly, these kinds of tools were identified to increase the rate of thinking among their users since they force the users to discover a certain solution to achieve their goals. Based on computer games, the past decade has seen the rapid development of virtual intelligent environments.

Therefore, using the virtual environment as a learning system could have a number of attractive advantages including increased interaction among the users, which raises enthusiasm and motivation, and the provision of a more attractive environment for students and teachers alike.

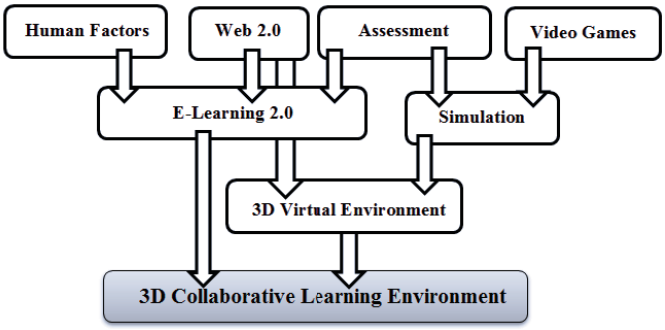

Figure 3. The 3D Collaborative Learning Environment's Factors

There are many common factors in the two figures above, such as Web 2.0 and human effects including human factors and human interaction. If the intermediate levels in figures 2 and 3 are ignored and these two diagrams are merged, the following diagram can be arrived at.

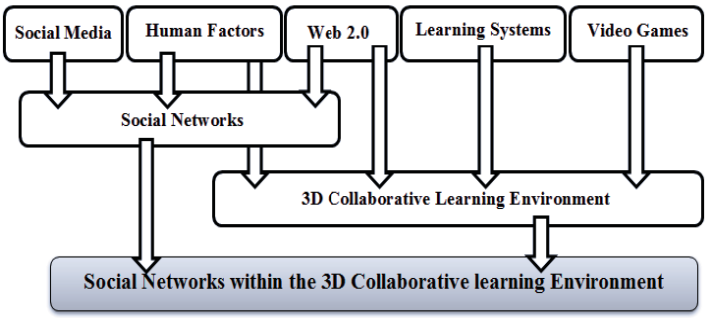

Figure 4. The Gap between Social Networks and 3D Collab. Learning Env.

Hence, it could conceivably be hypothesised that: The integration of a Social Network Group or Community into 3D Collaborative Learning Environment can better meet the learners' need for collaborative tasks such as discussions.

B. Research Methodology

A community consists of many members who have common interests and a specific goal. All of the members have some particular tasks and activities which must be carried out in order to achieve an ultimate goal. If the members of a community are distributed around the world, they use a network for communication. With the evolution of Web 2.0, communication among the users can be established on the Internet. This type of community is known as virtual community or Social Networks. Since the final aim of the students is identical, it can thus be suggested that it is possible to use a community or a group of students within Social

Networks with an academic purpose. For example, it is possible to find a group of students who attend a specific subject/year in a specific University.

So far, the integration of a social network and learning platform has only been applied to 2-dimensional and non-real-time learning environments. However, this study set out with the aim of assessing the importance of Social Networks in 3D Virtual Collaborative Environment.

The methodology which is used to integrate a group in a Social Network within the virtual collaborative learning environment seems to cover both of two types of knowledge, including explicit and tacit, since it supports document-based learning as well as real-time discussions.

In this proposed model, all users have a dual identity including a Social Network profile and 3D collaborative learning username. They can use the chat facility to send direct messages to others in a 3D learning environment. However, when they participate in a particular discussion they can add their comments on the specific title. Furthermore, our proposed model allows the users to talk to each other via the collaborative learning facility. Therefore, this model increases the rate of interaction among the users and this factor may cause the growth of motivation and original thinking and consequently might be an important reason for enhancing the learning. Besides, users can access all kinds of learning content and load them into 3D space, since the source of them is in the Social Network. These contents can be in forms of textual documents, presentations, videos, or even a question or a poll. Moreover, the voice conversation between the users can be recorded via the virtual environment and can be saved into a group within the Social Network.

From the students' view, they can check their classmates' profiles very quickly and gather some information about them since all of the usernames in the collaborative learning environment are linked to their corresponding profiles in the Social Networks. This action can be carried out in real-time by simply clicking on one of the user's posts in the virtual environment. This situation is highly likely in the distance learning environment, where many new students are talking about a new discussion and they have never previously met each other. Therefore, they can quickly browse their Social Network's profile and it may possibly ease and accelerate the introduction process. Furthermore, this model can determine cheating among the students. This feature can be implemented via monitoring the graph of the relationships (aka. network) among the students. For instance, it can facilitate the identification of plagiarism since tutors can see the students' network. Therefore, the tutors' ability to seek the learners' network and identify any suspicious user help them to find the source of plagiarism. It is worth noting that two people can be in the same network despite not being friends or even friends of a friend.

In this research, one of the variables is a group of students studying at the University of Essex. This group has been created on Facebook, which has been defined as the most popular Social Network in 2012. The instance of 3D collaborative environment which is used is Open Wonderland. Open Wonderland is an open source pure Java platform. In order to understand how the proposed system may enhance the learning process, a series of tasks were performed. Some evaluation methodologies employed to assess the effectiveness of the proposed system. The *usability evaluation* applied via a *user-satisfaction* questionnaire as well as *Think-Aloud protocol* and *Focus Group*.

III. PROTOTYPE

In the research approach, it has been stated that a new prototype was developed to evaluate the effectiveness and acceptance of our proposed system among the learners. This section will review some requirement aspects of the implemented prototype.

A. Functionalities

One of the most important functional requirement for this system is *authentication and authorisation*. Since the Facebook authentication service is highly rigid, the authentication and authorisation of Facebook group users and permission issues are highly problematic. It is important to note that the Facebook group which is used is not an open group and only its members can see and post items.

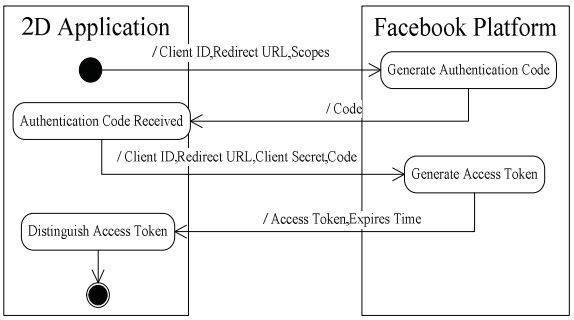

Figure 5. Authentication Activity Diagram

Before a user can set up a Facebook viewing window in Wonderland, they must use the intermediate Facebook application (2D Application) to generate an Access Token. When unauthorised-users select the *Facebook Group Integration* module from the Wonderland *Cell Pallete,* a HUD[2] appears on their client's browser requests an access token. They can then copy this Access Token from the 2D Application into a HUD in the Wonderland world to access Facebook group's content. This process is based on *OAuth 2.0* which is a token-based authorisation technique to allow the users access the contents of the source platform in other secure platforms. The figure 5 displays an activity diagram for the authentication. Each arrow in this diagram indicates a secure HTTP request and the labels on the arrows are the parameters which send via each request.

Once the Access Token has been validated, Facebook viewing windows can be opened in-world. These windows can show discussions in private Facebook groups, that the authenticated users have access to, as well as public group. The Facebook viewing windows are based on the Wonderland *HTML Poster module*, therefore, all links in these windows are real-time. Thus, the other significant functional

[2] Heads-Up Display

requirement can be retrieving the data from a Facebook group into a 3D world which illustrates the spatial representation of 2D Facebook group functionality in a 3D collaborative environment. Consequently, a feature is required to add a new comment to existing posts as well as create a new post. The other functionality of this system is a communication feature, provided by voice/text chat, is a significant issue to increase the rate of interaction in the proposed system.

In summary, the proposed system has four major functionalities: Authenticate Users, Retrieve Data, Create a New Discussion and Add a New Comment. In addition, Authorised User which is inherited from Unauthorised User with an additional Access Token is the main actor of the system. Furthermore, Facebook 2D Application and Facebook Group are two external actors in the system. The system use case diagram is shown in the figure 6.

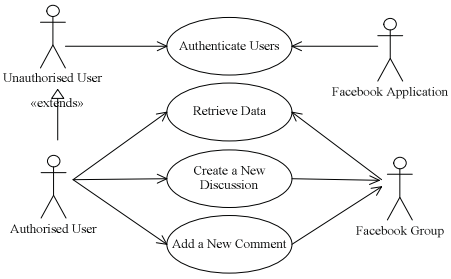

Figure 6. Use case Diagram

B. Open Wonderland Architecture

The Open Wonderland platform is formed on the client-server architecture. From the high level view, it is possible to divide the wonderland platform into three layers. The *virtual world browser* concept, brings up in the highest level, connect to the different Wonderland servers and download the contents and behaviour of them. The *rendering engine (MT Game)*, applied to this browser, is built to add the multi-processing capability to the old *jMonkeyEngine* [26].

Below the first level, server layer, consists of many different services which can collaborate to make a specific world. There are four major servers in this layer including: the *web administration server*, run over the Glass Fish[3] Java EE Application server, is applied as a service coordinator; the *Darkstar server,* participates in communications via its simple messaging techniques, is used to keep track of the users' and objects' positions; the *Standard Server Component*, run over *Linux*/*Solaris* systems, is employed to share the server-hosted applications; finally, the *jVoiceBridge* enables the VoIP [4] technology for server-side voice mixing [26].

Furthermore, the lowest level, specific virtual world, is mainly the connection between the client and darkstar server. It is made of the objects with the specific position in the world and some set of shared-properties which can be seen by all the users. This synchronisation is carried out by the darkstar messaging mechanism. For instance, avatars, buildings, mountains, chairs and all of the other objects are grouped in this level. The figure 7, produced with regards to the network diagram model, illustrates the client-server architecture of the Open Wonderland platform.

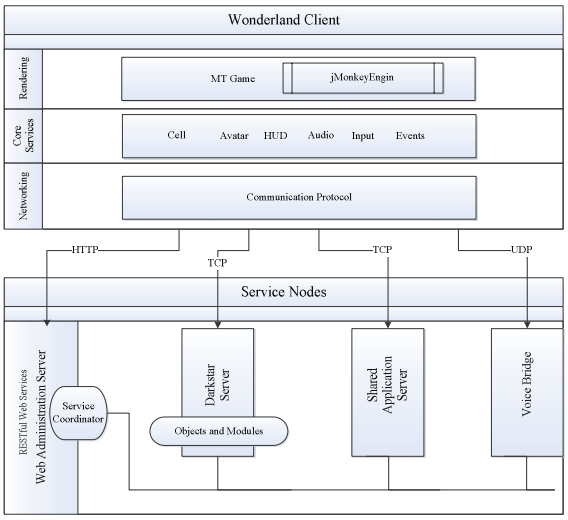

Figure 7. Open Wonderland Architecture

C. Package Diagram

The figure 8 illustrates the relationships between packages within the prototype.

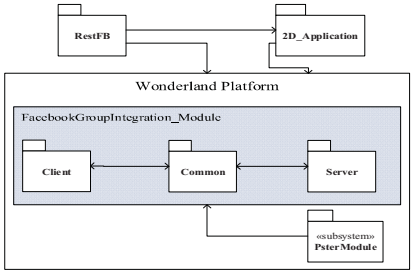

Figure 8. Package Diagram

RestFB package is employed as an API for converting the Facebook JSON objects to an appropriate objects such as Post, Comment, User and Group. 2D application is applied for the generating an access token as well as creating a new discussion and adding a new comment. The new proposed module has three main packages including: Client, Server, and Common package. Common package was required for the common classes between client and server. Furthermore, the current state of client and server was held in this package.

D. Class Diagram

The figure 9 shows the relationship between the main classes in the 2D application. These classes are placed within *2D_Application* package which is shown on figure 7. This package has three Java classes including a servlet. The first class is *AuthenticationProperties* which is used for creating an appropriate *HTTP Request* to the servlet, named *TempServlet*. After this process, an *accessToken* will be generated and passed as a string parameter to the *FacebookTestApp* class which includes all the required methods for dealing with the Facebook contents. Furthermore, six JSP pages are designed to show the results via web browser. The *temp.jsp* is employed to

[3] Voice Over Internet Protocol

generate an Access Token. The *Index.jsp* is the main user interface of the 2D application which includes all the posts, comments and extra information about the content of Facebook Groups. The remaining pages will be required for adding a new content to the Group from virtual world via 2D App.

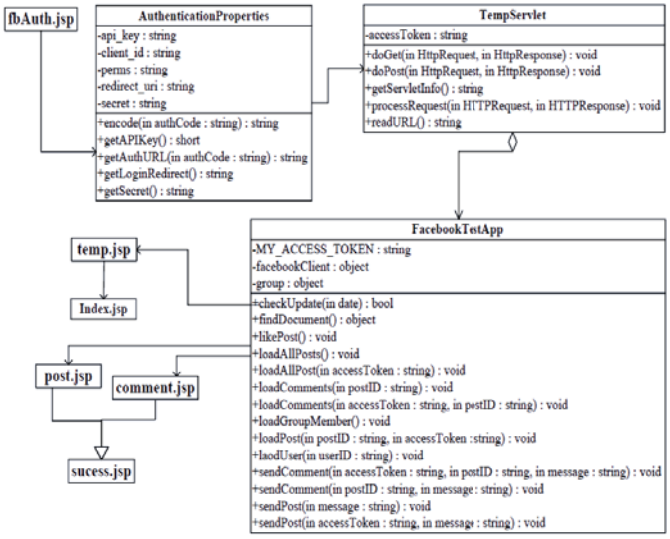

Figure 9. 2D Application Class Diagram

The figure 10 briefly explains the connection between the client and server packages. However, more precise model should consist of an intermediate package which holds *FacebookCellServerState* and *FacebookCellClientState*.

Figure 10. Wonderland Client-Server connection

An abstract class diagram of the proposed Wonderland module is presented in the figure 11. In addition to client package, a new inner package, called jme.rendered, is added to the model. All the essential wonderland classes are filled with light grey. The dashed line indicates an indirect relationship between two classes via their parents.

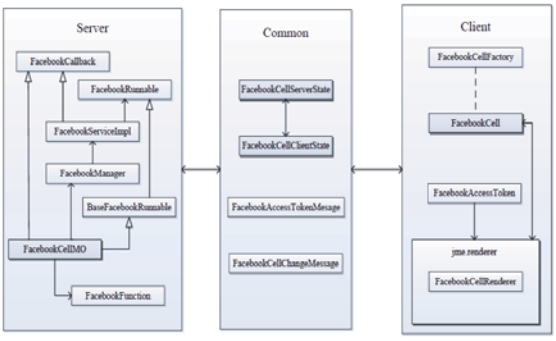

Figure 11. Wonderland Class Diagram

IV. EVALUATION

Most of the interactive environment is designed according to users' needs. Therefore, it is essential to evaluate these products by their consumers.

Usability evaluations of the proposed prototype conducted during a role-play session based on the *think-aloud* protocol. In this method, however users were not the actual clients of the system, they pretended to be and thought about their requirements. It is worth mentioning that all the volunteer users were MSc and PhD students at the Universities of Essex and Manchester who had previous experienced of a traditional learning environment. Therefore, they have been acquainted with the weaknesses and strengths of the aforementioned education system. Furthermore, a *focus group* methodology applied to assess the effectiveness of discussion in the collaborative learning environment within a group of people in terms of explicit/tacit knowledge. This method helped the evaluator to gain better feedback from the users' perception of the proposed system. Finally, users filled in a five-point Likert scale questionnaire designed with regard to Jakob Nielsen's *Framework of System Acceptability* and Ben Shneiderman's *criteria* for usability of a digital system [27]. The first framework considers *learnability*, *efficiency of use*, *memorability*, *few and non-catastrophic errors* and *subjective satisfaction*, while the other relies on the quality and appeal of *pictures* in the environment, *readability* of contents, applying different and harmonised *colours*, facility of *navigation* to the correct spot, increasing *interactivity* among the users as well as the objects, application *features* and *functions* and *accessibility* of the content.

Figure 12. Evaluation Trial Session

The user trial[5] evaluation process was conducted in a two-hour practical session and a twenty-minute questionnaire[6]. Each user was in a separate location and they were connected to the Wonderland server via the IP address and port number. The order of activities which had been done during the trial session can be seen in the following: at the beginning of the session, the admin provided a description regarding virtual worlds and allowed the user to customise their arbitrary avatar as an ice-breaker activity. However he highlighted the importance of collaborative group-based tasks, he did not discuss the advantages of using a Social Network group to prevent any bias in the result of the evaluation. A new discussion, titled explicit vs. tacit knowledge was held among the participants in a specific location with seven chairs and some tables. Finally, the admin asked users to gain their Access Token via the 2D application. Continuously, it was requested that certain tasks be carried out in a specific time, such as adding a new comment on an existing discussion or creating a

[4] http://www.youtube.com/watch?v=OEOlLXSrtE0

[5] http://www.surveymonkey.com/s/WVWQMGH

new discussion from the virtual world in a Facebook group. The figure 12 captured during this trial session.

It seems the experiment has confirmed that, learning outcomes are associated with rate of high-fidelity interaction among the participants in the 3D spaces. Therefore, each component in a learning environment which can help to increase this type of interactions, may be suggested as a positive factor for such systems. For instance, since the *avatar* employed to express the users' emotions as well their reactions, it may be a beneficial element for the virtual worlds. In the context of this project, adding some representative fidelities aspects such as user representation and spatial audio besides interaction features such as the ability of verbal communication to the members of Facebook Group, could cause certain learning benefits among them. Since Facebook Group can encourage the students to contribute in the discussions, because of its popularity, it can be applied as a communication media to raise the rate of interaction. This factor also considered as learning affordances for the proposed system. It can be thus that, there are similarities between the attitudes articulated by the learning benefits in this study such as collaborative and contextual learning and those described by Dalgarno in [28].

Upon completion of the evaluation process, the statistical information from the questionnaire reviewed and analysed. These results divided into two separate categories including the outcome of the task-based usability test, which was calculated by the evaluator, and the scores of the questionnaire queries which were filled in by the participant. In the following, some remarks from the results are collected.

- The differences between tacit and explicit knowledge were discussed during the trial. Tacit knowledge was more acceptable for 3D virtual learning. However, the explicit knowledge result was over the satisfactory level (satisfactory level is when above 50% of participants grade scale 1 or 2 (extremely/very well).
- The low rating in technological infrastructure (high-speed connection, high graphic requirement …) was predictable, and we received more than 70% dissatisfaction on this item. Similarly, no one was completely satisfied with navigation through the virtual world; however, they were not disgruntled either.
- Before this session, all of the participants had the same opinion; they believed that Social Networks could distract students from concentrating on learning purposes. After the evaluation, surprisingly, 70% changed their mind and agreed with the possibility of using a group of Social Networks for learning purposes.
- Astonishingly, an unexpected result occurred on the proposed system, where 70% believed that this system could be beneficial for learning systems. Just 10% of the participants strongly disagreed with using a virtual 3D environment for learning.

From these outcomes, it can be therefore concluded that the idea of this integration seems to be valuable for the learners with regard to both social and educational viewpoints.

V. CONCLUSION

This paper investigated the potential of using a Social Network group or community in developing a 3D virtual collaborative learning environment. The challenge was to find a novel innovative approach to support learners' requirements, such as accessibility for learning collaboratively. A 'group' or 'community' within a Social Network was assigned as a research variable since its members have a common goal, which is compulsory for collaborative activities.

Based on the breadth and depth literature review, there were few studies to connect these two mentioned fields. A new hypothesis was posed which claimed that '*The integration of a Social Network Group or Community into 3D Collaborative Learning Environment can better meet the learners need*'. Therefore, the requirements for designing and implementing an integrated system were identified and a prototype was proposed which has four certain functionalities required for an integrated system including: *authentication and authorisation*, *retrieving data*, *create a new discussion* and *add a new comment*.

Since Facebook is known as the most popular Social Network in the world, a Facebook Group was selected as an instance of an online social community. The idea of using Facebook in *group form* instead of its typical manner offers excessive motivation for its members to shape their interaction into goal-based communication which is highly appreciated in the learning environment, where users seek for knowledge during their interactions. Based on this statement, it seems that Social Network Group or Community has enough potential to be applied to intelligent learning systems such as 3D virtual collaborative learning environments. An example of this environment applied in our prototype was the Open Wonderland platform.

One of the required actions for the hypothesis was to develop a new Wonderland module to integrate these two platforms. The implemented module communicates with the Facebook Group via an Access Token which is used for privacy, authentication and authorisation purposes. To generate an Access Token, a new Facebook Application was developed which employs the OAuth 2.0 technique to link the user to their Facebook account. Moreover, this application was applied to create a new post or add a new comment from the 3D world to the Facebook Group. Therefore, the developed Wonderland module supports mentioned functional requirements of the proposed model and represent group contents of Facebook into virtual world.

The initial results of the questionnaire illustrated that the prototype was accepted among the trial-session users and it encouraged them to participate in the discussion and interact with other group members more effectively. Furthermore, they were able to access to contents very quickly via the Facebook Group as well as connecting to the 3D virtual world. The other issue which was appreciated by the participants was the ability to navigate to the Facebook profile of each user since they did not know each other in the beginning of the session.

Overall, returning to the hypothesis, it seems that using a Social Network Group or Community within a 3D virtual collaborative learning can improve the ability to meet learners'

requirements for collaborative learning tasks. One implication of these findings is that both social group interaction and the concept of accessibility should be taken into account for a 3D collaborative learning environment.

Considerably more investigation is required in order to develop a comprehensive integrated module. For instance, one of the most attractive features for the learners, based on the user request, can be recording the voice conversation among the students and saving it to the Facebook group as file content. This can be done via a module within the Open Wonderland platform. With this functionality, learners can listen to their previous conversations. Moreover, this functionality can help the learners through gaining tacit knowledge. The other important functional requirement can be checking the popularity of content. This functionality may be more important for teachers than learners. They can understand which content is more attractive for the learners and which content does not motivate them enough to initiate discussion.

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