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Integrating Gamification into Future Educational Leadership Education: a Case of Cognitive Apprenticeship for Inexperienced Learners

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Abstract: *Adopting a "cognitive apprenticeship" (CA) approach to instruction (Lave & Wenger 1991; Collins & Kapur, 2014), a strategy game 'SimSchool' is developed to create situated learning for both undergraduates and postgraduates to act like school leaders to select colleagues and apply strategies in decision-making and problem-solving. The CA approach addresses the challenge of providing a simulated, situated school environment for many students lacking or have little teaching and school working experience. Players/learners have to apply knowledge in the courses in playing the game, while the simulation "coaches" them through feedback, hints, and scaffolding during gameplay. The new simulation game is designed to integrate motivational gamification elements to enhance players' user and learning experiences. The system requirements and gamification algorithm in a cognitive apprenticeship framework are discussed to highlight the unique functions of the three main components of the game.*

Keywords: educational leadership education, gamification, situated learning, system requirement, algorithm

1. Introduction

This paper provides descriptions of the ongoing development and implementation of an online module involving a web-based game to promote understanding in school governance and school organisation. Students have to integrate and apply knowledge learned in the courses offered by an educational leadership department at a university in Hong Kong. The learning process with gamification elements is designed to motivate students to explore different combinations of strategies to tackle problems and challenges in schools. These combinations of strategies are grounded on research findings found in previous research in educational leadership (Walker & Ko, 2012; Bryant, Ko & Walker, 2018). Learners are thus immersed in several situational contexts resembling what they may encounter in authentic school situations.

The developers of a pioneer simulation on teaching organisational change in higher education *Making Change Happen*™ (Showanasai, Lu & Hallinger, 2013) reported that management courses integrating simulation-based learning significantly higher student ratings on overall perceived instructional effectiveness, action-directed learning, student engagement, quality of assessment and feedback, and instructor effectiveness in Thailand (Lu, Hallinger & Showanasai, 2014). However, this simulation lacks gamification. Therefore, the current game is designed to enhance pedagogical innovativeness, maximise broad applicability in courses at different levels, and ensure sustainability that keeps learners' long-term interests. Upon completing the online module with this game, students are expected to address problem-solving tasks in situational contexts in schools.

2. Application of cognitive apprenticeship in educational leadership education

The ecology of educational leadership education in Hong Kong has changed significantly in the last two decades that poses a challenge for traditional educational leadership education. There is a new demand for providing preservice teachers knowledge of school governance at the undergraduate level as teacher participation in school leadership and management is much emphasised in the government's school-based management policy (Ko, Cheng & Lee, 2016). Moreover, most postgraduate intakes have shifted from experienced teachers two decades ago to fresh graduates and inexperienced teachers with little and no school administration experience. Traditional educational leadership

programmes and pedagogies are often developed assuming the learners are experienced teachers who can understand theories and concepts by reflecting on their experiences and knowledge of school contexts.

Accordingly, a cognitive apprenticeship approach (Collins & Kapur, 2014) provides a theoretical framework to design a game to engage these inexperienced learners with an apprenticeship of learning to handle complex school management tasks that cannot be simulated in a typical university classroom setting. "Cognitive apprenticeship emphasises that knowledge must be used in solving real-world problems" (Collins & Kapur, 2014, p.110). "A serious game is a digital game created to entertain and achieve at least one additional learning goal" (Dörner, Göbel & Effelsberg & Wiemeyer, 2016, p.3). While traditional apprenticeship of school management requires years of experience or practicum to develop the target skills in a real school, a cognitive apprenticeship through a serious game can simulate a situated learning environment (Lave & Wegner, 1991) of school management that bring the cognitive processes required in decision making into the open, where students can observe and practice them, and the instructor can check student practices and accumulate data for learner analytics.

3. Gamification in a serious game simulating school situations

"Gamification refers to a process of enhancing a service with affordances for gameful experiences to support user's overall value creation" (Huotari & Hamari, 2017, p.25). Applying gamification to support learning depends on situational contexts and motivational affordances of a game. A motivational affordance is effective if it can increase the learner/player's enjoyment and engagement. Examples of motivational affordances include points, leaderboards, badges, levels, and feedback (Fischer, Heinz, Schlenker & Follert, 2016). When developing a serious game for a broad range of courses, the developers have to consider what gamification elements, or motivational affordances, can and should be included for a wide range of learners as players, from undergraduates to doctoral students. *SimSchool* is designed to serve as a "virtual school" that augments teacher-leader preparation by supporting the development of leadership skills before working in real schools or other educational contexts. This serious game immerses the learners in challenges that bother resilient teachers and schools (e.g., classroom management; curriculum innovation) (Day & Gu, 2013; Gu & Day, 2007; 2013) and result in new crises that add complexities to teachers' work (e.g., cyberbullying; COVID).

4. Design Plan of Online Module

The online module was required to adopt a student-centred design. The teacher education university's faculty office developed a proposal template to facilitate course instructors to use a Backward Design model to work out the lesson design (Childre, Sands, & Pope, 2009). The Backward Design model involves three stages: Stage 1 is to identify the desired outcomes. Stage 2 is to determine acceptable levels of evidence (i.e., assessment). The final stage is to design learning activities that will make the desired outcomes happen. The Faculty eLearning team assisted the instructors in refining their initial thoughts into a final plan.

The plan required instructors to enhance the student learning experience, scope out and structure the learning tasks and activities to support students in performing well in the lesson and ultimately achieve the intended learning outcomes. There were two guiding questions:

1) What are the elements of the simulation game that will build up learners' fundamental knowledge/skills?
2) Will the simulation game guide students to develop higher-order skills such as application, analysis, evaluation, or creation outlined in the course module?

5. Design and Implementation of the Gamification Algorithm

The gamification algorithm was first conceptualised with an architecture, followed by a series of system requirements identifying all the game stakeholders and captures all the user stories. Once the system requirements were written up and

captured, the gamification algorithm design was drawn.

5.1 System Requirements

A series of system requirements was written up based on discussions of four developers of a grant on an online module of educational leadership education courses: the first author as an instructor of various educational leadership courses at a leading teacher education university in the Asia Pacific region, the second author as a programmer, a graphic designer specialised in game interface design, and a programmer coordinator experienced in online course development. The proposed game is expected to involve two major stakeholders, an instructor, who would set up the game parameters, and the player who is the student interacting with the game. The instructor asked himself a series of questions regarding the game application:

a) Why and how would the instructor interact with the game application?
b) How and when would the player interact with the game application?

The instructor wrote up the system requirements based on inputs from other developers on these questions. The requirements provided a high-level description of what the application should be doing and why the functionality is needed. Acceptance criteria were included to ensure the application has achieved the defined user requirements. There are three components in the game: The Instructor, the Player, and the System. The Instructor component is a unique component of *SimSchool* to ensure its applicability and sustainability by allowing an instructor to set and reset the gamification for current and future course content. The Instructor can *create* and *add* Strategy, Task, Colleague, and Random Crisis for the Players and *view* their learning progress as shown in the selected system requirements. The Player component will select a Task or Crisis set for different simulated schools; they can *choose* their Strategy and Colleague to tackle the Task or the Crisis. To motivate the Players to compete, they can compare their results and ranks with other Players. Lastly, the System component of *SimSchool* will *randomise* a Task or a Crisis, *generate* Strategy specifications and Colleague characteristics, and *update* Players' scores and records during and after the gameplay.

5.2 Gamification algorithm and cognitive apprenticeship

The proposed gamification algorithm is unique in several areas compared to other algorithms. First, in addition to the scenarios and tasks specified in the existing database or a system process, a GameMaster(or leader) can set up new ones. Such an addition allows the GameMaster to tailor the game to students' abilities by creating different situations and tasks for them to respond to, thus providing a unique experience for each player. Second, the gamification algorithm ensures the GamesMaster can set the difficulty for each 'level' for the game. Third, the algorithm ensures that gameplay would also be challenging for the player and ensure they have sufficient skills. Finally, the randomisation of the gamification elements ensures the player would have to respond adaptively. Therefore, the Players cannot rely on memory or exploit specific game mechanics to complete the level.

A player develops his/her skill in the game like a school management apprentice advances skills in school management. Once the player has completed all the TASKs set by the GameMaster, the gamification algorithm would calculate the overall 'Effect' points. If the player has accumulated sufficient 'Effect' points, they would be allowed to proceed to the next level and play the game with or complex scenarios set by the GameMaster. However, if the player has not accumulated enough points, the algorithm will not allow the user to proceed to the next level. Instead, they would be present with the different failed tasks or crises in a 'Progress' report, which allows them to look at areas to improve on before going to the level.

To ensure the apprenticeship reflects in the gameplay, we designed the algorithm such that the GamesMaster can set up the game with the different tasks and situations for the student to interact. In this setup, the gamification algorithm would generate a series of tasks and crises for the student. In a typical game, the student will need to earn 'Effect' points

based on their interactions with the game environment. Thus, a Player is an apprentice in both the gameplay and conceptual knowledge of school management strategies. Still, the more s/he applies what they learn in the classroom about school management, they learn how to select strategies and staff to tackle different tasks at different school levels. Successful completion of a task will reinforce the Player in choosing the specific effective strategy and develops a rich web of memorable associations between them and the simulated problem-solving contexts.

6. Conclusion

We have introduced the rationale and design of a new serious game to support educational leader preparation. We adopted a cognitive apprenticeship framework to address how we need to coach students who lack the understanding of school contexts as their predecessors through situated learning outside the classroom. The simulation allows the learners to apply concepts, knowledge, and theories learned in the lectures to select strategies and colleagues to tackle simulated tasks and crises. The gamification is also expected to provide fun and cognitive appeals to the new generations with digital games. Researchers and teacher educators can benefit from the derived data and learner analytics to improve the game and course content.

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