

Experiences from Implementing an Educational MMORPG

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Abstract— This paper describes the implementation of an educational Massively Multiplayer Online Role-Playing Game (MMORPG), named World of Wisdom (WoW). WoW is designed under the context of game design theory and game features extracted from surveys of popular MMORPGs. It is an open educational platform where students can “play exercises” instead doing them in the traditional paper way. Further, it provides an editor for teachers to create new game plots and content without the need of programming. As an aid for lectures, WoW can motivate the students to do the exercises more thoroughly. Finally, the paper presents both positive and negative experiences from the design and implementation of the game. We find that there are various theories that can benefit the design of educational MMORPGs. However, the key problem is how to choose and apply relevant theory to support the design, our experiences in the paper are examples that explore and explain this problem.

Keywords - MMORPG, Flow theory, educational game

I. INTRODUCTION

Massively Multiplayer Online Role-Playing Games (MMORPGs) have recently achieved tremendous success, and its characteristics can be beneficial for the learning purposes. Further, there are some cases studies [1-5] that describe how to apply the learning in MMORPGs, and evaluate its effectiveness for education. Most of these evaluations show positive results that such games can motivate the learners to study more actively. This also certifies that educational MMORPGs are fun to play and provide good learning experiences. Based on this context, our research has been to look into these kind games and identify how features from popular MMORPGs can be applied in educational MMORPGs to enrich useful design methods that guide the implementation of educational MMORPGs. In detail, we will present a short survey of recent educational MMORPG games, and investigate their design and implementations. And finally, we will propose an educational MMORPG design method to implement a MMORPG for learning, named World of Wisdom (WoW). This WoW prototype presents an open knowledge world for reviewing the contents of various courses. Finally, we discuss the positive and negative experiences we learned during the process of designing and implementing WoW.

The goals of WoW project are: 1) Develop an 2D educational MMORPG that can be used as an aid in lectures in

higher education instead of traditional paper exercises by providing “playable exercises, 2) Provide the toolsets for WoW that can be used to create new games for different courses without any programming requirements, and 3) Provide an example on how to design an educational MMORPG through supportive theories to make it enjoyable and effective for learning. WoW is mainly considered as a supplement to the formal classroom teaching in order to diversify lecture teaching. How to combine WoW with the course content depends on the lecture design of the teacher. We can use it in the classroom for a short time playing to review several knowledge points or let students play it on their own.

II. METHODS FOR DESIGN

A. Game design theory

Through our survey, we found that there are very limited game design theories that guide the design of educational MMORPG games. Most of common theories are from Malone. Here we give one example of a game design method from Nicoletta and Kelly [4] that have defined a set of game design criteria which are likely to promote user’s interest, enjoyment and learning; these elements are adapted by us and summarized in Table I. These features are from the three elements of intrinsic motivation (challenge, curiosity, and fantasy) identified by Malone and Lepper [6, 7].

TABLE I. GAME ELEMENTS FOR DESIGN ADAPTED FROM MALONE AND LEPPER

ID	Game elements that may promote engagement, motivation and fun	Reference
1	A shared, imaginary story context that establishes and support the activities	[8, 9]
2	An overarching goal	[6, 8, 10]
3	A gentle on ramp	[6, 8, 10]
4	Multiple levels with variable difficulty	[6, 11]
5	Uncertain outcomes	[6, 8, 10]
6	Various ways to win	[9]
7	A well defined advancement system	[6, 8, 9]
8	Rewards associated with advancement	[6, 8, 9, 12]
9	Opportunities to build new content	[8, 9, 13]
10	Ability to progress at the user’s own rate	[9, 10]
11	Hints not answers	[10]

To our knowledge, there are no papers that specifically describe examples of applying other game design theory beneficial for the design of MMORPGs. Thus, we would like to apply the flow theory from Csikszentmihalyi [14] for game design. He has conducted extensive research into what makes experiences enjoyable, based on long interviews, questionnaires, and other data collected over a dozen years from several thousand respondents. Flow is an experience “so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous” [14]. Two individual papers by Sweetser and Cowley [15, 16] map the elements from games literature to the elements of flow, shown in Table II, adapted by us.

TABLE II. MAPPING THE ELEMENTS FROM GAMES LITERATURE TO THE ELEMENTS OF FLOW

ID	Flow theory	Games play elements
1	A task that can be completed;	The game
2	The ability to concentrate on the task;	Concentration
3	Concentration is possible because the task has clear goals;	Clear goals
4	Concentration is possible because the task provides immediate feedback;	Feedback
5	The ability to exercise a sense of control over actions;	Control
6	A deep but effortless involvement that removes awareness of the frustrations of everyday life;	Immersion, Flexible challenge
7	Concern for self disappears, but sense of self emerges stronger afterwards;	Immersion, Links between of virtual and real worlds.
8	The sense of the duration of time is altered.	Immersion
9	N/A	Social interaction

B. Characteristics from MMORPGs

Since we plan to implement a MMORPG for learning, we have surveyed current trends of MMORPGs and their characteristics. Finally, we would like to quote results from Achterbosch [17]. He attempts to determine the many aspects that make a successful MMORPG by a questionnaire survey. He also attempts to ascertain what new and innovative features are expected by the users from the next generation of MMORPGs. The research focuses on four areas of MMORPG: the social interactions between players in MMORPGs; the different architectures to build MMORPGs; the effects of latency on MMORPGs; and the problems that plague MMORPGs. We summarize the most popular and relevant features in Table III that could be used as indications for the design of educational MMORPGs. And some of the features were ignored, as they were only relevant to pure commercial MMORPGs, and to a less extent to the educational field. Such as some features feedback by the player, like “real world services”, “elaborate crafting system”, and “competition for resources”. These are not common issues relevant for learning games. Most relevant features for design of an educational MMORPG are shown in Table III.

TABLE III. MOST RELEVANT FEATURES FOR DESIGN OF AN EDUCATIONAL MMORPG

ID	Existing features	Remarks
1	Three character development models	Skill Points-Based System; Class-Based System; Combination of Class/skill
2	Multiplatform Support	-
3	Highly Customizable Characters	-
ID	Favorite Features	Remarks
4	Preferred Character Types in Ranking	Combination of Class/skill; Skill Points-Based System; Class-Based System
5	Top 3 Game setting	Fantasy, Futuristic, Post Apocalyptic,
6	Top 5 MMORPG	Lots of class/skill options, Graphics and effects, Large world to explore, Play vs Play, socialization
ID	Improving existing features	Remarks
7	Player versus Player combat	Such as balancing between classes
8	The level Grind	Repeated battles to level up
ID	Anticipating new features	Remarks
9	Player created and controlled content	-
10	Mini games	-
11	Dynamic content and quests	-

C. Final design for WoW

According to above preparation work, most of WoW’s features are based on what being described in Table I-III. Here we give examples of designs that are from above design methods, shown in Table IV. The left column is our design and right three columns are reference IDs for this design feature.

Such as *A* feature from Table IV (shorted as “A”), it mainly comes from the ID 1 in Table I, and we choose kingdom as a fantasy world since fantasy is top one game setting from ID5 in Table III. And the feature *B* is designed based on the ID 2 in Table I and relevant to ID 1,3,4,6 from the Table II when we implement it in detail. Also, the feature that is no need to struggle with level up is in *B*, which is from ID 8 in Table III. The feature *C* is designed mainly based on the ideas of flexible challenge to the different players. The features *D* and *E* are designed based on the idea of providing random rewards after killing the enemy non-playable character (NPC) or finishing the quest, making player feel encouragement and immerse in the game, but *E* also shows that the game is only one part of the lecture content. The feature *F* is hinted by the factors in the ID 1, 3, 4 in Table III. The toolset from feature *G* is inspired by the new content creating from ID 9 in Table I and ID 11 in Table III. The feature *H* mainly comes from ID 6 in Table II. Feature *I* has many functions, such as teacher can give hints (ID 11 in Table I), or discuss with the teacher for other help and make socialization (ID 9 in Table II, ID 6 in Table III). The feature *J* is an example that high score student will get bonus in real world by the teachers. The features *K* and *L* are two cases from Table III.

All of above features are general features, which are only a part of the whole WoW’s feature set, but we can design based on these features to make WoW more concrete and interesting. Besides of these features, we still have others issues, like

technical implementation, which describes in the following sections.

TABLE IV. FEATURES OF WoW AND ITS REFERENCES

ID	Features of WoW	ID in Table1	ID in Table2	ID in Table3
A	Consider each course as one imaginary kingdom, the kingdom have safe zone and battle zones. In each kingdom have different quests issued to the players	1	-	5
B	The goal is various and intact. Such as one quest requires you get level 2 from battles, but no more level up.	2	1,3,4,6	8
C	We classify the quests from easy levels to hard levels. Also we classify the questions from easy level to hard levels.	3, 4.	1, 2,	11
D	We have different random rewards (item, experiences) to the player if they win the battle.	5, 8	4, 6,	-
E	The exercises will have different definite way to win according the lecture design.	6	-	11
F	Character Development Models are mixed of class and skill-based	-	-	1,3,4
G	Use toolset to create new worlds, such as new and large battle zone, monsters or update questions	9	-	11
H	Have different level quests to challenge the newer player and skilled players.	-	6	-
I	Teaching assistant can log in world and help players. Players could chat each other or to teaching assistant.	11	9	6
J	Playing exercises is part of the lecture, having effect to the real world, Also best player gets bonus in real lectures.	-	7	-
K	Choose Java as main programming language	-	-	2
L	Mini game	-	-	10

III. FIRST PHASE: WORLD OF WISDOM

This section describes the prototype of WoW from aspects of the game plots and architectural design.

A. World of Wisdom introduction

World of Wisdom provides several kingdoms, where one specific kingdom focuses on one curriculum (one course). Each kingdom has several zones, mainly categorized as safety zone and battle zones. The safety zone has re-spawn point, shops, buildings, etc. If players get quests from a NPC or a teacher, they can go to the different zones to complete quests. If the quest involves some fighting, the players should go to the battle zones, and they will fight with monsters though answering different questions related to the curriculum. Further, the players and teaching assistants can chat with each other in WoW for socializing or help purposes.

Figure 1 shows the battle zone with different players and enemies. On the bottom of the figure are chatting window, player status, and system button from left to right. Figure 2 shows a screenshot of a question popping up during battle. Here the player has one minute to answer a question. The question is answered by selecting one of the alternatives below the time-left counter.



Figure 1. Battle zone from WoW



Figure 2. Questions during battle from WoW

B. Prototype overview

The prototype is divided into four applications: Client, Lobby Server, World Server and Database Server. The applications use a common package called Shared Library, which contains models used by several applications and the shared network implementation for sending messages between the applications. Figure 3 shows an architectural overview of the World of Wisdom prototype.

1) *Client*: The client is the main program for the user to log on to a kingdom. When starting the client, it connects to the Lobby Server, and the user creates or inputs a username and password. The Lobby Server checks if the information is correct via the Database Server. If the user is authorized to log on, the Lobby Server will return a list of World Server that the user may connect to. When the user has connected to a World Server, the user will be in the game world. Client will present the kingdom that user plays in. While in the kingdom, the user may fight with enemy or walk around and chat with other players. The user can also look at the states of the character,

attributes, attacks and inventory. In the inventory the user can drag-and-drop items from their bag onto their body to equip items.

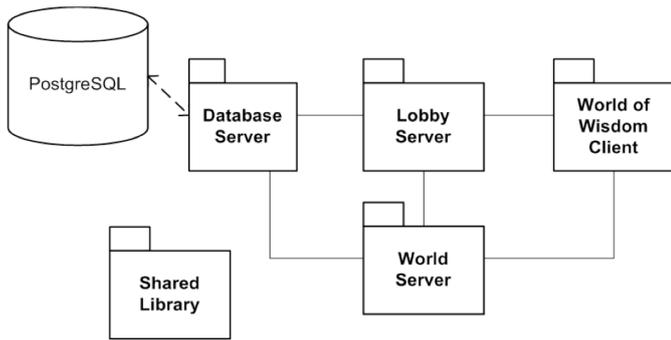


Figure 3. Architectural overview of the WoW Prototype

2) *Lobby Server*: The Lobby Server handles the verification of players, and contains a list of the World Servers that are available online. The Lobby Server is a small but central part of the WoW prototype.

3) *World Server*: The World Server contains the game worlds that the users can move around in. When the world server starts, the teacher will choose a kingdom to register as an online state and informs the Lobby Server, so that users may connect to. When the user performs an action, like movement or attack, a message will be sent to the World Server with information about the action. The action will then be handled, and in case of movement, it will be broadcasted to the other players so that their worlds are updated.

4) *Database Server*: The Database Server receives and handles requests from the World Server and the Lobby Server for access to the PostgreSQL [18] database. It uses serializable objects to package the information and send it over the network using the TCP/IP protocol in Java.

IV. SECOND PHASE: WOW EDITOR

Before creating the WoW toolsets, we performed a survey on the features of different toolsets in MMORPGs and tried to integrate educational functionality when designing an editor that are helpful for the teachers to create their own kingdom (course) and input relevant questions and answers in the WoW educational MMORPG.

A. Preparation works

The earlier type of game editors were often simple, using text editors, or using simple primitives for representing game elements, such as the editor that was made for Wolfenstein 3D [19]. It was not an official editor, but shows how colors and letters can be used as representatives when creating a map. The letters represented object, like creatures or power ups, and colors represented floors and walls.

Recent game editors are more advanced and often feature in-game graphics that shows how it will look when you play in the maps. Examples are Trackmania [20], which is a arcade

game, and Farcry [21], which is a first person shooter. This allows quick testing of changes and also makes it faster to develop new maps (levels). Another example is the Adventure Construction Set [22] from 1985, which could be used to generate entire role-playing game. Trackmania from 2003 to 2008 offers an easy to use in-game level editor, whereas LittleBigPlanet [23] from 2008 contains a perfect example of a state-of-the-art game with an integrated editor which is also a part of the gameplay itself. Aurora [24] is the game engine developed by Bioware for the game Neverwinter Nights, and the Aurora Toolset is the world editor that comes with the game. With this editor the players may create their own worlds and alter most of the variables in the game, like spells, monsters, NPC dialog, etc.

B. WoW Editor Interface Design

The main function of the WoW editor is to provide convenience for the teachers to create game levels, and update questions databases (not available for the players/students). The design of the WoW editor GUI is shown in Figure 4:

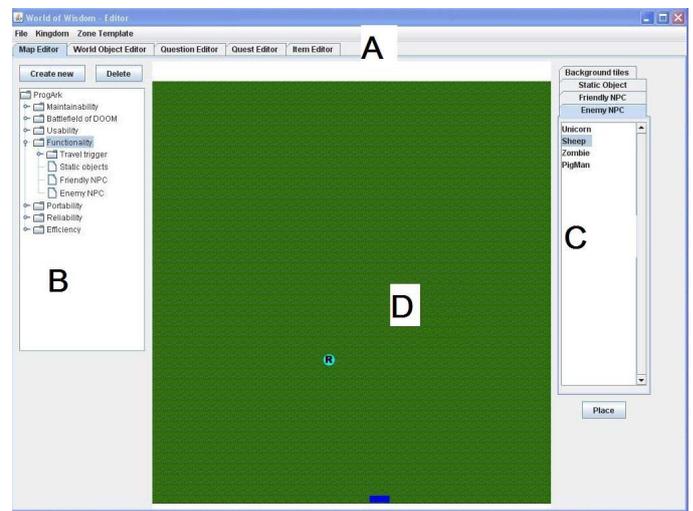


Figure 4. World of Wisdom Editor

We divide editor interface into four areas, as A, B, C, and D. Each area has its own function. A is the toolbar with major commands and preferences, including five panels: Map editor, World editor, Question editor, Quest editor and Item editor. B contains a list of the objects corresponding to each panel from A. C contains the content and its attribute that can be placed in the world. D is the main display that shows the world, and where most of the work is done.

Figure 5 is five screenshots of all panels, from the top to bottom is Map editor, World Object editor, Question editor, Quest editor and Item editor respectively.

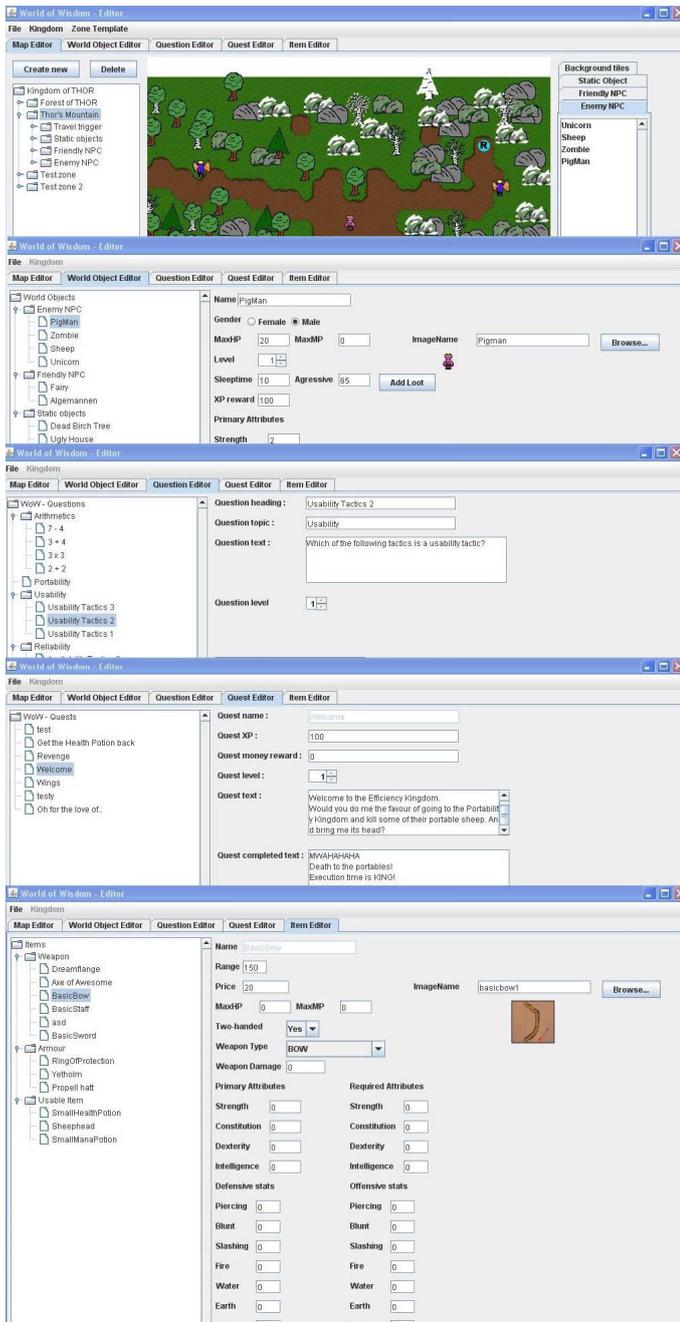


Figure 5. World of Wisdom Editor

1) *Map editor*: It is mainly used for creating different zones in a kingdom, such as add maps, trees, stones, friendly and enemy NPC in different zones, or put a trigger between two zones when a player wants to enter from one zone to another.

2) *World objects editor*: Teachers can add new world object and its attributes through world objects editor, such as new enemy NPC. It can also load this NPC images through external links.

3) *Questions editor*: Teachers can add or update questions through questions editor. And the questions can be classified

into various categories, and marked with varying levels of difficulty.

4) *Quest editor*: Teachers can add new or revise quests' content through the quest editor. The quests are marked with different difficulty levels with corresponding rewards.

5) *Item editor*: It can be used for adding or updating item attributes.

C. System overview

Figure 6 is an updated overview of the WoW system including the WoW Editor. Compared with Figure 3, WoW editor, shorted as world editor in the Figure 6, communicate directly with the Database server.

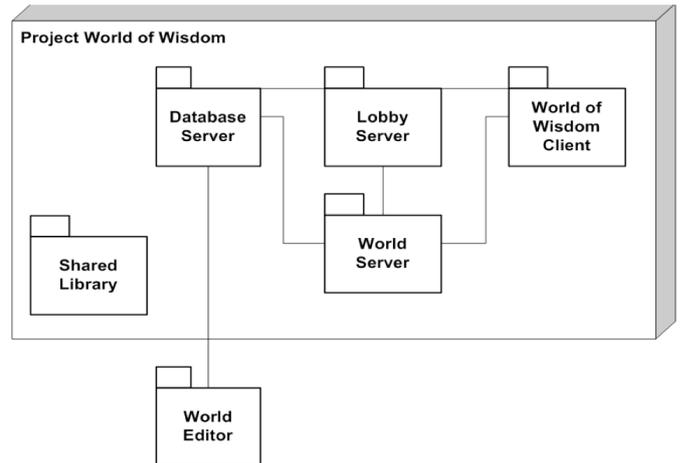


Figure 6. Architecture of World of Wisdom Editor

D. How to create a kingdom and exercises for students

Since WoW is an open educational platform, it can serve different courses. Here are the steps the teacher needs to go through to create the game world without any programming requirements:

First, the teacher uses the WoW editor to create a kingdom for a specific course. We can use the WoW editor to paint the maps or load an existing map template directly. *Second*, the teacher can use the Map editor to place the NPCs and items or he/she can create new NPC and items through the world object editor and the item editor. *Third*, a teacher will create the quests and questions in the kingdom. For the questions used in the battle, a teacher can input questions of varying difficulty levels related the course, and link these questions to different levels enemy NPCs. Similarly, quests can be created and issued to the friendly NPCs. *Finally*, students can log into the world and find friendly NPCs to get quests and go to the battle zone to perform challenging tasks. Figure 7 shows an example of a final kingdom ready to be played.

V. DISCUSSION: EXPERIENCES FROM DESIGN AND IMPLEMENTATION

This section presents experiences we learned during developing an educational MMORPG.

A. Positive experiences

We would like to share our positive experiences that could be useful as reference for others wanting to design and implement an educational MMORPG.

- **Use game design methods to guide the design and implementation.** When preparing to develop an educational MMORPG game, we had limited supportive theories to use. Most of the examples describe a direct way to implement MMORPGs for learning from their own experiences, but without any support in theory. Here we propose to apply suitable theories for this genre in the game design. Further, we provide an example of how to apply the combination methods of Malone, flow theory and features of MMORPG in the integrated design of the WoW framework. We find it quite useful to use this approach during the process of design and implementation. Most of the functions and scenarios become more and more concrete and interesting through the interwoven design method.

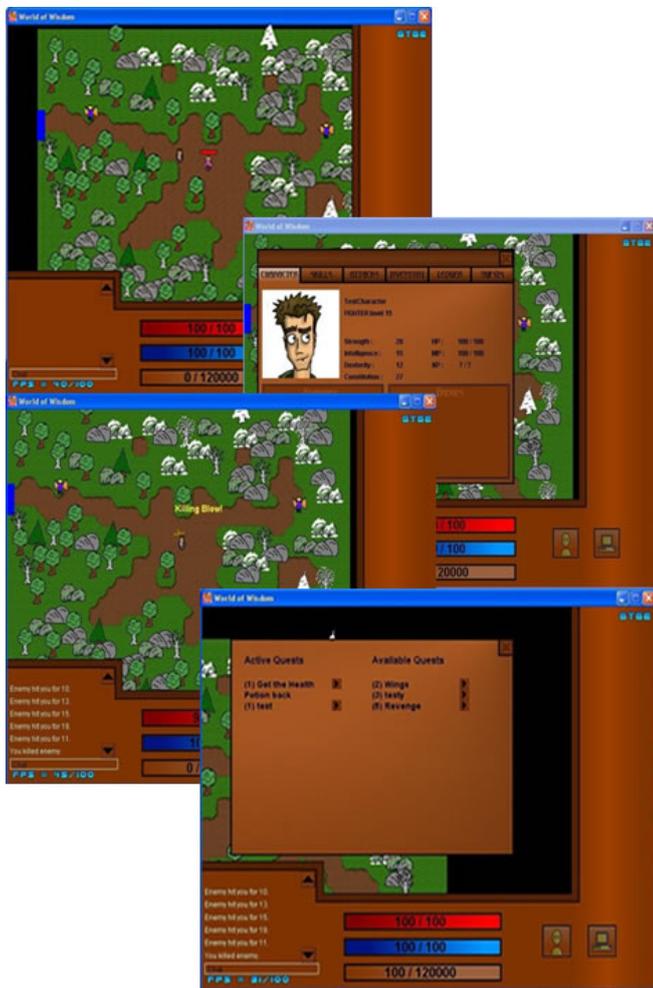


Figure 7. World of Wisdom

- **Use toolsets to create games based on the WoW framework.** Our toolset was inspired by some open editors from existing computer games, which can be used to create new maps and scenarios for game players without requiring any programming. This makes possibility for users to create their own imaginative worlds and plots from the existing game frameworks. We extend this type of editor to provide not only the creation of traditional game plots, but also related educational functionality. Thus the teachers can create new games for courses, and update questions databases and quests using the provided editors.
- **Massive Multiplayer Foundation.** The system is designed with several servers (world server, database server and lobby server) to support the client. This is an important part of a MMORPG architecture since these server are implemented with some specified functionality. The client must log in with the lobby server before being allowed to join one of the potentially many world servers. Both the lobby server and world servers talk to the database server to get information from the database. From our experiences, this foundation, while somewhat time-consuming to develop, proved to be reliable and effective. We had little problem with this aspect of the system, other than it consumed quite a lot of development effort.
- **Good Teamwork.** The developers are all last year master students from Norwegian University of Science and Technology. It is positive experiences that students can works in pairs or groups to implement the projects. They can cooperate with each other to solve the coding problems and use their personal advantages to help teamwork. Another benefit of using students to implement such games is that the students know the game genre well and how such games should behave since they are regularly playing such games.

B. Negative experiences

These negatives experiences need to be taken care of and could be seen as improvement reference for the educational MMORPGs.

- **Lack of pedagogical background or learning theory to support the design.** Even we use game design methods to implement the WoW, adding learning theory should improve the prototype and make it more effective for learning. Sancho describes how MMORPG can be applied to problem-based learning [5], while Economou shows how MMORPG can be applied to collaborative learning [25]. These papers can be a starting-point to improve our WoW design methods. Since the mini-games in WoW are still under development, we will consider applying the learning theory in the mini-games.
- **Lack of MMORPG features.** There are still other interesting or anticipating features from Achterbosch's survey of MMORPGs [17], such as "Technical enhancement", "Item crafting and Player Economy", to have a game master (an intermediary) between the

developers and players [26]. Due to our limited resources and time and that these are not highly relevant educational factors, such features are not implemented in our prototype.

- **Use of other theory.** Besides of learning theory and game design theory, there is still room for using other theories to support educational MMORPGs design. One example is from Nicoletta and Kelly [4], using color psychology to guide the design: “The choice of the color and lighting schemes was based on research studies on the impact of color and light on learning [27, 28], and on the association between colors and children’s emotions [29]. One study shows that desaturated colors have a negative impact on stimulation while highly saturated colors increase alpha waves in the brain which are directly linked to awareness.” It will demand a huge amount of work to do experiments of different supportive theories to design educational MMORPGs. Further, there might be duplicating or conflicting parts in these theories. If this is the case, we need to conduct more experiments to gain more experiences to make trade-off between these theories during the design process.
- **Limited help from a game engine.** We chose to use an existing game engine to develop WoW to save time. Since our game should be cross-platform game, we only considered Java game engines. Based previous experiences, the most parts of the Golden T Game Engine (GTGE) [30] works well, but suffer from some existing bugs. Such as, when the file could not be found on the hard drive by using the URL, it returns a null object, and this caused a null pointer exception in GTGE. The problem was that the GTGE framework returned an error message, but didn’t throw an exception, so the line where the error occurred was not specified as usual with error traces. As a whole, the GTGE is a decent game development framework for Java, but we did encounter a few issues while using it. In the end we are not sure if we really saved much time by using the GTGE, since of the time demanded to learn the parts we used, and fix bugs that we found. In the end, we did not end up using much of the GTGE framework and had to implement most part of WoW from scratch.
- **Lack of intact documentation for a long project.** This WoW project has lasted more than one and half year. We developed the WoW prototype first, and later continued to add the editor functions and make some changes. Since the developers are all students with half year projects, it is necessary to keep the intact logs and complete development documentation useful for the new comers to the project. Even we predicted this problem, we encountered problems of effective software management. We cannot predict which logs are important for the new incoming coming students since they can choose their own focus on the project. We try to put everything in logs, but it costs a lot of time and the work might be useless. To overcome this problem, we make the student do the most important

key documentation. This is not always easy, as the students have different background in programming, experiences in Java and MMORPG, and what one student find is sufficient documentation is not always sufficient for another. Another aspect is that we suggest making a classification of the documentation to enable quick search and identify the information we need if the logs become too large and too cluttered.

As a summary, it is still harder than we think to use an interwoven design to implement an educational MMORPG, but we think it will pay off in the long run. Such a design approach covers various design methods that exceed the field of learning, and games design theory. Our experiences presented in this paper are examples that explore and explain this problem.

VI. CONCLUSIONS

This paper describes the implementation of an educational MMORPG game and shares related experiences, including positive and negative aspects. Most of the features of our WoW game come from existing game design methods. But based on our experiences, we find that there exists a cross-topic of applying design methods to educational MMORPGs. From the case study, we find that more research and experiments are needed to find a set of criteria or a framework to guide the design of the educational MMORPGs. This is not end, it is just a beginning of research in this area.

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