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Evaluation of a dynamic role-playing platform for simulations based on Octalysis gamification framework

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Abstract. The use of serious games (SG) in education and their pedagogical benefit is being widely recognized. However, effective integration of SGs in education depends on addressing two big challenges: successful incorporation of motivation and engagement that can lead to learning; and high cost and specialised skills associated with customised development to achieve the required pedagogical results. This paper presents a SG platform that offers tools to educators to dynamically create three dimensional (3D) scenes and verbal and non-verbal interaction with fully embodied conversational agents (ECA) that can be used to simulate numerous educational scenarios. We then evaluate the effectiveness of the platform in terms of supporting the creation of motivating and engaging educational simulations based on the Octalysis gamification framework. The latter includes a number of game design elements that can be used as appropriate in the optimization of the experience in each phase of the player's journey. We conclude with directions of the further extension to our platform to address the aforementioned gamification framework, as well as directions for further development of the Octalysis framework.

Keywords. Gamification, framework, Octalysis, dynamic, role-playing platform, simulations, cognitive, learning

1. Introduction

A number of projects have investigated the use of SG in education and their pedagogical benefit is being widely recognized. The successful use of SG for learning is based on adopting gamified elements that support increased motivation and engagements which are usually considered prerequisites that lead to learning. The incorporation of game elements in non-game contexts is widely referred to as "gamification"[1][2]. Gamification is being increasingly recognized [5] as the process/technique of extracting motivating and engaging elements found in games and applying them to real-world productive or educational activities. Chou [2], recognizes this process as "Human-Focused Design" or else User-Centered Design (UCD), which appreciates user motives, cognitive and emotional states and therefore optimizes for their feelings, motivations, and engagement, as opposed to "Function-Focused Design",

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which is designed for pure efficiency. The term gamification has been adopted because it was the games industry that was the first to master UCD.

The successful incorporation of gamification particularly in educational context is challenging. Rickel [6], notes that stories with interesting characters have a powerful ability to engage and capture our attention and leave memorable impressions. Students, in interactive smart virtual environments (VEs) with interesting virtual characters, may experience the scene in a more interactive, engaging and immersive manner. Hence, the virtual experience can enhance their learning constructively by providing new educational capabilities [7]. A number of research projects have attempted to embody virtual characters with verbal and nonverbal communication and to evaluate their impact in computer-based learning environments [8][9]. Generally, ECAs allow richer learning experiences as the interaction is multimodal (e.g., gaze, facial expressions, head nods and gestures).

However, despite the increased number of systems featuring ECAs in various learning domains, current systems offer limited options to instructors to adapt the system to suite various scenarios within a single domain, not to mention to apply gamified elements that would aid the educational experience. Typically, these environments offer a level-builder that allows some degree of content adaptation. In particular, users can load a predefined 3D object in the builder and modify its appearance through a menu of choices. The main advantage of this approach is that the user can apply various props (e.g., hair, clothes, etc.) on the 3D mesh without modifying its basic attributes (e.g., animations, morphs, etc.). Creating fully instructor/lecturer-driven scenarios requires tools that allow the creation of custom-made 3D environments (including the appearance of the models and the content of the dialogue between the student and the ECA) and gamified features, like competition, time constrains, levels of difficulty, milestones, feedback etc. that fully reflect a given scenario.

Section 2, of this paper presents a SG platform architecture that allows the dynamic creation of 3D scenes, interaction with ECAs and setting up milestones and duration to simulate numerous educational scenarios, without requiring specialized technical or artistic skills. Section 3, we present a gamification framework, which includes a number of game design elements that can be used in the optimization of the experience of the player's/students journey. Section 4 evaluates the effectiveness of the aforementioned platform in terms of supporting the creation of motivating and engaging educational simulations based on the Octalysis gamification framework. The paper concludes with directions for further extension to the SG platform to address the Octalysis framework, as well as directions for further development of the framework.

2. Westminster Serious Games Platform (wmin SGP) System architecture

The wmin SGP has been designed following a UCD process, aiming to address specific educational requirements in Higher Education of academics of the Department of Politics and International Relations and Westminster Law School at the University of Westminster, who use simulations as teaching and learning tool. The wmin SGP is a 3D interactive system that allows multimodal interaction with ECAs (play mode) and dynamic creation of gamified scenarios and dialogues with the use of an intuitive graphical user interface (GUI) (edit mode) [12]. Thus, the wmin SGP promises to enable the creation of endless scenarios intended for a wide range of topics and student needs.

The Wmin SGP edit mode (see Figure 1) consists of five components:

1. *Scene Editor (SE),* which offers a matrix-style environment where instructors/learners can develop custom-made scenes with fully-functional ECAs.
2. *Natural Language components (NLC)*, which processes input text in plain English and generate relevant responses.
3. *The non-verbal behaviour generator (NVBG)*, a rule-based component that analyses an ECA response and proposes appropriate non-verbal behaviours (gestures, face expressions and gases) which is defined in its behavioural file.
4. *The Speech components (SC)*, a Text-to-Speech (TTS) component generates the ECA's speech and the timing needed to synchronize the speech with the non-verbal behaviours.
5. *The Dialogue Editor (DE)*, a tool designed to help instructors/learners create dialogues and select relevant non-verbal behaviours.

To build a role play simulation, instructors/learners must go through five steps:

1. Create the 3D scene and bring in Virtual Humans (VHs) – Instructors/learners can load an empty environmental template and VHs to create a scene that fully reflects the requirements of a given scenario. The GUI offers tools and guidance to assist the editing process (see Figure 1). Objects have a standard menu with various manipulation options (e.g., move up or down, rotate, etc.). A dummy character provides a visual indicator of the user's viewpoint of the scene.
2. Create a text based introduction to describe the game objectives.
3. Create Conversational Milestones – Conversational milestones are key-points in the dialogue that can be displayed to aid/direct the learners to elicit the required information via their interaction/communication with the VHs. It is also a means of feedback for the learners about their progress in achieving their goals.
4. Toggle simulation timer – Content authors can increase the level of challenge each scenario poses by adding a countdown timer. This means that learners have to play against time to meet the requirements of the scenario. The game ends once the allocated time has expired.
5. Create and assign dialogues to characters using a modified version of the virtual human builder (VHBuilder)– Instructors/learners define the verbal and non-verbal responses of the ECAs in the scene. Q&A pairs are entered in plain English and are linked to VHs and behavioural rules (animations, facial expressions) can be modified or created. The tool can access a number of predefined libraries of face, body and location animation (e.g., walking, running, etc.).

Once a simulation is completed it is being added in a database/a library of simulations that can be accessed from a drop down menu. The users can then play/run the simulation and interact in the VE and with the VHs in order to: for learners, to achieve the objectives of the simulation; or for instructors, to assess the completeness of a simulation that learners might have created.

The wmin SG platform has been developed using Unity 3D game platform [10] coupled with the ICT Virtual Human toolkit [11]. The latter is an open-source collection of modules, tools and libraries that facilitates the creation of ECAs. Its main render is Unity3D that makes contents created with the toolkit accessible through the WWW through Unity's Web player.

Figure 1. A screenshot of the edit mode of the wmin SGP that provides guidance to the user to edit the scene and use the available editing tools.

Empowering lecturer/instructors to create custom-made scenarios and iteratively improve them with the help of the students should provide a more comprehensive coverage of the intended learning outcomes than when the scenario is crafted by the developer alone. The Octalysis framework which is presented in (Section 3) offers the potential to reviews the gamified features supported by wmin SGP that contribute to the creation of engaging and motivating educational experiences.

3. Octalysis gamification framework

Octalysis is a framework that organizes systematically a list of gamified elements or cognitive drives (see Figure 2) that can be used in UCD to make an application engaging and motivating [2]. The framework suggests that almost every game is "fun" because it appeals to certain core drives within human that motivate players towards certain activities. The Octalysis framework organizes those motivating factors into the following 8 core drives which is based on an octagon shape hence its name:

1. *epic meaning and calling* is the need to participate in something bigger than just yourself;
2. *development and accomplishment* is about motivating people because they are feeling that they are improving, they are leveling up and achieving mastery;

3. *empowerment of creativity and feedback* is the core drive that motivates people to incorporate their creativity, try different combinations and strategies, seek feedback and adjust;
4. *ownership and possession* is the primary core drive that motivates people to accumulate possessions, improve it, protect it and get more;
5. *social influence and relatedness* refers to the activities motivated by the influence of other people (e.g., by what other people do or think);
6. *scarcity and impatience* is what motivates people to want something they cannot have (e.g., because it is not immediately or easily obtainable);
7. *unpredictability and curiosity* is willingness to discover the unknown outcome and involve chance;
8. *loss and avoidance* refers to the motivating factors that help people avoid situations they do not want happening (e.g., to die in a game).

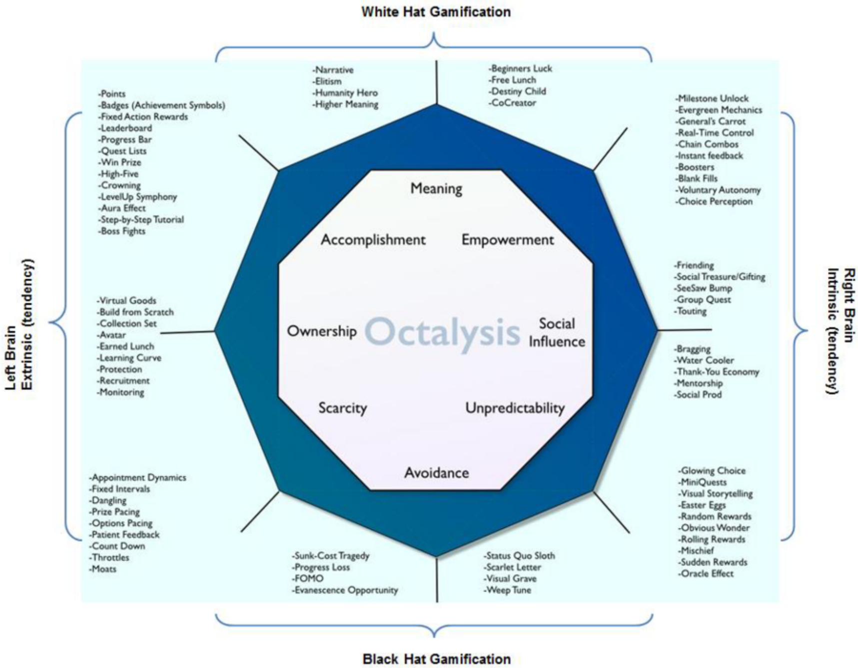

Figure 2. The Octalysis Gamification Framework [2]

Within Octalysis, the core drives on the right (see Figure 2) are considered Right Brain core drive and are related to creativity, self-expression, and social aspects. The Left Brain core drives have a tendency of being more based on Extrinsic Motivation which means that the motivation is to obtain something, whether it is a goal, a good, or anything you cannot obtain. The core drives on the left (see Figure 2) are considered Left Brain core drives and are associated to logic, calculations and ownership. The Right Brain core drives have a tendency of being based on Intrinsic Motivations which means that the motivation is that the activity itself is rewarding on its own and you do not need a goal or a reward.

Some extra dimension to the framework is that the top core drives in the octagon are considered very positive motivations – white hat, while the bottom core drives are considered more negative motivations – black hat. The white hat gamification involves motives that engage the user/player in activities that allow expressing creativity, and achievement through skill mastery, which encourages a higher sense of meaning, confidence and empowerment. The black hat gamification on the other hand involves motives that drive active engagement based on uncertainty and the fear of losing something. Such type of interaction nurtures bad emotions. To achieve good gamification all 8 core drives should be considered on a positive and productive activity so that everyone ends up happier and healthier.

The following section reviews the gamified features that are supported by wmin SGP using Octalysis framework. This analysis provides an indication of how satisfactory the platform supports tools to allow the creation of engaging and motivating educational experiences.

4. Evaluation of the wmin SGP based on the Octalysis framework Core Drives

Creating an experience incorporating the right game mechanics and game design techniques to engage and motivate people to achieve their learning objectives requires deep analysis, reasoning, testing and adjusting. This section reports preliminary expert evaluation result of wmin SGP against Octalysis core drives (see section 3) based on four expert evaluators using the Octalysis Tool. This is an online tool that allows evaluators to assess a product/process against the Octalysis core drives using a scale of one to ten, where 10 is "best" and based on the overall scoring it reports on how well those have been incorporated in the system/process. The scope of this evaluation was to review the wmin SGP play mode features and editing tools (see section 2) that are used to create bespoke game simulations that fulfill specific educational requirements.

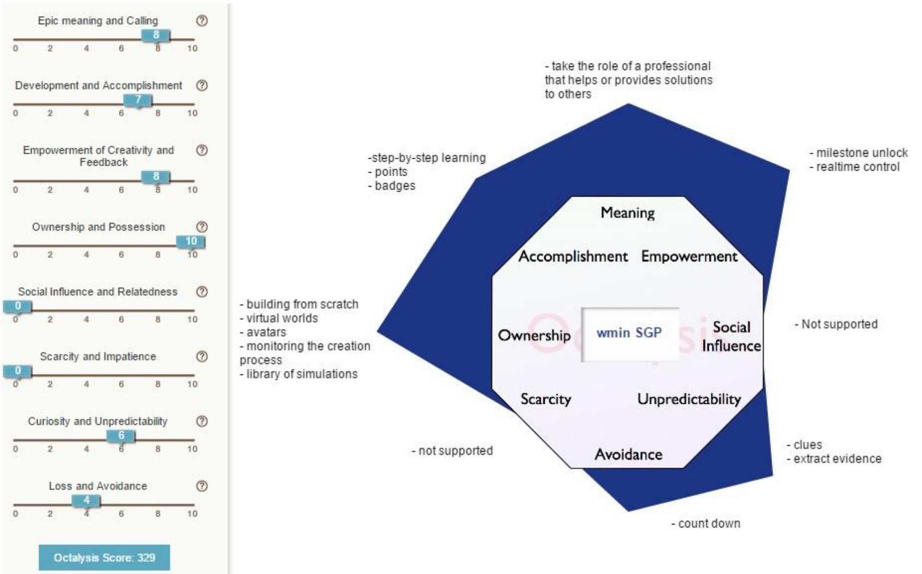

Figure 3. Average of the score provided by expert evaluators to wmin SG using the Octalysis Tool.

The expert evaluators spend enough time getting familiar with the use of the wmin SGP. Then they followed an explicit list of expected user actions to create two game simulations one for politics and one for law, and they have been asked to provide a score for each of the Octalysis core drives for wmin SGP tools and a short justification for their score. Below we provide a summary of the evaluators reasoning of their review, while figure 3, presents the average rating for each core drive accompanied by a graph that demonstrates the balance between them.

Epic meaning and calling – wmin SGP is designed for the creation of simulations that support learners to practice the professional role for which they are being trained. For example they may take the role of a lawyer, a counselor who intends to defend a person in need, or help their client respectively, or the political leader who is involved in influencing public policy and decision making. The simulations engage the learners in a **narrative** that involves **elicitation** of information to apply the law, extract evidence based on which to defend a client, provide the best advice to their client, negotiate or take political decisions. Thus, the platform is considered as a tool that strongly supports meaning.

Development and accomplishment – wmin SGP provides an environment that supports a **step-by-step** process that helps the learners achieve a set of **milestones** linked to learning goals. Milestones could be associated with **points** or **badges** to be won that could reveal their level of achievement.

Empowerment of creativity and feedback – is supported in terms of **unlocking milestones** and controlling the narrative and the way that the activity advances in **real-time**. There are various directions that empowerment could be enhanced that would be very suitable to the abovementioned learning activities. By providing **instant feedback** and awarding learners with boosters for example.

Ownership and possession – is strongly supported by the wmin SGP, as the whole concept of the platform is based on allows **building from scratch** bespoke simulations, with custom made **virtual worlds**, **avatars** and narratives. The five steps process of building simulations presented in (section 2) assists **monitoring** the process of creating the simulations. The system allows the creation of a **library/collection set** of simulations that could be linked when the learners progress through their learning journey.

Social influence and relatedness and *scarcity and impatience* are not supported by the platform. Social influence and voting are interesting concepts with potentially strong benefit to learning to be exploited.

Unpredictability and curiosity – is supported as far as **visual storytelling** is concerned, gradually discovering clues and collecting information that aids the creation of the broader images of a simulation based on which decision making can occur.

Loss and avoidance – is supported in terms of increasing the level of challenge each scenario poses by adding a **countdown timer**. The learners have to play against time to meet the requirements of the scenario. The game ends once the allocated time has expired. An interesting concept that could increase or sustain engagement would be to add a factor of negative marking, loosing points or boosters that have been gained, that could be linked to time that a task is completed or the learner to progress to the next level.

The Octalysis Tool average score for wmin SGP was 329 which demonstrates that the platform allows the creation of fairly balanced simulations in both White Hat and Black Hat core drives. In addition, it showed that there is a good balance between Left

Brain and Right Brain core drives, which means that there is a prospective to support a good equilibrium between Intrinsic and Extrinsic Motivation.

5. Conclusions and future directions

In this paper we presented the viability of wmin SGP to: dynamically create 3D scenes; and interaction with fully ECAs; simulate a number of hypothetical scenarios to support educational purposes. We analyzed the platform's gamified features using a small number of expert evaluators against Octalysis gamified framework and we encouraging review of a fairly balanced simulations that can lead to the creation of motivating and engaging experiences. The evaluation process indicated that future work should be focusing on improving or adding various game-like features to better assist educational purposes. For example linking milestones with time constraints for the completion of a task, offering a scoring system linked to the resolution of the simulation and linking this to the provision of educational support (like feedback and direction to relative readings/resources). Last, emphasis should be on improving the VHs' contextual awareness to be able to intervene when necessary to engage the users. Last extending the platform to support social influence, should be exploited. In addition, the Octalysis framework core drives need to be evaluated to assess how effectively learning is addressed.

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