Dean&Francis
ISSN 2959-6149

The Contradiction and Unity of Group Difference and Individual Characters in Gamification Education

Junling Yan

Faculty of Education, The University of Melbourne, Melbourne, Parkville, VIC3010, Australia
yanjunling634@gmail.com

Abstract:

Gamification Education (GE), by combining game concepts like game elements with scaffolding and other teaching methods, can effectively stimulate students' learning interest, cognitive thinking, and emotional expression. However, due to the diversity of student groups, individuals within and between groups also exhibit unique characteristics due to differences in cognitive abilities and other factors. These differences lead to conflicting educational goals, hindering the effectiveness of GE in education. Therefore, this paper uses a literature review method to study the generation, manifestation, and application of the contradiction between group differences and individual characteristics in GE. After that, it proposes a framework based on Universal Design for Learning (UDL) and a dynamic process based on adaptive learning, combining the two through swarm intelligence. UDL increases the breadth of gamified instructional design, ensuring it fully accounts for the differences and needs of groups, while adaptive instruction increases the depth of general education, tapping into the unique characteristics of each individual within the group. Through the collective discussion and screening of swarm intelligence, combined with UDL and adaptive instruction, it can achieve a balance between group differences and individual characteristics.

Keywords: Gamification Education, Universal Design for Learning, Adaptive Learning, Swarm Intelligence

1. Introduction

With the boom of technology, an increasing number of AI devices are being applied in the education world, which contributes to the process of teaching and learning. AI can prompt the acquisition of knowledge from three layers, respectively, including development, application, and integration. Gamification, as a part of the integration layer, is an inevitable trend for future education. Although artificial intelligence in education (AIEd) has a bright prospect, there are some problems that need to be addressed.

ISSN 2959-6149

AIEd should be critically used and thought about. The over-dependence on AIEd may lead to ignoring the unreasonableness of AI algorithms, which are mastered and operated by social privilege [1]. From this perspective, individualised design of AIEd following students' characters aims to avoid the risks of this unreasonableness.

Authorities in China also enact and emphasize the "Wisdom Education", which satisfies the requirement of student-centered education [2]. The purpose of this educational reform is the construction of adaptive learning by applying cutting-edge technology. However, despite the significance of "Wisdom Education", it is limited for schools in China to apply technology in class due to the lack of resources, such as teachers' ICT skills, funding, and equipment. Students with different socioeconomic resources have distinct individual characters and abilities in "Wisdom Education". Collective differences and individual characters mutually impact each other. Meanwhile, these differences support or hinder the implementation of AIEd in China. Similarly, gamification, as one of the practical methods of "Wisdom Education", faces the difficulty of the imbalance between collective differences and individual characters. Therefore, how to optimize the efficiency of gamification education based on group differences and individual characteristics is still a controversial and worthy topic.

2. Gamification Education (GE)

2.1 The Definition of GE

Gamification Education (GE) is regarded as the application of game elements in non-game environments, such as the classroom [3]. This definition calls attention to the game elements in education. From the macro perspective, Zeybek and Saygı have categorized game elements into five types, including mechanics, dynamics, esthetics, story and technology, though many researchers do not consider the function of narration in games [3]. Points, badges and leader-board, as the significant components of mechanics, have been illustrated to arouse students' emotions and feelings which are the same as the dynamics and esthetics [3]. In addition, augmented reality (AR) in education, as a kind of technology, also integrates with mechanics and other game elements [4]. These game elements can individually or collaboratively benefit from students' active learning.

Significantly, it is still controversial for educational practitioners to distinguish the difference between gamification education (GE) and gamified-based learning (GBL) [4]. The former focuses on the game mechanism, while the latter emphasizes games as tools of education, compared with traditional pedagogy. Despite the different emphasis of the two concepts, these concepts can mutually benefit from each other. GE makes a foundation on GBL. Specifically, GE implies why games can be applied to educational environments. In contrast, GBL provides practical experiences and possibilities for the implementation of GE. Following the reform of education, GBL will become an inevitable trend in authentic educational practice. Therefore, to some extent, GE can not be explored individually without the basis of GBL.

2.2 The Benefits of GE

The benefits of GE in education depend on the functions of game elements. Conversely, game elements can be influenced and changed by the purpose of education [3]. One of the important benefits is motivation, which includes intrinsic and extrinsic levels. The former is more beneficial to students' learning than the latter, as implied by the flow theory and self-determination theory. However, no matter intrinsic and extrinsic levels, by applying game elements, educators can devote themselves to continually attract students' interests in learning. The points and badges, as timely and positive feedback, trigger students' active learning, while the leader-board, an incentive to improve poor academic performance, urges students to compete with peers. Based on these findings, game elements can be seen as a kind of useful scaffold, which can instruct and motivate students without the limitation of time.

Besides motivation, students' skills in GE have been developed. GE can impact students' behaviors, cognition, and affect. With the evaluations of these dimensions, during playing, the integration of gamification strategies and supporting pedagogical strategies can significantly improve students' critical thinking. To be more specific, students can construct a logical framework, illustrated by experiments and theories in the virtual gamified world. Additionally, the dynamics of game groups make it possible for students to interact with each other, cultivating their social and emotional skills, especially for people with autism spectrum disorder. Every student has the same goal. Meanwhile, the mechanism of the game regulates the uniqueness of each player, which requires students to gather partners with different abilities in case they fail to address problems.

2.3 The Application of GE

Despite the multiple benefits and types, GE can not function without the assistance of educational pedagogy. According to the educational theory of Constructivism, teachers' scaffolds assist in teaching and learning for a

certain purpose. This illustrates the need for constructing scaffolds of GE in practical teaching. Scaffolds are regarded as the intermediate mediation between the theory and practice of GE to better apply it in education. Huang and Hew noted the importance of timely feedback in GE [5]. Jong et al. described the role of cautions in monitoring students' safety while outdoors [6]. The former falls under cognitive scaffolding, while the latter falls under procedural scaffolding [7]. While their emphases differ, both demonstrate how teachers can provide students with scaffolding to guide the application of GE in teaching practice.

Scaffolding builds a bridge between game activities and educational purposes, acting as an intermediary. Chen et al. demonstrated that scaffolding can help students become more familiar with and understand how the various elements of GE are applied to achieve their educational aims [7]. Students who understand GE are more interested in participating in the various teaching activities constructed by teachers within GE than those who do not. However, these data also suggest that students with different cognitive abilities, guided by the same scaffolding, exhibit varying degrees of understanding of GE. This varying degree of understanding demonstrates that scaffolding assigned by teachers based on the average ability level of all students cannot address the impact of individual cognitive differences on the implementation of GE. This is the contradiction between group differences and individual characters.

3. The Contradiction Between Group Difference and Individual Characters

Currently, few studies focus on comparing and unifying group differences with individual characteristics. Although it is difficult for educators to design a game for every student, group differences and individual characteristics should also be comprehensively considered, instead of being ignored. This article is dedicated to studying this issue.

3.1 The Origins of Contradiction

The inherent nature of gamification design that accommodates group differences and individual characteristics creates an inevitable conflict between the two. Group differences refer to relatively stable dissimilarities between groups due to differences in characteristics such as gender and age. The goal of gamification design that accommodates group differences is to find optimal solutions applicable to a wide range of groups [8]. Ahmad et al. studied the impact of group size on general interest learning (GE) and suggested that GE is most effective in enhancing student interest at both the small and individual scales [9]. Kim and Castelli studied the behavioral validity of GE across age groups and suggested that college students exhibited the least significant behavioral changes under GE compared to older adults and K-12 students [10]. The gender differences were even more pronounced. GE not only failed to improve female students' learning performance but actually hindered it. Therefore, based on these studies, GE should be primarily applied to K-12 students at the small or individual scale, with technical optimizations designed to improve learning outcomes for all students.

Personality traits refer to individual factors within learners that may influence learning activities. They can be categorized as intra-individual and inter-individual factors. González-González et al. proposed the five-factor model (FFM) of personality, including openness, consciousness, extroversion, agreeableness, and neuroticism [11]. This model focuses on only one of the intra-individual factors: personality. Intra-individual factors also include motivation, thinking style, and ability. Inter-individual factors emphasize students' social and cultural capital, including their social relationships. The goal of gamification design that focuses on personality traits is to identify and meet the individual needs of each student [11]. This demonstrates the importance of customized design guided by personality traits in GE.

Comparing the differences in focus and GE design goals, the contradiction between group differences and individual characteristics in GE cannot be completely bridged, but they can be balanced. Narrowing group differences and achieving educational equity is the ultimate goal of GE, while emphasizing individual characteristics and meeting student needs is a key process. From a biomimetic perspective and theory, the collective optimal solution is based on the assessment and selection of individual characteristics [12]. This is the significance of studying the contradiction and unity between group differences and individual characteristics in GE.

3.2 The Performance of Contradiction

From a macro perspective, the definitions of group differences and individual characteristics determine the root cause of the irreconcilable conflict between the two. However, from the micro perspective of GE's definition, impact, and application, it can trace the different manifestations of the impact of the contradictions between group differences and individual characteristics on GE, and take targeted solutions based on these manifestations.

Different groups have different views on GE's game elements, and the personality and other characteristics of

ISSN 2959-6149

different individuals within the group also affect the effectiveness of the game elements. Research by González-González et al. shows that women prefer game elements that offer rewards and gifts, while boys prefer in-game voting mechanisms [11]. With age, the popularity of challenge mechanisms fluctuates and varies greatly among people of different ages. After grasping the general views of different groups on game elements, the analysis of individual characteristics in special groups is more meaningful for GE's improvement. The different motivations of different individuals mean that their player types are also inconsistent, which in turn affects their perception and application of corresponding game elements in GE. Specifically, how personal motivation comes from the acquisition of new knowledge and self-improvement belongs to the player type of achiever. This type of player values challenging this element of the game. However, players who are personally motivated by building relationships with others are more concerned about teamwork and communication in the game. Therefore, the different personality characteristics displayed by the student group with specific group characteristics can be adjusted by adjusting the distribution ratio of game elements in the teacher's scaffolding to promote the learning motivation of different types of students.

3.3 The Influence of Contradiction

According to the different causes of these contradictions, their influences can be categorized into two main types, including educational inequality and ineffective reform. The former stems from an overemphasis on group goals, while the latter stems from a singular focus on the impact of individual characteristics on the personalized design of GE. While these differ in their origins, both ultimately lead to GE's inability to motivate all students to learn in the long term.

The pursuit of optimal solutions within a group can lead to a one-size-fits-all policy, ignoring the impact of individual characteristics within the group. The use of non-customized games in large groups reduces individual participation and interest because they cannot provide targeted evaluation and feedback based on individual characteristics, leading to the anonymity of individuals within the group [9]. In this anonymous learning environment, students lack a sense of responsibility and commitment to participating in general education. This is especially true for students with low social and cultural capital, as a lack of material resources prevents them from having equal access to general education. Therefore, personalized design of general education is necessary. However, research on personalized design that fails to take group characteristics into account will lead to the ineffectiveness of personalized reforms. Current research has rarely focused on how teachers can reconcile the contradiction between group differences and personality traits in general education, but has instead focused more on individual-level issues, such as player type [13]. Oliveira et al. criticized customized games that overemphasized individual characteristics for not being more engaging than non-customized games [13].

4. The Unity Between Group Difference and Individual Characters

A review of the existing literature on personalized game reforms reveals that the existing personalized game reforms still have flaws. Therefore, it is important to fully consider the balance between group differences and individual characteristics, rather than focusing too heavily on one or the other. This article focuses on the combination of UDL and adaptive learning, with swarm intelligence as the main method to bridge this conflict.

4.1 Universal Design for Learning - Framework

Universal Design for Learning provides a framework for unifying group differences and individual characteristics. Diverse presentation, diverse participation, and diverse expression are the main components of this framework, which respectively emphasize the need to pay attention to students' individual needs as well as their social background and group characteristics [14]. A diverse presentation emphasizes the use of multimodal presentation methods, such as a combination of visual and auditory methods. In GE, diverse presentation is more reflected in the expression of game elements. Teachers should increase the application of diverse game elements in teaching and use different presentation methods to attract students' participation. For example, in teaching practice, multiple game elements such as challenges and rewards are included, and the presentation methods related to each game element have been carefully designed. Specifically, the acquisition of rewards is not only related to the accuracy of answering text questions, but also to the number of videos and audios related to knowledge points watched by students in the game and the quality of their reflection. Especially for poor students in those groups, teachers can provide a paper version of game materials to prevent these students from having fair access to educational opportunities due to equipment problems.

Diverse participation encourages teachers to design and provide a variety of flexible participation methods based on an understanding of the differences among student groups. By understanding the different perspectives and

interests of girls and boys of the same age group regarding various GE game elements, teachers can design targeted games that incorporate a variety of game elements to ensure both boys and girls can participate in the activities. In line with diverse presentations and participation, student output should also be more diverse, not just limited to written reports. Students can evaluate and reflect on summative assessments generated by the game, such as leaderboards. This can then transform summative assessments in the game into formative assessments in the learning process. This is also the safe environment that game narratives provide for students, where they don't have to worry about in-game leaderboards influencing their real-life school rankings.

4.2 Adaptive Scaffolding - Process

Within the multifaceted framework of UDL, teachers should recognize that teaching is a dynamic process and be able to adapt the design of generalizations to group differences based on students' individual characteristics. This process is called adaptive instruction. Adaptive scaffolding is a practical tool in GE design [7]. Adaptive scaffolding collects information such as students' initial behavioral characteristics and question accuracy in GE. Based on this information, it analyzes students' evolving needs over time and adjusts the game elements and other resources provided in the scaffolding to accommodate students' changing needs. Ultimately, by providing students with feedback on their current learning, it can further promote effective learning in the next stage. This process suggests that adaptive learning is an iterative process, through which it can achieve a more accurate comparison and positioning of students' individual needs within the UDL framework. Adaptive learning has been illustrated to attract more students' attention, leading to an increase in confidence and engagement [15]. Compared to UDL, which expands the breadth of GE, adaptive scaffolding focuses on in-depth analysis of GE. Therefore, using UDL as the initial framework and combining it with adaptive scaffolding, teachers can apply GE that takes into account both group differences and individual needs.

4.3 Swarm Intelligence - Method

How to integrate UDL with adaptive scaffolding is a valuable topic. From a biomimetic perspective, swarm intelligence can be used to combine broad group differences with singular individual traits. Similar to the hunting methods of fish, swarm intelligence first fully leverages and respects individual agency and hunting characteristics, engaging in individual predation within a random, arbitrary range. After multiple predations, the group collects the results and collectively selects and evaluates them [12]. Collaborative learning and peer evaluation are core steps in swarm intelligence in GE. Students first learn independently in GE using adaptive scaffolding, a process that demonstrates the influence of individual characteristics on GE. Subsequently, students collaborate in teams based on the knowledge gained through adaptive scaffolding to collectively produce knowledge. Teamwork enables students to exchange individual perspectives and integrate these perspectives into group outputs, thus socializing individual perspectives. Finally, groups share and evaluate their findings. Because the final results are evaluated and presented as a group, the learning process demonstrates the integration of group differences and individual characteristics.

5. Conclusion

Due to group differences such as gender and age, GE does not always function as expected. Furthermore, individuals within a group may have varying levels of interest in game mechanics and elements due to intra- and inter-individual differences in motivation, thinking, and abilities. Therefore, this paper employs User-Defined Learning (UDL) as a framework to ensure that the needs of diverse groups are met. Furthermore, adaptive scaffolding is employed to dynamically adapt during implementation to engage individuals. Simultaneously, group collaboration and peer evaluation are implemented to achieve a balance between group differences and individual characteristics. However, future research needs to further explore the mechanisms and influencing factors that influence the transformation of group differences and individual characteristics in this process.

References

[1] Perrotta C. Plug-and-play education: Knowledge and learning in the age of platforms and artificial intelligence. Routledge, 2024.

[2] Yan S, & Yang Y. Education informatization 2.0 in China: Motivation, framework, and vision. ECNU Review of Education, 2021, 4(2): 410-428.

[3] Zeybek N, & Saygı E. Gamification in education: Why, where, when, and how?—A systematic review. Games and Culture, 2024, 19(2): 237-264.

[4] Rađep T, & Hajdin G. Use of augmented reality with game elements in education–Literature review. Journal of Information and Organizational Sciences, 2021, 45(2): 473-494.

[5] Huang B, & Hew K F. Using gamification to design courses. Educational Technology & Society, 2021, 24(1): 44-63.

[6] Jong M S Y, Chan T, Tam V, & Jiang M Y C. Design-based

ISSN 2959-6149

research on gamified outdoor social enquiry learning with context-aware technology: Integration of teacher facilitation for advancing the pedagogical effectiveness. International Journal of Mobile Learning and Organisation, 2021, 15(1): 107-126.

[7] Chen C H, Law V, & Huang K. Adaptive scaffolding and engagement in digital game-based learning. Educational Technology Research and Development, 2023, 71: 1785-1798.

[8] Mellado R, Cubillos C, Vicari R M, & Gasca-Hurtado G. Leveraging gamification in ICT education: Examining gender differences and learning outcomes in programming courses. Applied Sciences, 2024, 14(17).

[9] Ahmad A, Zeeshan F, Marriam R, Samreen A, & Ahmed S. Does one size fit all? Investigating the effect of group size and gamification on learners' behaviors in higher education. Journal of Computing in Higher Education, 2021, 33(2): 296-327.

[10] Kim J, & Castelli D M. Effects of gamification on behavioral change in education: A meta-analysis. International Journal of Environmental Research and Public Health, 2021, 18(7).

[11] González-González C S, Toledo-Delgado P A, Muñoz-Cruz V, & Arnedo-Moreno J. Gender and age differences in preferences on game elements and platforms. Sensors, 2022, 22(9).

[12] Salpasaranis K. Introducing Artificial Intelligence (AI), Swarm Intelligence (SI), and Bio-inspired algorithms concepts to elementary and secondary (K-12) education using block-based programming environments: A simplified simulation inspired by Artificial Fish Swarm Optimization Algorithm (AFSO). European Journal of Artificial Intelligence and Machine Learning, 2024, 3(3): 9-17.

[13] Oliveira W, Hamari J, Shi L, Toda A M, Rodrigues L, Palomino P T, & Isotani S. Tailored gamification in education: A literature review and future agenda. Education and Information Technologies, 2023, 28(1): 373-406.

[14] Levey S. Universal design for learning. Journal of Education, 2021, 203(2): 479-487.

[15] Liu Z, & Jeong A C. Connecting learning and playing: The effects of in-game cognitive supports on the development and transfer of computational thinking skills. Educational Technology Research and Development, 2022, 70(5): 1867-1891.