

Influence of Gamification on Student Learning and Teacher Training

Nazreen Dasoo

University of Johannesburg
Johannesburg, South Africa

Abstract

Lecturers continuously change their teaching approaches to meet the evolving needs of their students in the teaching and learning environment. This occurrence necessitates integrating innovative methods to engage students with course content effectively. Teacher training programmes must adapt to challenges and update their content to include new technology, preparing future teachers for its integration into their practice. To address the challenge of maintaining student interest, some teacher educators have explored the introduction of Gamification as an alternative and engaging teaching strategy. Gamification involves using game elements in non-game contexts and using game thinking mechanisms to enhance problem-solving skills. An investigation involving 150 student teachers was conducted, inviting them to participate in a gamified learning environment where they would learn about a specific topic in their module on assessment. Following this, the students completed a survey in which they responded to the experience of using a game to learn the content. The collected data was analysed using self-efficacy theory and self-determination theory. The study's results revealed that most students reported heightened engagement and enjoyment when course content was presented through a gamified approach. They also expressed increased motivation and appreciation for the gamified material. The findings of this inquiry align with other recent research, emphasizing the benefits of Gamification as a pedagogical tool. Gamification has the potential to drive innovative teaching strategies, enhance student engagement, and boost motivation. The study also recommends how gaming elements can be seamlessly integrated into course design and discusses the implications of using Gamification on the scholarship of teaching and learning.

Keywords: gamification, student teachers, innovative pedagogy, teacher training.

1. Introduction

The COVID-19 global pandemic forced a shift in educational paradigms, particularly in pedagogical methodologies, requiring almost a complete review of the more traditional approaches to teaching in higher education. Under these extraordinary times, lecturers have been called upon to rapidly respond and flexibly adapt their pedagogical practices to the dynamic environment within the classroom. The interest

in adopting new pedagogical methods to sustain student engagement and retention has increased. Coined in 2002 by Nick Pelling, gamification gained significant momentum about a decade later, with the industry's potential growing exponentially daily (Parsad, 2021). Gamification involves game thinking and mechanics to engage users in problem-solving contexts, utilising game elements to motivate and include learners (Kickmeire-Rust & Niggi, 2023). The concept of gamification gained significant traction in the business world by the turn of the 21st century and subsequently captured the interest of educators and researchers as an increasingly popular approach to motivating students (Boudadi et al., 2020). However, the empirical evidence supporting its educational benefits is still an area of ongoing development.

According to Dichev and Dicheva (2017), gamification is a strategy to enhance student engagement by integrating gaming elements into the educational environment. This investigation aimed to evaluate if using gamification, which meant incorporating a computer game into a second-year module in a teacher education qualification tailored to learn about rubric design in assessment, would enhance student engagement and learning. The primary goal of this gamification strategy was to create engagement levels analogous to those found in typical games, utilising game "building blocks" to motivate specific behaviours within the gamified scenario.

As a tool, gamification offers some promising benefits for supporting the improvements expected in student learning experiences. Gamification means applying game design elements and mechanics in a non-game context to achieve learning-identified objectives, motivation, and engagement. It leverages game dynamics, such as features, challenges, leaderboards, badges, and points, to make learning more engaging and fun. The concept is promising for broad prospective use in different industries and education, and it rapidly began gaining momentum in the early 2000s. According to Deterding et al. (2011), Gamification is transferring game mechanics into non-game environments to make them exciting and motivational to the users.

Putting Gamification into an educational process would surprisingly make one's learning time more interactive and joyful. Teachers can offer more energetic and engaging learning environments that interest students by embedding game design elements into their lesson plans. This is important for online and distance learning settings where keeping students engaged is challenging. It brings immersive and stimulating learning experiences that keep the students interested and engaged with their study. Empirical research has provided sufficient evidence on the effectiveness of gaming to improve learning outcomes, further underscoring its educational potential. For example, Su and Cheng (2015) surveyed the application of gamification in English vocabulary learning. They found that students using a gamified application would be much more engaged and show higher learning performance than those using a non-gamified application.

Also, according to Sailer et al.(2017), Gamification increases intrinsic motivation and time spent on a higher education course, hence its potential to improve learning and motivation. While there are several benefits, Gamification in learning has its challenges. One primary concern is the undermining of intrinsic motivation due to extrinsic rewards. While gamification can be a means to engage students through external rewards or incentives, it is also essential to make sure that these elements do not undermine the students' desire to learn. The achievement of this critical balance between extrinsic and intrinsic motivators will, therefore, depend on how educationists develop a meaningful, sustainable environment for learning.

Challenges do occur when implementing gamified elements in a teaching and learning environment. For Gamification to work, one must consciously consider the audience, the academic goals and the game elements. Gamified activities must be developed to match the learning objectives and offer students appropriate challenges and support. Creating compelling, engaging gamification for learning thus requires collaboration between educators, instructional designers, and game designers. More focus should be given to the preparation of teachers for the pragmatic application of gamification. Pre-service teacher education programs are essential in that they allow future teachers to acquire the necessary competencies for using new technological and pedagogical approaches. This enables teachers to teach effectively in gamified learning environments, understand fundamental theories of gamification, and develop hands-on experience in developing and implementing gamified lesson plans in classrooms.

As has been underscored by the COVID-19 pandemic, there is a need to develop creative ways of teaching students to achieve effective learning processes. Gamification makes it possible to reach these targets through game design and creating a more engaging, dynamic learning environment. Grounded in highly researched theoretical frameworks – self-determination theory, flow theory, and self-efficacy theory – Gamification can potentially enhance students' motivation for learning, engagement, and learning outcomes. Its successful implementation will require proper planning with motivational considerations and the appropriate training of teachers. Indeed, more research and practical insight would need to be done to realise this potential gamification in education and to answer the challenges related to its smooth integration into educational setups as this field grows.

Theoretical Framework

Gamification in the classroom is a theoretical approach that supports motivation and engagement in learning by satisfying three psychological needs: relatedness, competence, and autonomy. According to Deci and Ryan's (2000) Self-determination theory (SDT), satisfying these needs strengthens intrinsic motivation and deepens engagement and learning outcomes. Csikszentmihalyi's Flow Theory explains the condition of complete absorption and deep concentration in an activity, where skill level overlaps or matches the difficulty level associated with the task. Gamification can ensure students reach a state of flow by providing assignments with ideal challenges that match skill levels, boosting engagement and motivation.

Bandura's (1997) self-efficacy model emphasises the importance of an individual's belief in their ability to perform specific actions. Gamification can boost self-efficacy in an educational environment through immediate feedback, mastery opportunities, and a levelled sense of achievement through the attainment of objectives and rewards associated with the game. This approach enhances motivation, enjoyment, and student engagement by injecting fun into teaching.

In conclusion, gamification in the classroom can improve learning outcomes by addressing critical motivational elements, creating an engaging and productive learning environment, and addressing the psychological demands of the SDT. Teachers can benefit from gamification's ability to innovate and adapt to new learning needs while improving teaching and learning processes.

2. Research Methodology

Design

As part of the study, one hundred and fifty student teachers participated in "The Rubric Game" an educational game intervention designed and developed by the researcher. The game focused on one aspect of a compulsory module on Assessment of Learning in an undergraduate B.Ed qualification. This gamified learning exercise aimed to improve their comprehension of a section of work on understanding what rubrics were and how to design them.

A qualitative research methodology was used to understand the student teachers' experiences when engaged in an educational game called the "The Rubric Game". A closed and open-ended survey served as the data collection tool. The survey's main goal was to examine the participants' experiences and opinions regarding Gamification as a teaching and learning approach to the module's content on rubrics. The survey was administered via Google Forms, enabling respondents to provide thoughtful and in-depth answers on the game. Ethical clearance was sought for this investigation from the university's ethics committee and was granted

Participants

The participants were second-year education students completing their B.Ed degree at the University of Johannesburg. "The Rubric Game" was based on content from a compulsory module in the second year of the B.Ed programme. The age of the students ranged from 19 -21 years. The students first learnt about the nature and design of rubrics on the online learning management system, Black Board. After that, they played "The Rubric Game" online as part of the grading process. If they achieved all the badges for the particular levels in the game, they received an online certificate of completion and a score towards their module mark. On completion, they answered the online survey relating to this investigation.

Data Analysis

Data analysis aimed to understand students' experiences, motivation, and involvement while playing the game. I used a thematic analysis approach to code the data to identify significant themes and recurring patterns. This procedure involved reviewing the survey answers to ensure a complete understanding of the data.

I first used open coding to categorise the raw data from the open-ended responses into several topics and sub-themes. I then used axial coding to further analyse and clarify these themes' connections. The final step involved selective coding, which allowed me to identify the main themes that most accurately reflected the participants' experiences.

The study's qualitative approach offered deep, contextual insights into how Gamification affected the learning and engagement of the students. An in-depth analysis of their experiences yielded valuable perspectives on the potential application of Gamification as a state-of-the-art teaching tool in teacher preparation.

3. Results

The results from the survey for the close-ended questions are indicated in the table below. Questions 1 to 8 were formulated on a 7-point Likert scale.

Table 1. Results of closed-ended questions

	QUESTION	Unanswered	Not Applicable	Disagree	Strongly Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	The Rubric Game helped me to engage more with the module content.	1.4%	0.0%	1.8%	0.0%	10.1%	48.6%	38.1%
2	I prefer using the Rubric Game to learn about Rubrics	0.7%	0.3%	4.5%	5.6%	21.3%	32.2%	35.3%
3	The use of the Rubric Game made TST 2B more interesting.	1.0%	0.3%	2.8%	5.6%	13.3%	38.5%	38.5%
4	The Rubric Game helped me to think critically and understand complex concepts	0.7%	0.0%	2.1%	2.8%	14.0%	56.6%	23.8%
5	The Rubric Game	0.8	0.4	2.5	7.7	23.0	45.4	20.2

	structured my learning so that I feel more confident in preparing for the tasks and exams.							
6	The design layout of the Rubric Game was attractive.	1.8	0.0	4.2	2.8	15.0	45.1	31.1
7	I want to use games more often as a means of learning content.	1.4	0.4	3.9	7.3	14.7	38.1	34.2
8	I prefer to use a game to learn instead of traditional methods.	0.7	0.7	4.9	8.0	20	37.0	28.7

Gamification in "The Rubric Game"s educational framework has yielded notable discoveries about its influence on student motivation, engagement, and learning encounters. I cover these recurrent themes in more detail below.

Emergent themes from the codes

Seven themes were identified due to the coding of evidence from the questionnaire. These are:

Theme 1: "Interaction with Module Content."

Coding:

1. "Enhanced Engagement" - "I interacted with the module content more because of the Rubric Game."
2. "I prefer using the Rubric Game to learn about Rubrics" is the preference for Gamification.
3. Using the Rubric Game enhanced the interest level of the TST 2B module.

Theme 2: Understanding and Critical Thought

Coding:

1. Development of Critical Thinking: "The Rubric Game assisted me in developing my critical thinking skills and comprehending difficult ideas."
2. Structured Learning: "The Rubric Game structured my learning so that I feel more confident in preparing for the task and exams."

Theme 3: Usability and Design

Coding:

1. Design Layout - "The Rubric Game's design layout was intriguing."

2. Instant Response - "It made sense, and I loved the immediate response."

Theme 4: Preference for Gamified Education

Coding:

1. A greater desire to use games to learn content – "I want to use games more often."
2. Preference Over Conventional ways - "I would rather learn through games than traditional methods."

Theme 5: Use in the Real World and Prospective Applications

Coding:

1. Future Classroom Application - "It was simple to use, entertaining, and interactive." I have had experience using technology in a classroom setting."
2. Creative Method of Teaching - "That was a creative teaching method. I discovered I could apply this teaching methodology in my class one day."

Theme 6: Gratitude and Social Contact

Coding:

1. Factors that Make You Happy: "I liked how the Rubric game had different levels and colours." It has a nice layout.
2. Genuine and Self-paced - "Enjoying this game allowed me to be in control and was genuine and self-paced."

Theme 7: Recommendations for Enhancements

Coding:

1. Navigation and Game Length: "With the option to go back levels, the game could be a little shorter."
2. "Too many articles to read in the various levels" was the comment made regarding the content volume.

These themes and categories provide a structured framework for assessing the qualitative data acquired from student teachers' interactions with "The Rubric Game." This framework will show the primary areas where gamification has boosted student motivation, engagement, and learning, as well as the potential areas for improvement.

4. Discussion

Interaction with the Module Content

According to the survey results, Gamification significantly raised students' interest in the module's subject matter. When students said, "The Rubric Game helped me to engage more with the module content," they expressed how much more fun and dynamic the learning experience was than with more conventional approaches. This is consistent with other research showing that by making learning sessions more engaging and immersive, Gamification can boost student involvement (Hamari et al., 2014).

Critical analysis and comprehension

Additionally, it seemed that Gamification encouraged critical thinking and a more thorough comprehension of complex ideas. The students said, "The Rubric Game helped me think critically and understand complex concepts." This suggests that the

game's structure and mechanics promoted higher-order thinking in the pupils, which is essential for learning complex subjects. The game's structured learning features also influenced their confidence in preparing for assignments and tests.

Design and usability

Students praised "The Rubric Game's" layout and functionality. Positive feedback regarding the "design layout" and "immediate feedback" emphasises how crucial thought-out game aspects are for educational tools. Students especially appreciated the game's instant feedback as it assisted them in identifying their strengths and areas for development, thereby enhancing the self-efficacy component of the learning process (Bandura, 1997).

Preference for Interactive Education

The preference for gamified learning over conventional approaches was evident. Comments like "I prefer to use a game to learn instead of traditional methods" and "I want to use games more often as a means to learn content" highlight the allure of Gamification. This inclination suggests that Gamification encourages students to keep learning through interactive methods in addition to engaging them. It implies a shift in students' expectations and preferences toward more engaging and dynamic learning environments.

Use in Practice and the Future

One noteworthy issue was the practical implementation of Gamification in the teaching and learning environment. Comments such as "I know how to use technology in my class one day" and "I learned that I could use this teaching method one day in my class" showed that students recognised the potential of incorporating technology into their teaching methods. This highlights the long-term advantages of gamification integration into teacher training programs by demonstrating the transferability of gamified learning experiences to future teaching scenarios.

Pleasure and communication

Participants often cited the game's participatory nature and fun as positive qualities. The authentic and self-paced aspect of the learning process, along with the "different levels and the colours used in the Rubric game," was liked by the students. This enjoyment is essential because it can result in positive attitudes toward learning and sustained engagement, which are necessary for effective education (Csikszentmihalyi, 1990).

Suggestions for enhancements

Although the comments were generally positive, students offered helpful recommendations for enhancements. They observed that "there are too many articles to read at the various levels" and that "the game can be a bit shorter with the ability to go back levels." These recommendations identify areas where the game could enhance the user experience and maintain player interest without excessive cognitive strain. The results of the data analysis show that Gamification can significantly improve the educational experience if done right. The positive feedback about enjoyment, critical thinking, and engagement validates the theoretical underpinnings of self-efficacy

theory, flow theory, and self-determination theory (SDT). SDT strongly emphasises relatedness, competence, and autonomy; the game's design and feedback mechanisms addressed each concept (Ryan & Deci, 2000). Student's descriptions of the game as captivating and inspiring demonstrated the balance between skill and challenge that Flow Theory advocates (Csikszentmihalyi, 1990). The quick feedback and sense of accomplishment that the students reported validated the importance of self-efficacy theory (Bandura, 1997).

However, the feedback also emphasises the necessity of giving game design features significant thought to prevent cognitive overload and guarantee that the content is still digestible and accessible. Maintaining the best possible learning environment entails balancing the game's length, the activities' difficulty, and the number of reading materials.

Suggestions on improving the "Rubric Game."

Overcoming technological obstacles

Technological obstacles were one of the main issues in putting "The Rubric Game" into practice. Many students complained about needing more stable internet connections and limited data, making it very difficult to interact with the gamified material. This problem is most noticeable in online and remote learning settings where high-speed internet access is only sometimes guaranteed. I would suggest creating offline versions of gamified learning resources to address the issue of erratic internet connections. If allowed to download the required materials in advance, students can engage with the game without constant internet access. This approach provides students with greater adaptability across diverse environments and ensures uninterrupted learning due to connectivity issues. Developing a data-efficient version of the game can reduce the data required for participation. Students with data plans can have better access to the game by limiting high-bandwidth features, optimising graphics, and compressing files. This can improve performance and decrease load times, improving overall user experience. By ensuring the gamified tools are compatible with a variety of gadgets, including tablets and smartphones, accessibility can be improved. Making the game mobile-friendly can significantly improve the user experience, as many students prefer to learn on their mobile devices. Also, students' frustration while playing the game can be reduced with support tools to troubleshoot common questions. By providing prompt support, you can guarantee that students stay interested in the game and do not give up on it because of technical issues.

Improving accessibility and game design

Participants offered input on "The Rubric Game's" layout and usability, outlining potential areas for development to improve the educational process. Some recommendations were to shorten the game, enable level navigation, and reduce the amount of reading content. Implementing a modular design allows students to complete shorter, self-contained game sections, which can help maintain engagement without producing cognitive overload. Students may find learning more enjoyable and manageable. Adding elements to the game that allow students to return to earlier

stages or segments can improve the educational process. This flexibility allows students to revisit content at their own pace and helps improve their understanding of essential ideas. Allowing students to revisit earlier stages can help them reinforce their learning and gain confidence. Reducing the emphasis on text-based materials and introducing more interactive content, such as movies, animations, and quizzes, can make the learning experience enjoyable. Interactive aspects appeal to diverse learning styles and keep students interested. Finally, ensuring the game is usable by all students, including those with impairments, is critical. Adding features like text-to-speech, movable text size, and alternate input methods can make the game more inclusive. Incorporating accessibility considerations into the design process can ensure that every student has an equal learning experience.

Implications of Gamification for the Scholarship of Teaching and Learning Pedagogical Shifts Towards Gamification

Integrating Gamification in educational settings constitutes a fundamental shift in pedagogical practices, underscoring the need for innovative teaching and learning methods. The findings from this study highlight many critical implications for the Scholarship of Teaching and Learning (SoTL) that educators and institutions should consider as they progress towards implementing Gamification into their curricula.

Enhancing student engagement and motivation

The favourable reactions from student teachers regarding their engagement and motivation when utilising "The Rubric Game" imply that Gamification can boost these essential aspects of learning. Traditional teaching approaches typically need help to keep student engagement, especially in remote or online contexts. Combining game elements like points, badges, and leaderboards can help create a more dynamic and interactive learning environment which supports sustained engagement and intrinsic motivation (Ryan & Deci, 2000).

Customised learning experiences

Gamification adapts to each student's unique needs and preferences. This can be particularly effective in diverse classes where students have various levels of prior knowledge and learning styles. The modular design and flexible navigation features advocated for "The Rubric Game" enable students to move independently, review challenging ideas, and receive immediate feedback tailored to their performance. This individualised strategy can lead to more effective and meaningful learning results (Csikszentmihalyi, 1990).

Promoting Active Learning

Research shows that involving students in learning through activities and conversations enhances their retention and understanding of course material. Gamification naturally fosters active learning by requiring students to participate in tasks, make decisions, and solve problems within the game context. This hands-on involvement can boost critical thinking skills and deepen knowledge, making Gamification a helpful teaching method (Hamari et al., 2014).

Promoting Collaborative Learning

Many gamified learning environments integrate elements of collaboration and competitiveness, which can enhance social interaction and teamwork among students. Features like leaderboards, group challenges, and cooperative assignments encourage students to collaborate, share knowledge, and support each other's learning. This cooperative gamification feature can support the development of a feeling of relatedness and community, both of which are critical for creating a supportive learning environment (Bandura, 1997).

5. Conclusions

Findings from the study suggest that Gamification can be used as a teaching technique in higher education, especially for programmes that prepare teachers. Gamification can be a valuable supplement to conventional teaching techniques, as seen by the positive effects on motivation, learning, and engagement. By addressing the areas identified for improvement, educators can further enhance the efficacy of gamified learning experiences, making them both pleasant and educationally meaningful. Although this study provides valuable insights into the benefits of Gamification in education, the investigation had some limitations. The students were 19-21 years old; the results for another age group may be different. The "Rubric Game" was only used in one second-year module in a B Ed. programme. Results may vary if used in other modules in the programme. Games may be a barrier to students who are not used to playing games and may find the mode of delivery distracting or difficult. The game's design was labour-intensive, and I needed the expertise of a game designer to assist with the design. This study offers new research directions. To fully fulfil Gamification's potential, further research is needed to investigate its long-term impacts, ideal design components, and implementation in diverse educational settings. Longitudinal research, for example, can shed light on the relationship between continuing use of gamified learning environments and improved academic performance, skill development, and knowledge retention. It may also detect any long-term negative consequences or issues linked with Gamification (Deci & Ryan, 2000). From a Teacher Professional Development standpoint, it is vital to investigate how technology influences teacher training and professional development as it becomes more prevalent in the classroom.

Future research should investigate the incorporation of gaming into teacher preparation to enhance teachers' ability to utilise these resources in the school. Furthermore, research can examine how continuous professional development programmes can help educators incorporate Gamification into their lessons (Greaves & Vlachopoulos, 2023). In summary, Gamification has enormous potential to improve learning results, motivation, and student engagement in educational environments. Educators can build more dynamic and successful learning environments by implementing more individualised and interactive pedagogical practices. However, further investigation is required to fully understand the long-term effects, ideal design elements, and implementation of Gamification in various educational contexts to grasp this emerging technology's promise completely. These initiatives will enhance our understanding of how Gamification can improve teaching and learning and lead to more successful and motivated students.

6. References

- Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman.
- Boudadi, N. A., & Gutiérrez-Colón, M. (2020). Effect of Gamification on students' motivation and learning achievement in Second Language Acquisition within higher education: A literature review 2011-2019. *The EUROCALL Review*.
<https://doi.org/10.4995/eurocall.2020.12974>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.
- Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. Harper & Row.
- Csikszentmihalyi, M. (2014). *Applications of flow in human development and education: The collected works of Mihaly Csikszentmihalyi*. Springer Science + Business Media. <https://doi.org/10.1007/978-94-017-9094-9>
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification." *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, pp. 9-15.
- Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain: A critical review. *International Journal of Educational Technology in Higher Education*, 14, Article 9.
- Greaves, R., & Vlachopoulos, D. (2023). The Use of Gamification as a Vehicle for Pedagogic Sharing and Teachers' Professional Development. *RIED-Revista Iberoamericana de Educacion a Distancia*, 26(1), 245-264. <https://doi.org/10.5944/ried.26.1.34026>
- Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does Gamification work? – A literature review of empirical studies on Gamification. *Proceedings of the 47th Hawaii International Conference on System Sciences*, 3025-3034.
- Kickmeier-Rust, M., & Niggli, C. (2023). The Effects of Gamifying Mathematics Lessons at High School Level. *European Conference on Games Based Learning*, (), 319-326.
- Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.
- Nakamura, J., & Csikszentmihalyi, M. (2014). The concept of flow. In *Flow and the foundations of positive psychology* (pp. 239-263). Springer.
- Prasad K. D. V. (2021). "Gamification and its Applications". *Journal of Business Strategy Finance and Management*, 3(1,2). <http://dx.doi.org/10.12944/JBSFM.03.01-02.02>
- Patton, M. Q. (2015). *Qualitative research and evaluation methods: Integrating theory and practice*. Sage publications.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and Ill-being. *American Psychologist*, 55(1), 68-78.
- Sailer, M., Hense, J., Mayr, S., & Mandl, H. (2017). How Gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, 69, 371-380.
- Spiro, J. (2019). *Artng and writing to transform education: An integrated approach for culturally and ecologically responsive pedagogy* by Meleanna Aluli Meyer, Mikilani Hayes Maeshiro and Anna Yoshie Sumida.
<https://core.ac.uk/download/326509618.pdf>
- Su, C. H., & Cheng, C. H. (2015). A mobile gamification learning system for improving learning motivation and achievements. *Journal of Computer Assisted Learning*, 31(3), 268-286.