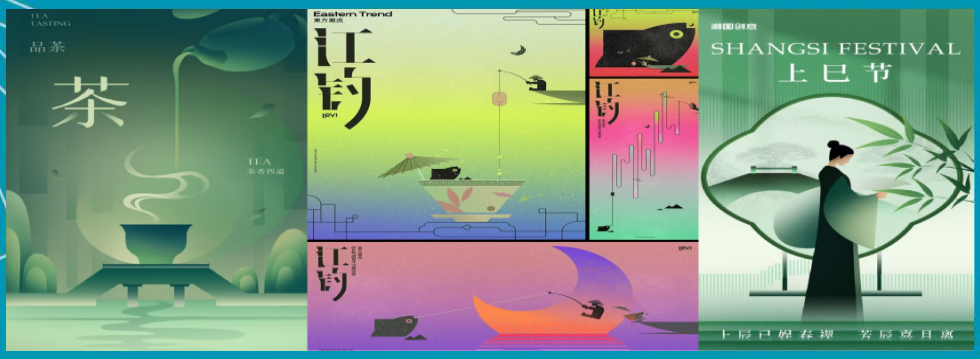
GAMIFICATION IN FORMATIVE ASSESSMENT DESIGN (GAM-FAD)



Enhancing Engagement and Learning Outcomes in MOOCs

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2025

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Published in **2025** by **UCSI Press**
No. 1, Jalan UCSI, UCSI Heights (Taman Connaught), Cheras, 56000
Wilayah Persekutuan Kuala Lumpur
ISBN 978-629-7673-87-5

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eISBN 978-629-7673-87-5

UCSI Press

PREFACE

This book seeks to deliver an exhaustive examination of the design, development, and validation processes for the gamification formative assessment instrument, "ShiYi · ChuanMei." The major objective of this technology is to tackle the issue of inadequate sustained engagement among learners in MOOCs.

This book outlines the design and development steps, encompassing critical stages such as content preparation, interview design, creating gamification documents, and team collaboration. By integrating the ideas of intangible cultural heritage education with modern gamification strategies, the tool attains a harmony between scholarly rigor and user engagement. "ShiYi · ChuanMei" is functionally categorized into three principal modules: self-assessment, progressive evaluation, and peer evaluation. This book details the design rationale and functional attributes of each module, illustrating the integration of gamification aspects within the formative assessment framework.

This book provides a comprehensive assessment of the instrument via a multidimensional validation framework, outlining the design of the evaluation questionnaire and the data collection methodology. This creates a comprehensive validation pathway from theory to application. Gamification in formative assessment design (GAM-FAD) entails the use of game elements—such as leaderboards, badges, points, and interactive platforms—into formative exams to augment student engagement, motivation, and achievement. Studies demonstrate that gamified instruments, such as leaderboards and platforms like Kahoot! and Quizizz, can markedly enhance learner engagement and achievement in several educational settings, including engineering, language acquisition, and medical training.

Gamification promotes the internalization of assessment value, stimulates active engagement, and delivers prompt feedback that enhances learning and skill acquisition. Nevertheless, the efficacy of particular game components may differ. Although leaderboards and badges might enhance short-term incentive, they may fail to maintain long-term interest if not meticulously crafted. Consideration must be given to challenges such as the necessity for deliberate integration to prevent cognitive overload and to ensure alignment with learning objectives.

GAM-FAD signifies a promising method for enhancing the interactivity and efficacy of formative assessment; yet, it requires meticulous design and continuous evaluation to optimize its advantages.

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CHAPTER ONE

INTRODUCTION

INTRODUCTION

Gamification in formative assessment design (GAM-FAD) involves the intentional integration of game elements—such as leaderboards, badges, points, and interactive platforms—into formative assessment activities. This technique aims to enhance student engagement, motivation, and overall performance. Research indicates that utilizing gamified tools, including leaderboards and platforms such as Kahoot! and Quizizz, can significantly improve student engagement and performance. These tools augment the allure and incentive of assessments across diverse educational contexts, including engineering, language acquisition, and medical training (Maraza-Quispe, 2024; Hoang, 2024; Ismail et al., 2019).

The incorporation of gamification improves students' understanding of the importance of assessment. It fosters active participation by making learning sessions more lively and enjoyable. Moreover, gamification provides immediate feedback, essential for promoting learning and skill development. This feedback mechanism allows students to assess their performance and make requisite adjustments, hence enhancing their learning results (Ismail et al., 2019; Larrosa et al., 2023).

Nonetheless, the effectiveness of specific game elements can vary significantly. Although leaderboards and badges can boost immediate motivation, they may fail to maintain long-term engagement unless they are carefully customized to meet the learners' needs and settings (Cigdem et al., 2024). Numerous studies emphasize the importance of intentional integration to mitigate cognitive overload and to ensure that

gamification tactics correspond with established learning objectives (Gejandran & Abdullah, 2024).

Although the outcomes of gamification are largely positive, obstacles persist. Challenges include resource availability, technological infrastructure, and the novelty effect—where early enthusiasm wanes over time—must be meticulously controlled during deployment (Litardo et al., 2025).

This book seeks to deliver an exhaustive examination of the design, development, and validation processes for the gamification formative assessment tool, "ShiYi · ChuanMei." The primary objective of developing this technology is to tackle the issue of inadequate sustained engagement among MOOCs participants. This book addresses essential phases of tool construction, encompassing content preparation, interview design, creating gamification papers, and team collaboration. The tool integrates intangible cultural heritage teaching with contemporary gamification design, achieving a balance between scholarly rigor and user engagement.

In practical implementation, "ShiYi · ChuanMei" comprises three fundamental modules: self-assessment, progressive evaluation, and peer evaluation. This book offers a comprehensive elucidation of the design rationale and operational attributes of each module, illustrating the integration of gamification aspects within the formative evaluation framework.

The book thoroughly assesses the instrument using a multifaceted validation framework, detailing the design of the assessment questionnaire and the data gathering methodology. This creates a comprehensive validation pathway from theory to application. GAM-FAD provides a robust framework for improving formative assessment via heightened interaction and effectiveness; but, to maximize its benefits, careful design and continuous evaluation are essential. Ongoing assessment of gamification strategies will aid educators in enhancing their approaches, ensuring they meet the changing requirements of learners while effectively promoting sustained engagement and achievement (Boytchev & Boytcheva, 2020; Khan et al., 2021; Rani et al., 2023; Villacres et al., 2024; Amornrit et al., 2025).

THE CONCEPT AND CURRENT RESEARCH STATUS OF MOOCS

"MOOCs" is an acronym for "Massive Open Online Courses." This study constantly employs the plural "MOOCs" to accurately represent the variety of courses accessible, guaranteeing clarity and consistency, despite certain texts referring to the singular "MOOC" (Portney, 2014). The term was presented in 2008 by Dave Cormier from the University of Prince Edward Island to define an open course entitled "Connectivism and Connective Knowledge," co-developed with George Siemens and Stephen Downes (McAuley et al., 2010).

The Rise of MOOCs

MOOCs garnered considerable interest in 2012, a year commonly designated as "The Year of the MOOC" (Jordan & Goshtasbpour, 2022). This signified a pivotal moment in online education, garnering the attention of educators, institutions, and learners globally. Since that time, the MOOC environment has experienced significant transformations, marked by considerable investments and millions of enrollments.

Expansion of Research

The investigation of MOOCs has proliferated swiftly, especially with a significant surge in publications in 2021, reflecting an escalating scholarly emphasis on this novel educational paradigm (Irwanto et al., 2023). Nonetheless, despite initial enthusiasm regarding their capacity to transform conventional higher education, MOOCs have not fully realized these anticipations. They have progressively evolved into platforms for providing online master's degrees targeted at professionals seeking to augment their qualifications (Reich & Ruipérez-Valiente, 2019).

Challenging Confronting MOOCs

The evolution of MOOCs has faced numerous obstacles. A significant concern is the consistently poor completion rates among learners, which prompts inquiries on

the efficacy and engagement of these courses. Moreover, the majority of MOOCs are predominantly located in affluent nations, so constraining their accessibility and influence in less prosperous areas (Reich & Ruipérez-Valiente, 2019). Critics contend that the MOOCs model may unintentionally endorse digital neocolonialism by privileging Western-centric ideologies and marginalizing alternative viewpoints (Adam, 2019).

Continuing Investigation and Examination

Notwithstanding these problems, MOOCs continue to be a dynamic field of inquiry. Researchers are diligently investigating many facets of MOOCs, including their acceptance, design, and administration, to enhance comprehension and advancement of this developing educational phenomena (Meet & Kala, 2021; Ucha, 2023). This continuous investigation underscores the intricacies and possibilities of MOOCs to shape the future of education, reflecting a persistent interest in their function within the wider educational framework.

Unique Characteristics of MOOCs

This paper contends that MOOCs are inherently distinct from conventional remote learning approaches, such as television broadcasts and mail courses. MOOCs are characterized as "a large-scale online course framework employing Internet technology, publicly accessible, featuring structured pedagogical designs and mechanisms for autonomous learning." Essential attributes encompass open enrollment, extensive learner accessibility, adaptable engagement, structured course material, interactivity, feedback systems, and attainable results. In China, MOOCs function as essential augmentations to conventional education, transforming into cohesive platforms that amalgamate instructional resources, community engagement, and learning evaluations.

Influence on Worldwide Education

The ongoing advancement of MOOCs has significantly influenced worldwide education by dismantling geographical and resource obstacles. They enable a diverse

array of learners to obtain high-quality educational resources at minimal or no expense, hence enhancing educational accessibility and equity (Ponce et al., 2025). This decentralized learning concept promotes an open and collaborative educational experience beyond conventional institutions. Innovative digital pedagogical techniques—such as films and interactive quizzes—forge a novel educational milieu that integrates technology, content, and community (Deng, 2024; Shi et al., 2024). Studies indicate that MOOCs facilitate self-directed learning and lifelong education, especially for part-time learners managing multiple obligations (Iniesto et al., 2024). Furthermore, MOOCs promote cross-cultural information exchange and interdisciplinary cooperation, hence augmenting global knowledge distribution and cultivating various learning communities (Arpaci et al., 2020). Their versatility renders them indispensable for lifelong learning, particularly in times of global crises (Strehlow et al., 2024; Sewan Johnston et al., 2025).

Concerns and Future Directions

Nonetheless, apprehensions regarding MOOCs endure, especially in relation to elevated dropout rates. A thorough analysis by Onah et al. (2023) indicated that completion rates frequently dip below 10%, prompting inquiries over the educational efficacy and motivational viability of these courses. Critics contend that MOOCs presuppose a "self-motivated ideal learner," neglecting the support requirements of numerous learners and intensifying exclusionary behaviors, particularly in culturally and digitally diverse contexts (Bonk & Doo, 2020; de Waard & Kukulska-Hulme, 2020).

As research on MOOC transitions from a technological emphasis to a learner-centered approach, it will be imperative to address dropout rates and examine initiatives for educational equity as critical areas for additional investigation.

OVERVIEW OF DROPOUT IN MOOCS

Since their introduction, MOOCs have garnered millions of global learners (Perifanou & Economides, 2022). Despite providing adaptable learning options that accommodate various schedules and tastes, high dropout rates remain a significant barrier for MOOC educators. Research reveals that average dropout rates fluctuate between 80% and 90%, a troubling ratio for an educational approach intended to enhance accessibility and engagement.

A survey by Zheng et al. (2020) indicates that, despite the significant convenience offered by MOOCs, fewer than 10% of enrolled learners complete the courses satisfactorily. The concerning dropout rate prompts essential inquiries regarding the efficacy of the curriculum and the comprehensive learning experience provided by MOOCs. Moreover, it constrains the capacity of MOOCs to promote lifelong learning and enhance educational justice.

In light of these issues, comprehending the reasons that lead to MOOCs dropout have emerged as a critical area of research in recent years. Examining the fundamental reasons for dropout can facilitate the identification of measures to augment learner engagement, refine course design, and eventually decrease attrition rates. By resolving these difficulties, MOOCs can more effectively realize their potential of delivering accessible education to a worldwide audience.

Review of Dropout Factors in MOOCs

This paper offers a thorough evaluation of the primary factors influencing dropout rates among MOOC learners, as established in prior studies. The factors encompass technical difficulties, academic obstacles, lack of motivation, inadequate social support, and challenges related to autonomous learning environments. These aspects are interconnected and profoundly affect learners' engagement levels. The principal categories are as follows:

Lack of Motivation

Numerous MOOCs are self-directed and informal, leading to minimal repercussions for unsuccessful outcomes. As a result, students' initial objectives frequently diverge from their sustained dedication. In the absence of external control or robust motivation, learners may demonstrate diminished commitment to their studies and encounter difficulties with self-regulation (Kizilcec & Schneider, 2020). Moreover, intrinsic motivation, which compels learners to participate out of interest or personal development, is frequently absent. Sun and Rueda (2021) discovered that numerous learners experience a decline in motivation early in the course, primarily attributable to the lack of examination pressure or academic obligations. Zhang et al. (2020) observed that the absence of methods to enhance self-motivation in course design leads to a swift decrease in learners' engagement.

Discrepancy Between Challenges and Capabilities

Academic difficulties in MOOCs constitute a substantial component contributing to dropout rates. Courses must equilibrate accessibility and difficulty to accommodate varied learner demographics. Research indicates that students are more prone to withdraw if they perceive course content as excessively hard (Eriksson et al., 2016). Subpar course design, characterized by tedious content that depends exclusively on technology, may elevate attrition rates (Osuna et al., 2018). Time management presents a significant challenge; when the workload deviates from learners' initial expectations, it may lead to disengagement (Xavier-Meneses, 2022). Recent research by Liu et al. (2021) reveals that numerous MOOC participants are adults who encounter time limitations, reducing their capacity for profound learning.

Lack of Social Support

Inadequate social connection is a significant factor influencing dropout rates. In conventional classrooms, students obtain emotional support, intellectual aid, and feedback from interactions with peers and educators. The relative solitude of MOOCs may result in emotions of loneliness and helplessness. Tang and Bao (2021) discovered

that learners with minimal social connection are more prone to frustration and consequent attrition. The substantial participant volume in MOOCs frequently hinders the provision of individualized feedback, exacerbating the problem. Hew et al. (2020) propose that improving community engagement and social support in online education may reduce dropout rates. A qualitative investigation of 965 MOOC students revealed that student engagement was affected by the instructor's participation, enthusiasm for the subject, and the caliber of educational tools.

Loneliness in the Educational Context

The autonomous structure of MOOCs presents difficulties for numerous learners who are inexperienced in self-regulating their education. In contrast to conventional classrooms, where students get instruction from teachers, MOOCs necessitate that learners design their own educational strategies and seek assistance autonomously. Wang et al. (2022) identified a substantial positive link between learners' self-management skills and their sustained engagement in MOOCs. Individuals who have difficulties with time management and autonomous learning are at a heightened risk of discontinuing their studies. Consequently, providing learners with efficient learning methodologies and self-management tools is crucial for enhancing completion rates. Henderikx et al. (2019) contend that obstacles such as diminished motivation and insufficient time management impede learners from realizing their educational objectives.

Technical Issues

Technical difficulties are a substantial element influencing MOOC attrition rates, particularly in regions with inadequate internet connectivity. Despite advancements in online learning platforms, difficulties such as unreliable systems and inadequate connectivity continue to pose substantial obstacles for numerous learners. Pardamean and Susanto (2019) discovered that approximately 40% of MOOC participants encounter frustration stemming from technological issues, resulting in course dropouts. This is especially common in underdeveloped nations, where low

broadband connection and system faults hinder the learning experience. Technical challenges also include learners' lack of familiarity with the necessary tools and technology. Albelbisi and Yusop (2020) observed that the technical self-efficacy of MOOC learners substantially influences their learning outcomes; individuals with diminished self-efficacy are more susceptible to attrition owing to frustration.

Supplementary Considerations

Certain studies identify personal characteristics and behaviors that may influence learners' capacity to complete courses. Van de Oudeweetering and Agirdag (2018) analyzed demographic data, whereas Abe (2020) investigated personality qualities to discern common features between individuals who disengage from online learning and those who excel in traditional schooling. Aldowah et al. (2020) identified multiple reasons for non-completion, classifying them as personal (62.5%), situational/social (50%), course-related (47.5%), and academic factors (42.5%). This classification demonstrates previous studies suggesting that the causes for dropout are complex, involving personal, academic, social, and curriculum-related factors.

Comprehending these aspects is essential for formulating methods to improve learner retention in MOOCs, hence optimizing their capacity as platforms for accessible and egalitarian education.

Problems Caused by Dropout

The elevated dropout rate of MOOCs has resulted in various substantial issues for individuals and society, adversely affecting learners, educational institutions, and the overall online education framework.

The decline in Academic Achievement

The dropout phenomena in MOOCs considerably impedes learners' academic achievement. Due to the reliance of MOOCs on self-regulation, withdrawal

frequently hinders learners from obtaining vital knowledge and skills. Recent research by Lee (2021) reveals that numerous learners experience a decline in interest or motivation midway through their courses, resulting in disengagement from essential content and exams. This disengagement can significantly impact their academic achievement, especially for those seeking to improve their professional abilities through these courses. Repeated dropout experiences may undermine learners' self-efficacy and trust in their online learning capabilities. Nam and Song (2025) assert that participants who have disengaged from several MOOCs may exhibit reluctance in choosing future online courses, resulting in self-doubt that adversely affects their long-term academic and professional development.

Psychological Health Problems

The elevated dropout rate in MOOCs adversely impacts academic results and negatively influences learners' mental well-being. Discontinuing a course may result in diminished self-efficacy, amplified self-doubt, and greater irritation. Students who dedicate time and effort yet do not finish their courses sometimes encounter anxiety and stress. Tao and Li (2021) discovered that numerous MOOC dropouts express feelings of isolation and a deficiency in essential social support and feedback during their learning experiences, which might negatively impact their mental well-being. Wang and Zhou (2020) identified a positive association between feelings of isolation in MOOCs and anxiety levels, especially in the lack of interactive chances and prompt responses. This feeling of isolation can intensify psychological stresses, resulting in a cycle of dissatisfaction and disengagement. Moreover, Chen (2021) observed that students with inadequate self-regulation exhibit heightened anxiety, as they find it challenging to manage their time and meet course requirements, hence exacerbating their susceptibility to psychological discomfort.

Wasting Educational Resources

MOOCs necessitate significant continuous investment in resources to maintain their operations, and the increasing dropout rates lead to inefficient resource

utilization. The creation and upkeep of MOOCs—encompassing course content design, technical assistance, and faculty engagement—expend considerable educational resources. Garcia and Cortes (2020) indicated that more than fifty percent of enrolled students do not finish their courses, resulting in resources that fail to meet their intended educational objectives, particularly in courses requiring significant engagement and individualized support. Rahmani and Groot (2024) assert that rising dropout rates need that platforms and educational institutions invest more resources to improve course experiences, upgrade technology infrastructure, and bolster learner support services. Nonetheless, the ongoing dropout issue has markedly diminished the overall resource use.

Influence on the Quality and Credibility of Online Education

The elevated dropout rates in MOOCs adversely affect the perceived quality and legitimacy of the overall online education market. The prevalent incidence of dropout calls into question the efficacy of MOOCs education, prompting skepticism over the ability of these courses to deliver authentic high-quality learning experiences. Studies demonstrate that high dropout rates might tarnish the reputation of MOOC platforms and diminish prospective learners' confidence in these courses (Vander Ark & Steiner, 2019). The sustainability of MOOCs as a sustainable educational approach is increasingly being questioned.

The elevated dropout rates in MOOCs pose considerable issues that impact both individual learners and the wider educational ecosystem, underscoring the pressing necessity for initiatives to improve learner engagement and retention.

Existing Strategies and Interventions for MOOCs Dropout

To reduce the elevated dropout rates in MOOCs, experts have suggested numerous preventive tactics and intervention measures. These tactics encompass all facets of the learning process, including educational design, technological assistance,

individualized learning pathways and feedback, as well as the execution of formative assessments.

Enhance Course Structure

The design of MOOCs is essential for improving learner engagement and retention. Research demonstrates that suitably modifying course difficulty, enhancing interactive content, and integrating visual learning resources can markedly elevate engagement and completion rates (Aldowah et al., 2020). Courses that have a reasonable difficulty level with well-defined learning pathways assist learners in maintaining motivation and circumventing frustration caused by excessively tough or simplistic material. Interactive components, including real-time dialogues and collaborative assignments, effectively enhance participation (Romero Rodríguez et al., 2019).

Numerous scholars (Cobos & Ruiz-Garcia, 2020; Ortega et al., 2019) have presented innovative pedagogical interventions grounded in course design elements. Strategies such as instructor presence (Hone & Said, 2016), enhancements in accessibility (Hew, 2016), and efficient assessment and feedback systems (Bonk et al., 2018; Monllao Olive et al., 2020) are essential. Implementing demanding challenges and diverse learning trajectories can significantly augment engagement. Facilitating learners through more challenging tasks can cultivate a sense of accomplishment, sustaining their enduring motivation (Ortega-Arranz et al., 2019). Gamification components, including scores, badges, and leaderboards, enhance the enjoyment of learning and motivate continuous engagement, hence increasing completion rates (Romero Rodríguez et al., 2019).

Enhance Technical Support

Technical assistance is crucial for the effective execution of MOOC platforms. Numerous empirical investigations have employed the Technology Acceptance Model (TAM) and Task Technology Fit (TTF) frameworks to examine learners' uptake of MOOCs (Joo et al., 2018). Studies indicate that factors such as platform instability and intricate user interfaces may result in user dropout (Wang et al., 2022). Improving

platform stability, availability, and mobile learning support can markedly decrease disruptions in learning, especially for students with varied study schedules. Enhanced mobility facilitates increased flexibility in the completion of courses.

Moreover, technical support is essential in providing individualized learning experiences. Technologies like Learning Analytics (LA) and Educational Data Mining (EDM) provide real-time analysis of student behavior, offering tailored learning recommendations and feedback (Hew et al., 2020; Xing & Du, 2019). Dropout prediction algorithms can discern at-risk students by their interactions with the platform, facilitating rapid interventions like as reminder emails or motivational messages (Prenkaj et al., 2020).

Offer Customized Learning Directions and Evaluative Feedback

Customized learning pathways and feedback have been recognized as successful strategies for decreasing MOOC attrition rates. Progress in artificial intelligence and data analytics enables educational systems to provide customized suggestions based on individual learner data. This tailored feedback aids learners in tracking their advancement and boosts their motivation (Hew et al., 2020; Xing & Du, 2019).

When systems identify that learners may encounter difficulties or are at danger of disengagement, prompt interventions—such as reminder emails or positive reinforcement—can redirect their focus towards learning objectives. Cobos and Ruiz-Garcia (2020) propose that these strategies may assist learners in alleviating course-related stress and restoring focus. Furthermore, Shinogaya (2022) introduced a testing intervention structure designed to enhance students' confidence through the provision of preparatory materials and study guides before evaluations.

Formative Assessment as a Strategy and Intervention

Formative assessment is an effective approach for facilitating behavioral adjustments in learners through ongoing feedback, demonstrating its significance in mitigating MOOC dropout rates (Bonk et al., 2018). Studies indicate that formative

assessments offer prompt, multifaceted feedback, allowing learners to consistently enhance their skills and behaviors within the educational process (Fu et al., 2019). Formative assessments provide detailed and incremental feedback, elucidating learning objectives at each stage and mitigating anxiety related to overall course requirements. This method not only sustains learner motivation throughout autonomous study but also markedly decreases attrition rates (Leenknecht et al., 2020).

In conclusion, an amalgamation of optimal course design, comprehensive technical support, tailored learning experiences, and efficient formative evaluations can together mitigate the causes leading to elevated dropout rates in MOOCs, hence improving learner engagement and success.

REVIEW OF RESEARCH ON FORMATIVE ASSESSMENT

Definition and development of Formative Assessment Theory

The philosophy of formative assessment is a fundamental concept in this study, emphasizing its influence on learners' ongoing engagement in MOOCs.

Origins and Historical Context

The origins of formative assessment can be linked to early 20th-century educational thought, especially within the progressive education movement. John Dewey, a pivotal figure in this approach, asserted that learning ought to be dynamic and interactive rather than exclusively outcome-focused (Ye & Shih, 2021). Dewey contended that education ought to emphasize personal growth rather than solely assessing results via standardized examinations. This theory established the foundation for the development of formative assessment.

In 1967, Scriven made a notable contribution by distinctly differentiating

formative evaluation from summative assessment. He claimed that the principal objective of formative assessment is to support learners in their educational progression rather than merely assessing them at the conclusion of a course. This distinction signified the formal inception of formative assessment and has been crucial for the advancement of subsequent educational evaluation approaches.

Significant Advancements in Formative Assessment

In the 1990s, Black and Wiliam offered a seminal definition of formative assessment, characterizing it as a technique for the ongoing collection of data regarding student learning during the instructional process. This data is subsequently utilized to modify instructional tactics and enhance student performance. Their research emphasized the twin function of formative assessment: it improves teaching practices and prompts students to contemplate and develop their learning processes (Black & Wiliam, 1998).

As educational theory and practice progressed, the notion of formative assessment further developed. Popham (2008) asserted that the efficacy of formative assessment depends on teachers' application of the gathered data to modify their instruction and support students in reaching their educational objectives. Schildkamp et al. (2020) observed that formative assessment constitutes an interactive process engaging both educators and learners. This interaction cultivates a collaborative learning atmosphere where feedback is offered, promoting student engagement in self-evaluation and peer assessment, thus augmenting their sense of responsibility and autonomy in learning.

Bazhmina (2020) noted that educational technology tools in digital learning settings allow teachers to monitor student progress in real-time and provide individualized comments based on data. Advancements in online learning platforms and artificial intelligence have rendered formative assessment a potent technique for crafting tailored learning pathways, hence aiding students in improving their self-directed learning skills (Moreno & Pineda, 2020). Sanchez-Lopez et al. (2023) characterized formative assessment as the evaluation of students' competencies or comprehension of

certain course subjects, emphasizing immediate feedback via classroom interactions to assist students in modifying their learning approaches.

In summary, although numerous definitions of formative assessment exist, they all emphasize the importance of feedback and the learning process. This study defines formative assessment as a continuous evaluation strategy that offers timely and varied feedback, allowing learners to modify their tactics, enhance their behaviors, and promote deeper engagement during the learning process. This method highlights the dynamic interplay between assessment and feedback, concentrating on both end results and the learning process, thereby fostering continuous learner involvement (refer to Figure 1).

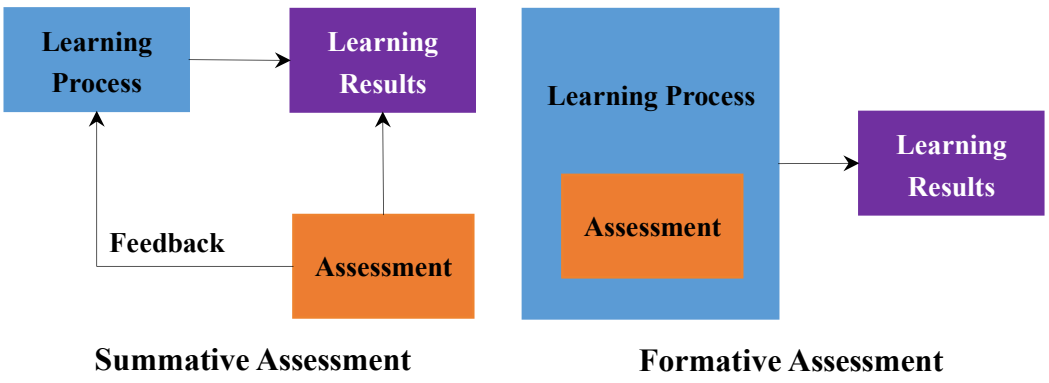

Figure 1 Difference between Summative Assessment and Formative Assessment

Researches of Formative Assessment in Teaching Applications

Formative assessment has become a pivotal focus of study in education, receiving considerable attention and implementation in conventional educational environments. Recent studies demonstrate a significant rise in research activity concerning formative assessment, especially from 2015 to 2022.

Trends in Research Engagement

Zhang et al. (2023) performed a bibliometric analysis of 94 papers regarding

formative assessment in science education, indicating a significant increase in publications since 2020. This tendency underscores the increasing interest in formative assessment as a crucial study subject, particularly in nations such as the United States where it has been widely referenced. Likewise, Sudakova et al. (2022) illustrated that the implementation of formative assessment in higher education is growing prevalent, especially with the swift progression of online formative assessment (OFA). Their examination of 898 papers revealed that formative assessment is becoming increasingly essential in e-learning and remote education, emphasizing evaluation design, tool accessibility, and tailored feedback.

Case Analyses and Practical Implementations

Numerous case studies demonstrate the practical implementations of formative assessment across many educational contexts:

Hong Kong Secondary Schools: Ko, P. Y. (2019) examined the integration of formative assessment methods, such as pre-tests and post-tests, into everyday instruction by instructors. This case study highlighted the necessity for educators to gather student input and modify their approaches accordingly, demonstrating that formative assessment improves both academic achievement and material comprehension.

High School Mathematics: Dayal (2021) examined two mathematics educators who employed formative assessment via student portfolios. The research indicated that elucidating learning objectives and success metrics, in conjunction with peer relationships, markedly enhanced classroom engagement and involvement. The contrasting methodologies of the educators underscored the influence of assessment beliefs on its efficacy.

University Biology Courses: Khajeloo et al. (2021) investigated the implementation of formative evaluation by two biology instructors in accordance with their pedagogical philosophies. Although their methodologies differ—one emphasizing motivation and the other prioritizing a stress-free experience—both acknowledged the beneficial impact of formative evaluation on student learning and strategic adaptation.

Five-Stage Cycle Model: Veugen et al. (2021) introduced a five-stage formative assessment cycle comprising the following stages: setting expectations, eliciting responses, assessing responses, providing feedback, and modifying instruction. Their research revealed that educators frequently overlook the concluding phases of this cycle, highlighting the necessity of a holistic strategy to adequately address student requirements.

Self-Directed Learning: Granberg et al. (2021) performed a case study in Sweden, demonstrating that courses utilizing formative assessment shown considerable enhancements in self-regulated learning practices relative to a control group. This study emphasizes the beneficial relationship between formative evaluation and the development of self-regulation skills.

Homework as Assessment: Perro et al. (2020) examined the utilization of homework as a formative assessment instrument by educators in grades 3 to 5. They recognized prevalent problems, including inadequate feedback utilization and ambiguous objectives, proposing that professional development might bolster instructors' self-confidence and boost the usefulness of formative assessments.

E-Books in Special Education: Yan et al. (2021) investigated the role of e-books in facilitating formative assessment inside special education classrooms. Their findings demonstrated that educators' practical evaluation theories substantially impacted their utilization of e-books, hence improving flexibility and efficacy in assessment.

Formative assessment has proven to be an effective evaluative tool in education, distinguished by prompt feedback and the ability to modify teaching strategies. The extensive scope of formative assessment has been evidenced by numerous research, highlighting its significance in informing instructional choices, delivering immediate feedback, promoting self-regulation, and individualizing evaluation in special education. The research findings emphasize the theoretical progress and practical achievements of formative assessment, establishing a robust basis for improving teaching methodologies and augmenting student learning outcomes.

Formative Assessment as an Intervention for Dropout

Formative evaluation is increasingly acknowledged not just as a means of evaluating student learning advancement but also as a potent approach for diminishing dropout rates. Multiple studies demonstrate that formative assessment can improve student motivation and promote sustained engagement in the learning process.

Data from K-12 Education

Lee et al. (2020) performed a retrospective analysis of the K-12 education system in the United States, including 33 studies pertaining to formative assessment. Their content study demonstrated that the integration of self-assessment and teacher feedback markedly enhanced student performance, particularly in language and mathematics. This ongoing reflection, combined with focused supervision, enhances students' comprehension of their learning objectives, thereby diminishing the probability of dropout. The feedback mechanism intrinsic to formative assessment encourages students to participate in learning and modify their techniques when encountering difficulties, so averting resignation due to uncertainty or lack of guidance.

Research in Higher Education

A study on university statistics courses revealed that the early implementation of regular quizzes enables educators to identify underperforming pupils and offer targeted assistance. These tailored interventions markedly diminished dropout rates and enhanced the probability of course completion, demonstrating formative assessment as a crucial alert mechanism that facilitates prompt teacher intervention (Figueroa Cañas and Sancho Vinuesa, 2020). Alkhateeb et al. (2019) investigated formative evaluation in a medical institution in Iraq, focusing on objective structured clinical examinations (OSCE). Their randomized controlled trial demonstrated that students engaged in formative evaluations achieved superior results in subsequent summative exams, suggesting that prompt feedback enhances student performance in intricate learning

tasks.

Practical Applications in Engineering and Secondary Education

Kereković (2021) examined formative assessment in electrical engineering courses, highlighting the need of group discussions and task feedback to enhance student motivation and engagement. This method enhanced engagement and interest in the material by including peer assessment and instructor feedback. Anders et al. (2022) conducted an analysis of embedded formative assessment procedures in 140 secondary schools in the UK. Their findings demonstrated that the systematic use of formative assessment markedly improves academic performance, especially reducing the achievement disparity between high and low-performing pupils. This indicates that formative evaluation can significantly enhance overall student performance and decrease dropout rates in extensive educational settings.

Implementation in MOOCs

Numerous research have investigated formative evaluation within MOOCs to mitigate dropout rates. Lukač and Shahriari Rad (2019) investigated the implementation of formative assessment procedures for learners utilizing CAD apps in MOOCs, employing short-term standardized assessments to monitor progress and adapt instructional methods accordingly. This dynamic feedback system substantially enhanced individualized learning and streamlined the educational process.

Abbakumov et al. (2020) introduced an enhancement of the Rasch model for formative assessment in MOOCs, integrating variables such as the number of attempts and learners' interest levels to enable educators to accurately evaluate progress and modify strategies, thereby mitigating dropout rates among high-risk students. Avgerinos and Karageorgiadis (2020) investigated intelligent adaptive formative assessment systems in MOOCs, integrated with in-person evaluations, to improve evaluation quality. This integrated evaluation method shown notable efficacy in mathematics courses and was also relevant in various other fields.

Chen et al. (2021) examined formative assessment in online education during

the COVID-19 pandemic, discovering that regular activities and quizzes offered fast feedback, which facilitated sustained student involvement and favorable results. A multitude of students indicated that this ongoing assessment system facilitated the maintenance of their motivation during the learning process.

Although the academic community has initiated investigations into the impact of formative assessment on dropout rates in many educational settings, research in this domain remains nascent. The research substantiates the efficacy of formative assessment in improving students' learning experiences and promoting ongoing engagement. Consequently, employing formative evaluation as a strategy to mitigate MOOC attrition rates is a viable and judicious method.

Advantages and Disadvantages of Formative Assessment

Formative evaluation provides distinct advantages relative to other assessment forms; nonetheless, it encounters considerable obstacles in actual execution.

Advantages of Formative Assessment

Ongoing Evaluation

Formative assessment offers continuous feedback during the learning process, enabling educators to track student advancement and modify their instructional approaches as needed. This adaptability mitigates the constraints of diagnostic evaluations, which yield insights solely in the initial stages, and summative assessments, which furnish comments exclusively at the conclusion of a course (Menéndez et al., 2019). Ongoing feedback allows learners to enhance their comprehension and methodologies, hence facilitating improved educational results.

Personalized Assistance

In contrast to conventional reference tests that evaluate if pupils achieve set standards, formative assessment provides a comprehensive perspective on individual

learning advancement. It enables educators to swiftly discern the needs of children, especially those necessitating supplementary assistance (Moreno & Pineda, 2020). In technology-enhanced settings, formative assessment can employ digital tools for the real-time monitoring of student advancement (Savinykh, 2022).

Encouragement of Self-Directed Learning

Formative assessment enhances students' capacities for self-directed learning. It promotes contemplation of their learning methodologies, facilitating strategic modification. This method differs from normative reference evaluations that focus on comparative performance within a cohort (Cevallos Menéndez et al., 2019).

Improved Motivation

Formative evaluation enhances student motivation and promotes active engagement in learning by emphasizing continuous feedback and progress. This ongoing involvement assists students in surmounting obstacles, enhances their self-efficacy, and sustains enduring motivation (Boström & Palm, 2023).

Disadvantages of Formative Assessment:

Insufficient Teacher Resources

Executing formative assessment may be laborious and resource-demanding for educators. Creating assessment tasks, gathering feedback, and assessing outcomes necessitate considerable effort, posing challenges for educators with substantial workloads, particularly in big classrooms (Johansson et al., 2022). Conversely, conventional summative evaluations require less instructor involvement.

Inconsistent Feedback Quality

The efficacy of formative assessment predominantly relies on the caliber of feedback rendered. If feedback is ambiguous, imprecise, or delayed, students may misconstrue their progress and find it challenging to implement appropriate modifications. Subpar feedback quality can obstruct the comprehensive evaluation

process (Henderson et al., 2019).

Diverse Student Reception of Feedback

Not all students react favorably to criticism, and others may experience distress due to frequent evaluations. Mental weariness resulting from subpar input can result in disengagement and diminished motivation (Vattøy et al., 2020). Excessive feedback might, in certain instances, overwhelm students, leading to disengagement from exams and a decline in their interest in the course (Andrade & Brown, 2019).

Psychological Pressure

Ongoing evaluation may induce psychological stress in certain students. When evaluations are viewed as too critical or rigid, students may reject involvement, adversely affecting their motivation and engagement. Boud and Molloy (2021) assert that sustaining a flexible and supportive evaluation environment is essential for alleviating stress and promoting active engagement.

Formative assessment has several benefits, including continuous feedback, individualized support, and increased motivation; yet, it also encounters problems, such as time limitations for educators and diverse student reactions to input. It is crucial to balance these aspects for the proper implementation of formative assessment in educational contexts.

USING GAMIFICATION AS MOOCS DROPOUT PREVENTION STRATEGY

Definition and Development of Gamification Theory

Definition of Gamification

Gamification denotes the implementation of game design components—such as points, badges, leaderboards, and levels—in non-gaming contexts to incentivize user behavior and improve engagement (Deterding et al., 2011). The fundamental concept is to utilize gaming mechanics to enhance motivation and enjoyment, rendering once monotonous chores more appealing and gratifying. Gamification focuses on creating feedback systems that foster intrinsic drive, hence enhancing long-term engagement and consistent behavior (Seaborn & Fels, 2015).

Origins and Development of Gamification Theory

Theory of gamification is essential for comprehending how to enhance learning motivation and encourage active engagement. The beginnings can be linked to behavioral psychology, namely the principles of reward and feedback systems (Skinner, 1953). The concept of "gamification" was first coined by Nick Pelling in 2002, primarily aimed at augmenting user experience and interface design to enhance product attractiveness and customer loyalty. Deterding et al. (2011) subsequently systematized the concept, describing gamification as the application of game design features in non-gaming contexts, which swiftly garnered recognition in academic and industrial spheres.

Initial gamification theories were significantly shaped by behaviorist psychology, especially operant conditioning, which encourages particular behaviors via rewards. Nonetheless, as cognitive psychology and motivation theory progressed, researchers acknowledged that dependence on external incentives alone was inadequate for maintaining long-term commitment. This resulted in the integration of intrinsic

motivation frameworks, notably the self-determination theory (SDT), which underscores autonomy, competence, and significance (Deci & Ryan, 2019). As a result, gamification transitioned from a basic reinforcement mechanism to a sophisticated design system aimed at cultivating intrinsic drive.

Differences Between Gamification, Gaming, and Serious Gaming

Gamification, gaming, and serious gaming all include game aspects, however they diverge markedly in their concepts and applications:

- Gaming denotes comprehensive products characterized by explicit rules, objectives, and feedback mechanisms, primarily intended for amusement. Players participate interactively and derive fulfillment and gratification from accomplishing tasks (Juul, 2005).
- Gamification incorporates game features into non-gaming contexts to augment interest in routine activities or professional responsibilities without establishing a comprehensive gaming system. It utilizes processes such as points, tasks, and incentives (Deterding et al., 2011).
- Serious games are created for goals beyond entertainment, such as teaching or training, while yet preserving an element of enjoyment. Examples encompass military simulations, health management games, and educational games (Michael & Chen, 2005). In contrast to serious games, gamification employs specific game aspects to augment non-gaming tasks.

Applications of Gamification

The notion of gamification has developed from electronic gaming and human-computer interaction. Researchers have investigated the potential of motivating mechanisms in games to improve non-gaming contexts (Zichermann & Cunningham, 2011). The adaptability of gamification facilitates the incorporation of game features into diverse situations without requiring a comprehensive gaming system, hence economically boosting user experience. Since 2010, gamification has proliferated across

various domains, including education, healthcare, business training, and marketing.

Gamification has markedly enhanced online education and MOOCs by incorporating aspects such as leaderboards and badges, which elevate learner engagement and completion rates (Zainuddin et al., 2020). These factors offer external incentive and assist pupils in tracking their advancement.

In healthcare, gamification has been employed to promote healthy behaviors. Xu et al. (2022) discovered that features such as exercise points and daily challenges on mobile health platforms markedly enhanced user involvement in physical activities, fostering sustained healthy behaviors.

In business environments, gamification enhances staff productivity and collaboration by segmenting tasks into challenges that result in incentives, promotions, or badges upon completion (Hamari et al., 2014). Organizations adopt gamification for employee training, establishing immersive learning environments (Robson et al., 2015).

Gamification tactics have been utilized in social welfare and environmental conservation, encouraging user engagement in community initiatives. Through the implementation of challenge and reward mechanisms, users can attain recognition for accomplishing actions such as recycling or minimizing their carbon footprint (Manasa, 2025).

Gamification has become an effective instrument for augmenting engagement and motivation in diverse domains. Its progression from fundamental behavioral reinforcement to a sophisticated design system emphasizing intrinsic motivation highlights its significance in both educational and non-educational settings.

Using Gamification in Learning Dropout Prevention

Gamification has arisen as a novel teaching instrument, extensively employed in conventional classrooms to stimulate student motivation and augment involvement. Recent studies demonstrate that gamification significantly enhances student engagement in learning and aids in overcoming obstacles through mechanisms such as real-time

feedback, incentive systems, and task difficulties. Keywords such game design, game elements, autonomy theory, student engagement, and academic achievement underscore the increasing application of gamification to examine student behavior.

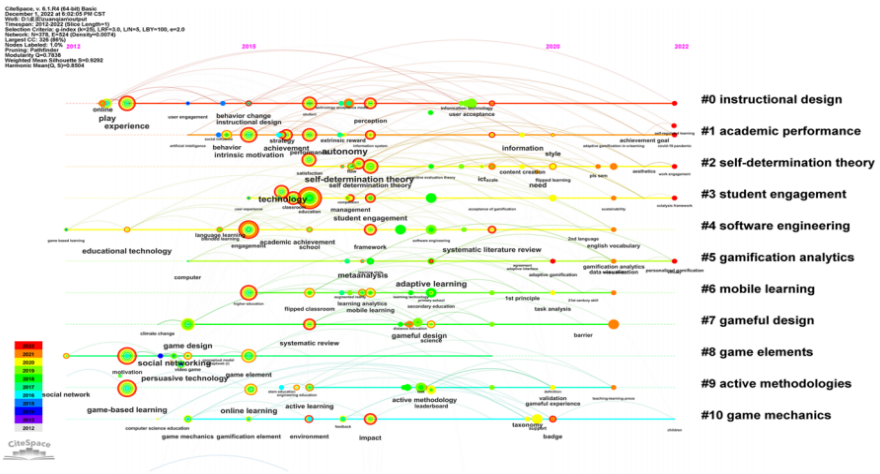

Figure 2 Gamification in Education Research's Keywords in 2012–2022

Employing Gamification for Learning Retention Strategies

Gamification has arisen as a novel teaching instrument, extensively employed in conventional classrooms to stimulate student motivation and augment involvement. Recent studies demonstrate that gamification significantly enhances student engagement in learning and aids in overcoming obstacles through mechanisms such as real-time feedback, incentive systems, and task difficulties. Keywords such game design, game elements, autonomy theory, student engagement, and academic achievement underscore the increasing application of gamification to examine student behavior.

Influence of Gamification on Learning Engagement

Gamification improves students' learning transparency and goal clarity through real-time feedback and visual incentives. A study conducted in a Malaysian secondary school demonstrated that the implementation of gamification markedly enhanced student engagement. Through the accumulation of scores and the pursuit of badges, students encountered heightened rivalry and accomplishment, which diminished

absenteeism and dropout rates (Zainuddin et al., 2020).

A separate study implemented a tiered challenge and real-time rating system for Canadian university students, enhancing their sense of progress and motivation. Huang and Soman (2019) observed that this gamification method, by incrementally increasing difficulty and providing real-time feedback, enabled students to surmount immediate obstacles and enhanced overall engagement, hence mitigating dropout rates caused by either excessive or insufficient learning challenges.

Arufe-Giráldez et al. (2022) performed a systematic review in primary school physical education, demonstrating that gamification techniques markedly enhance motivation and involvement, particularly increasing student satisfaction and engagement in the classroom.

In intricate disciplines such as programming and mathematics, where students frequently disengage, gamification has demonstrated efficacy. Moldez et al. (2022) employed gamification techniques in university programming classes, enhancing course completion rates by segmenting tasks into achievable difficulties. The experimental group surpassed the control group, exhibiting a notable decrease in dropout rates.

Firdaus et al. (2023) investigated gamified flip books in primary school mathematics, discovering that children reacted favorably to gamified components, which enhanced engagement and collaborative learning. Likewise, Tsai et al. (2020) discovered that gamification aids in sustaining focus and motivation during intricate activities, hence averting learning fatigue.

Gamification is essential in the creation of individualized learning trajectories. Van Roy and Zaman (2021) investigated adaptive gamification tactics for middle school students, discovering that these strategies not only sustained participation among high achievers but also markedly enhanced engagement among less motivated students. Customized task and incentive systems enable instructors to modify instructional approaches according on student performance, thereby mitigating dropout risks.

Koivisto et al. (2019) emphasized the efficacy of adaptive gamification systems in physics education, allowing students to choose assignments of differing difficulty levels. This tailored feedback mechanism bolsters confidence and assists

pupils in surmounting obstacles, thereby averting attrition caused by excessively demanding assignments.

Facilitating Social Interaction and Sustained Engagement

Gamification promotes social engagement among students, establishing a dynamic educational atmosphere that mitigates feelings of isolation. Marcos et al. (2020) observed that collaborative tasks and competitive activities in gamified classrooms augmented participation and fostered a heightened sense of accountability through teamwork.

Immediate feedback and incentives derived from gamification can effectively maintain student interest. A study conducted at a vocational institution in Germany revealed that gamified learning platforms enhanced student motivation by providing points and prizes for task completion, hence decreasing dropout rates. Sailer et al. (2021) shown that gamified platforms sustain elevated engagement rates, especially in vocational education.

In psychology courses, the implementation of gamified reward mechanisms resulted in increased student excitement, aiding in the management of fatigue and challenges (Looyestyn et al., 2020).

Influence of Gamification on Massive Open Online Courses

In MOOCs, where learners frequently encounter difficulties due to insufficient face-to-face support, gamification acts as a crucial intervention to improve engagement and decrease attrition rates. Zainuddin et al. (2020) emphasized that the integration of gamification features, such as points and badges, enhances engagement and interest in courses, especially those that are lengthy and demanding.

Leaderboards in MOOCs foster rivalry and exhibit individual advancement, hence augmenting motivation and community engagement (Pakinee & Puritat, 2021). Díaz-Rodríguez et al. (2021) discovered that the implementation of progress bars and success badges markedly enhanced student engagement, particularly among learners with deficient self-management skills.

Gamification mitigates attrition resulting from isolation and uncertainty throughout the learning process. Peña et al. (2021) established that diverse gamification components resulted in heightened engagement and diminished attrition rates in university distant education. Sümer and Aydın (2022) demonstrated that the integration of gamification into online learning platforms markedly enhanced student engagement and decreased dropout rates from 20% to below 5%.

Rohan et al. (2021) determined that various gamification features influence sustained participation in MOOCs, with achievement-oriented components such as scores and badges proving more beneficial in augmenting motivation and satisfaction.

Borrás-Gené et al. (2019) discovered that gamification in Spanish MOOCs enhanced interaction and fostered a sense of belonging within the learning community, markedly elevating participant engagement. Buchem et al. (2020) indicated that gamification tactics augmented emotional, cognitive, and social engagement, addressing varied learner requirements and enhancing overall educational experiences.

Gamification has demonstrated efficacy as an intervention for mitigating dropout rates in both conventional classrooms and online learning platforms such as MOOCs. Gamification enhances motivation, engagement, and social interaction, so cultivating a more supportive and dynamic learning environment, which significantly decreases dropout rates and improves overall educational achievements.

Application of Gamification in Education Assessment

In contrast to conventional assessments that mainly evaluate learning outcomes, gamification evaluations emphasize improving student engagement and involvement. Recent studies demonstrate that gamification may effectively engage students across different educational levels, employing technologies such as online quizzes, tiered learning platforms, and immediate feedback systems to facilitate comprehension of learning objectives and provide prompt assessments of their progress.

Gamification Instruments and Their Effects

Huang et al. (2021) developed a gamified online assessment instrument for high school physics classrooms, allowing students to accumulate scores by completing sequential quizzes and unlocking tasks. This method enhanced educational results and increased classroom participation. Keller et al. (2020) developed a gamification assessment platform for middle school mathematics, enabling pupils to progress through multiple challenging levels to improve their mathematical abilities. Studies indicate that immediate feedback from gamification enhances student involvement, autonomy, and accountability, resulting in superior academic performance.

Guillén-Nieto and Alison Carbonell (2019) investigated gamification evaluations in language classrooms, discovering that the integration of task-based scores and rankings markedly improved student motivation and participation in language learning activities. The motivating impact of gamification exams also prompted students to dedicate additional time to extracurricular activities. Kim and Castelli (2021) posited that prolonged engagement with gamification assessments cultivates enduring interest in learning and enhances academic performance by integrating external incentives (points, badges) with intrinsic rewards (success and self-improvement).

Utilization in Massive Open Online Courses (MOOCs)

In the realm of MOOCs, Savinykh (2022) examined gamification assessment instruments that monitor student advancement in real-time and offer tailored feedback. These technologies assist students in modifying their learning processes, resulting in markedly enhanced learning outcomes. Studies demonstrate that students exhibit increased engagement, a heightened sense of accomplishment, and improved academic outcomes through gamification.

Manzano León et al. (2021) introduced an adaptive gamification assessment system that modifies tasks and difficulty levels in response to student performance, enhancing the flexibility and efficacy of tests. Savinykh highlighted that immediate feedback during student interactions markedly enhances learning efficacy and motivation.

Adaptability and Availability

The assessment of gamification has improved learning flexibility via cross-platform technological support. Students can participate in gamified assessments through mobile applications or online platforms, thereby enhancing the reach and accessibility of these evaluations.

Certain MOOC platforms have incorporated gamified assessment designs for learners. This study references the DMC framework (Werbach & Hunter, 2012), which delineates three hierarchical layers: components, mechanics, and dynamics. This framework facilitates the comprehension of current gamification design instances in MOOCs, highlighting the role of these elements in a holistic gamification approach.

Gamification in educational evaluation signifies a notable transition from conventional methods by prioritizing interaction and involvement. Gamification, through numerous tools and adaptive tactics, boosts student motivation, promotes autonomy, and eventually results in enhanced academic outcomes across multiple educational situations, including MOOCs. The incorporation of gamification in exams enhances the learning experience and guarantees that evaluations are more adaptable and accessible to all students.

Khan Academy

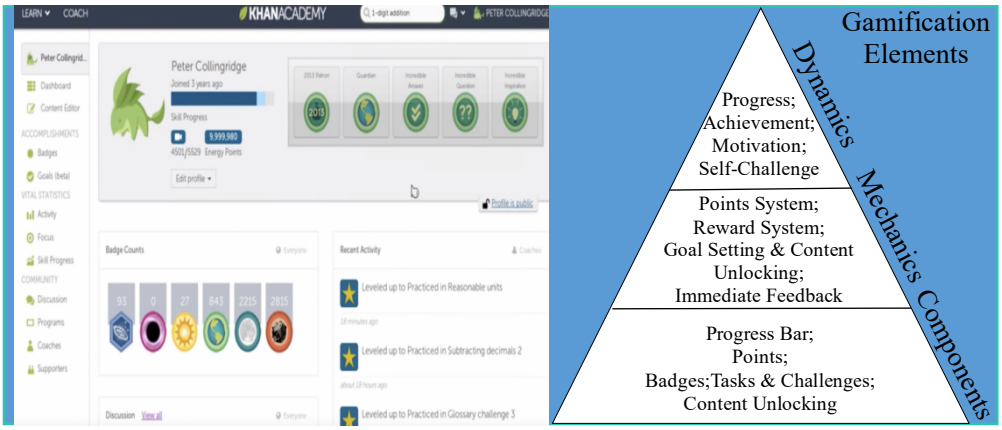

Figure 3 Gamification Assessment Design of Khan Academy

Khan Academy is a notable MOOC platform that integrates diverse

gamification aspects to improve the learning experience and increase student engagement (refer to Figure 3).

Progress Tracking

A prominent element of Khan Academy is its progress bar, which is embedded in every course and practical module. This visual instrument enables pupils to monitor their academic progress distinctly, showcasing both the completion percentage and outstanding chores. The progress bar offers a summary of successes, enabling students to track their learning journey and inspiring them to persist in achieving their educational objectives.

Points Systems

The points system constitutes a fundamental aspect of Khan Academy's gamification framework. Students accumulate scores by completing exercises, quizzes, and courses. The accumulation of points provides rapid feedback and encouragement, motivating students to participate actively in learning activities. Points not only signify academic success but also grant access to supplementary learning materials or privileges, promoting a sense of ongoing advancement and accomplishment.

Badge System

Khan Academy also incorporates a badge system that recognizes students for doing designated learning tasks, attaining educational objectives, or excelling in evaluations. Each badge signifies a unique accomplishment or proficiency, bolstering students' confidence and promoting continuous study. This acknowledgment of achievements not only inspires students but also strengthens their dedication to studying the content.

Khan Academy adeptly employs gamification components such as progress monitoring, a points system, and a badge system to foster an interesting and encouraging educational atmosphere. These characteristics enable students to visualize their accomplishments, obtain rapid feedback, and experience a sense of satisfaction, so

promoting a more engaging and enjoyable educational experience.

Duolingo

Figure 4 Gamification Assessment Designs of Duolingo

Duolingo is a prominent language learning website that utilizes distinctive gamification strategies to markedly improve the learning experience and increase student engagement (see Figure 4). The platform utilizes many gamification components, such as point systems, stages, challenges, virtual currency, and leaderboards, to enhance the enjoyment and motivation of language learning.

Hierarchical Structure

The fundamental aspect of Duolingo's gamification is its tiered system. The course structure employs a progressive methodology, allowing students to proceed to higher levels upon the completion of each learning module or task. Each level signifies students' advancement and proficiency in particular subject areas. This hierarchical method establishes explicit learning objectives while sustaining engagement through a progressive escalation of task complexity.

Engaging Challenges

Duolingo provides a range of stimulating challenges, including daily

objectives, winning streak contests, and special events. These challenges motivate students to accomplish particular activities within a specified timeframe, such as finishing a predetermined amount of workouts everyday or sustaining consecutive study days. Successfully overcoming these hurdles grants pupils supplementary points and prizes, promoting a constructive learning disposition.

Virtual Currency

A significant motivational element in Duolingo is the implementation of virtual cash. Students can acquire this currency to access supplementary learning materials or privileges within the app. The virtual currency system augments students' autonomy and personalization in their educational experience, resulting in heightened engagement and a reinforced sense of ownership over their learning.

Duolingo adeptly employs gamification components, including a tiered structure, stimulating challenges, and virtual currency, to foster a dynamic and compelling educational atmosphere. These attributes not only render language acquisition more pleasurable but also motivate pupils to maintain their dedication to their studies, hence augmenting total engagement and success.

Kahoot!

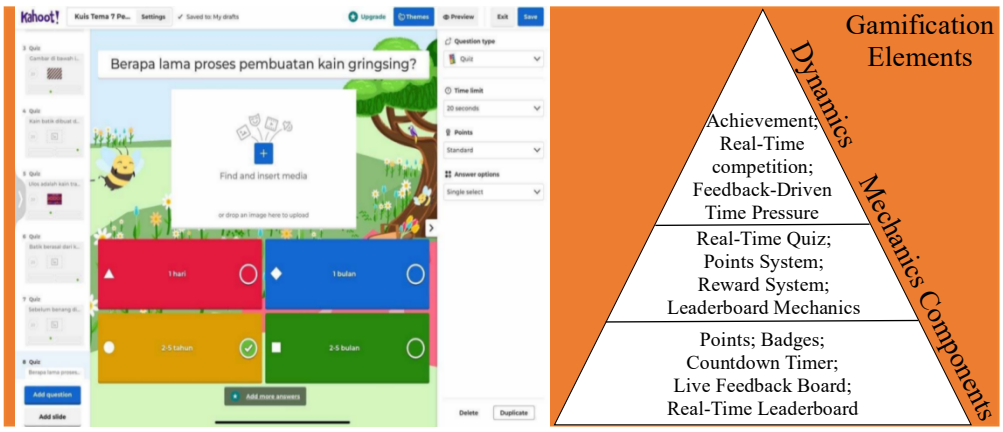

Figure 5 Gamification Assessment Designs of Kahoot!

Kahoot! is a pioneering educational platform characterized by a distinctive gamification framework, integrating diverse game components including real-time quizzes, competitive modes, point systems, leaderboards, and reward mechanisms (refer to Figure 5).

Real-Time Testing

A fundamental gamification element of Kahoot! is its real-time assessment capability. Educators or trainers can formulate multiple-choice, yes/no, or several other types of inquiries and administer them in real-time during classroom or online sessions. Students are required to respond within a constrained timeframe, instilling a sense of urgency and engagement in the educational experience. This instantaneous feedback system enables students to promptly ascertain the accuracy of their responses, so augmenting interest and boosting comprehension.

Rankings

The leaderboard constitutes a vital element of Kahoot!'s gamification framework. Subsequent to each quiz, Kahoot! presents a leaderboard that highlights students' positions and scores. This feature offers a transparent display of outcomes while also encouraging learners to pursue elevated ranks, thereby cultivating a competitive ethos.

Reward System

The reward structure of Kahoot! significantly boosts student participation. Students may obtain additional prizes, such virtual badges or special points, for continuously providing accurate answers or reacting promptly during quizzes. These rewards not only acknowledge student accomplishments but also promote sustained engagement and effort.

Real-Time Assessment

In addition to gamification features, Kahoot! quizzes allow educators to

evaluate students' learning advancement in real-time. Educators may swiftly discern areas of deficiency from quiz results and deliver focused reinforcement in subsequent courses, so facilitating a more individualized learning experience.

Kahoot! adeptly employs gamification components, including real-time assessments, leaderboards, and incentive systems, to foster an engaging and participatory educational atmosphere. These characteristics not only augment student motivation and engagement but also facilitate real-time evaluation of learning advancement, rendering it an invaluable resource for educators in both conventional and digital environments.

Quizizz

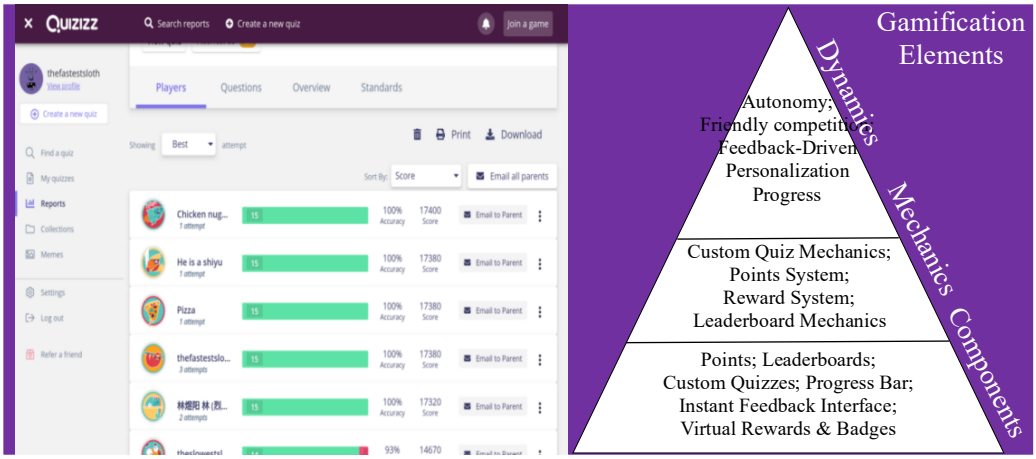

Figure 6 Gamification Assessment Designs of Quizizz

Quizizz is a pioneering online educational platform that incorporates several gamification components, such as interactive quizzes, a points system, leaderboards, and reward mechanisms, to enhance the learning experience (see Figure 6).

Interactive Quiz Feature

The primary gamification element of Quizizz is its interactive quiz capability. Users can generate and engage in various quizzes, including multiple-choice questions,

true-or-false items, and fill-in-the-blank exercises. These quizzes can be tailored for individual challenges or multiplayer contests, providing a versatile and dynamic educational setting. In interactive quizzes, participants obtain prompt feedback on their answers, facilitating a swift comprehension of their accuracy, so improving learning retention.

Customization Attributes

Quizizz prioritizes personalization, allowing users to design questions that align with their own learning requirements and preferences. Educators and learners can create customized quiz questions and disseminate them to others. This personalization enhances the diversity of learning information and renders the learning process more personalized and interactive, hence driving increased engagement among learners.

Point Allocation System and Ranking Boards

The platform features a points system that incentivizes users based on their quiz performance. Points are awarded for accurate answers and prompt responses, incentivizing users to enhance their performance. Furthermore, leaderboards exhibit rankings, fostering amicable competition and motivating learners to get superior scores.

Incentive Structures

Quizizz enriches the gamification experience via many reward mechanisms, including badges and certificates, that acknowledge users' accomplishments and milestones. These rewards function to bolster motivation and promote sustained engagement in the learning process.

Quizizz adeptly employs gamification components such as interactive quizzes, customizable features, point systems, and leaderboards to foster an engaging and tailored learning atmosphere. Quizizz increases the learning experience by facilitating instant feedback and promoting competition, so encouraging active engagement and ongoing progress among users.

RESEARCH GAPS

Despite several studies examining the application of gamification and formative evaluation in education, research on their integration within educational contexts, particularly in online learning environments, remains scarce. The current literature predominantly highlights the distinct functions of gamification and formative evaluation, failing to provide a comprehensive analysis of their synergistic effects, particularly in self-regulated and motivation-oriented online learning environments like MOOCs.

Lack of Integrated Research on Gamification Formative Assessment

Various research have shown that gamification and formative assessment substantially improve learner engagement, motivation, and educational outcomes. Comprehensive studies indicate that gamification and formative assessment markedly improve learner engagement, motivation, and educational results in many educational settings. Impact Evidence Engagement and Motivation: Gamified formative assessments, including leaderboards, points, and quizzes, regularly enhance student engagement and motivation. Research in engineering and EFL (English as a Foreign Language) courses indicates that the incorporation of gamification aspects into formative evaluations enhances engagement, enjoyment, and motivation to learn (Cigdem et al., 2024; Zhang & Crawford, 2023; Villacres et al., 2024; Li et al., 2024). Educational Outcomes: Gamification enhances motivation and elevates academic performance. Experimental and meta-analytic research indicate superior success scores and learning gains for children subjected to gamified formative evaluations relative to conventional approaches (Benben & Bug-os, 2022; Mula-Falcón et al., 2022; Alzaid & Alageel, 2023; Jaramillo-Mediavilla et al., 2024). The beneficial benefits are facilitated by enhanced intrinsic motivation, satisfaction, and a sense of competence. Prompt

feedback and constructive competition enhance learning and skill acquisition (David & Weinstein, 2023; Luarn et al., 2025; Nguyen-Viet & Nguyen-Viet, 2025).

Nevertheless, the majority of study predominantly concentrates on isolated components instead of examining the synthesis of these two potent instructional methodologies. The systematic integration of the fundamental benefits of gamification and formative evaluation to attain educational objectives remains inadequately understood.

Most current research focuses on incorporating individual gamification components—such as points, badges, and leaderboards—within educational environments. Moreover, initiatives to enhance feedback systems and self-evaluation instruments are prevalent. Nonetheless, there exists a significant deficiency in comprehensive research about a unified model of gamification in formative assessment. This gap limits our comprehension of its potential diagnostic, motivating, and feedback roles. In educational practice, formative assessment generally emphasizes prompt feedback and individualized learning assistance. Conversely, gamification highlights incentive structures and interactive engagement. However, there has been a lack of adequate theoretical and empirical study on how to successfully integrate these advantages within instructional design. The absence of integrated research has resulted in a deficiency in academic comprehension concerning the overall effects of gamification formative assessment on fostering learner autonomy, improving self-regulation, and bolstering intrinsic motivation.

Examining the systematic incorporation of gamification and formative evaluation can bridge these theoretical gaps and yield significant insights for educational practice. This is especially critical in online learning contexts, where ongoing motivation and engagement are essential for success. By examining the potential of gamification to augment formative assessment methodologies, educators can devise novel methods that promote learner motivation, engagement, and educational outcomes. A thorough comprehension of this integration may result in more effective instructional designs that address varied student requirements and enhance the educational experience.

The existing deficiency of cohesive study on gamification in formative assessment underscores a notable opportunity for investigation in educational research. By concentrating on the methodical amalgamation of these two methodologies, we can enhance our comprehension of their collective influence on learner motivation, engagement, and autonomy, ultimately resulting in more efficacious educational methods, particularly in online learning environments.

Lack of Research on Gamification Formative Assessment in MOOCs

Although research at the confluence of gamification, formative assessment, and MOOCs (Massive Open Online Courses) is expanding, it is still constrained. Several recent research have investigated how gamification can improve learner engagement, motivation, and retention in MOOCs. Research demonstrates that gamification components—such as achievements, leaderboards, and social interaction—enhance learning engagement, persistence, and results in MOOC environments. Nonetheless, a significant portion of these research predominantly emphasizes the efficacy of these gamification features rather than their incorporation with formative evaluation techniques (Buchem et al., 2020; Major & Mira, 2023; Slamet et al., 2024).

Formative assessment is acknowledged as an essential pedagogical method; nonetheless, the majority of MOOC research focuses on the effects of gamification on engagement and retention intentions, frequently overlooking the application of formative evaluation techniques. While certain studies reference the implementation of gamified quizzes and feedback mechanisms, there remains a deficiency in extensive research about the combined use of gamification and formative assessment in MOOCs (Zainuddin et al., 2020; Cigdem et al., 2024; Hoang, 2024).

The lack of direct instructor support and feedback in MOOCs may result in diminished learner motivation and increased dropout rates. Although gamification has been examined as a strategy to augment engagement, current research often prioritizes basic incentive mechanisms, such as leaderboards and point systems, neglecting the

potential of formative evaluation to boost learning outcomes. The capacity of formative assessment to provide timely feedback, tailored support, and self-regulation methods in autonomous learning contexts remains under investigated, highlighting a notable research deficiency.

Contemporary implementations of gamification in MOOCs frequently emphasize external incentive elements, neglecting the potential of formative evaluation to enhance learners' intrinsic motivation and self-efficacy. Conducting focused study on gamification in formative assessment inside MOOC contexts could address these theoretical and practical deficiencies. Such research could yield significant insights for the design of MOOC platforms and assist learners in effectively overcoming the hurdles associated with self-directed learning.

The deficiency of concentrated research on gamification in formative assessment within MOOCs underscores a significant domain for future investigation. By comprehending how these two factors can together improve the learning experience, educators and platform designers can develop more engaging and supportive settings that foster learner success and retention in online education.

Lack of a Systematic Design Framework and Empirical Research Support

Current research on gamification and formative assessment is disjointed, lacking a coherent design framework and empirical analysis, especially concerning the optimal integration of both components to achieve evaluation objectives in MOOCs education. Although certain studies have investigated gamification in formative assessment within particular fields, they frequently depend on case studies or limited-scale experiments. This method has not resulted in the creation of a standardized design framework or implementation strategy specifically for MOOC environments. Consequently, there is a notable lack of coherent techniques for educators and

researchers to effectively use these concepts in extensive online learning settings.

Moreover, the current measurement instruments and data analysis techniques pertaining to gamification formative assessment are disjointed and context-specific. There are few, if any, standardized instruments or metrics that can thoroughly analyze the efficacy of gamification and formative evaluation in MOOCs. The absence of standardized measurement complicates the ability of researchers and practitioners to provide definitive standards for the construction or implementation of gamification formative assessments and to comprehensively evaluate their educational impact. The lack of a systematic methodology presents challenges for academics and educators alike. In the absence of a clearly articulated framework, designing effective interventions and reliably evaluating their impacts becomes challenging. This gap constrains the capacity to discern optimal practices and to enhance methodologies grounded in empirical data.

The absence of a systematic design framework and empirical evidence for gamification in formative assessment within MOOCs underscores a significant necessity for additional research. Implementing standardized tools and thorough frameworks would boost the understanding of effective integration and offer helpful suggestions for educators seeking to improve learning outcomes in online settings. Rectifying these deficiencies can result in more efficacious educational designs that advantage both learners and instructors within the MOOCs landscape.

THE DEVELOPMENT TRAJECTORY AND DIAGNOSIS OF CURRENT PROBLEMS IN MOOCS IN CHINA

The development of MOOCs in China has been significantly influenced by increasing trends in online education and autonomous learning. Cheng and Yuen (2022) analyze the evolution of online education satisfaction, highlighting the need for a deeper understanding of student experiences in MOOCs. Their comprehensive assessment

reveals that ensuring student satisfaction is crucial for improving retention rates and overall educational outcomes. Psathas et al. (2023) conducted a bibliometric analysis that identifies key trends in self-regulated learning concerning MOOCs and AI-enhanced online education. Their findings indicate that the integration of self-regulated learning mechanisms is essential for fostering learner autonomy and motivation, both critical for success in online environments.

Moreover, the incorporation of innovative technologies may address specific challenges faced by MOOCs in China. Zobel & Meinel (2021) conducted a thorough investigation of technology-assisted scaffolding strategies, indicating that effective scaffolding enhances learner engagement and comprehension in online courses. Chen (2024) examined the effects of gamification on motivation and learning outcomes, demonstrating that gamified elements can significantly enhance learner engagement and satisfaction in digital educational settings. Meng et al. (2022) examined students' perceptions of chatbots in education, highlighting that the integration of technology acceptance models can improve user experiences and support systems in MOOCs. These studies collectively underscore the importance of using technological improvements and pedagogical strategies to enhance the effectiveness of MOOCs in China.

The integration of Massive Open Online Courses (MOOCs) in Chinese higher education has been a focal point of modern research, particularly concerning their effectiveness and the factors influencing learner results. Huang and Qi (2025) conduct a comprehensive analysis that highlights the potential of MOOCs to enhance educational equity, despite the persistent challenge of low completion rates. Their research identifies critical aspects affecting MOOCs performance, such as learning behavior, motivation, perceived value, learning environment, past experience, and self-regulation. These discoveries underscore the imperative of addressing both structural and psychological aspects of the learning process to improve engagement and completion rates.

The educational framework in Chinese higher education, especially within the social sciences and humanities, is experiencing considerable transformations influenced by innovative teaching methodologies like MOOCs and flipped classrooms Huang

(2024) conducted a comprehensive evaluation of several educational techniques, emphasizing the imperative for institutions to adapt and refine their pedagogical strategies to meet the evolving needs of students. Qin and Zeng (2021) simultaneously investigated the use of flipped classrooms in foreign language education, indicating that these interactive and student-focused methodologies can significantly enhance learning outcomes. These works collectively illustrate a substantial evolution in educational approaches, advocating for integrated solutions that employ technology to improve learning environments in Chinese higher education.

Nonetheless, despite the ongoing enhancement of technological platforms and the increasing availability of course resources, MOOC learners' actual experiences and learning outcomes continue to encounter numerous challenges, illustrating a trend of "superficial popularity but profound difficulties" (Cheng, R. et al., 2023).This research performed course observations and platform analyses on prominent MOOC platforms, including "Chinese University MOOC," "XuetangX," and "Smart Tree," along with several university-developed MOOC systems. The investigation primarily concentrated on course structure, instructional organization, interaction design, and user input from learning forums, resulting in the identification of many significant flaws.

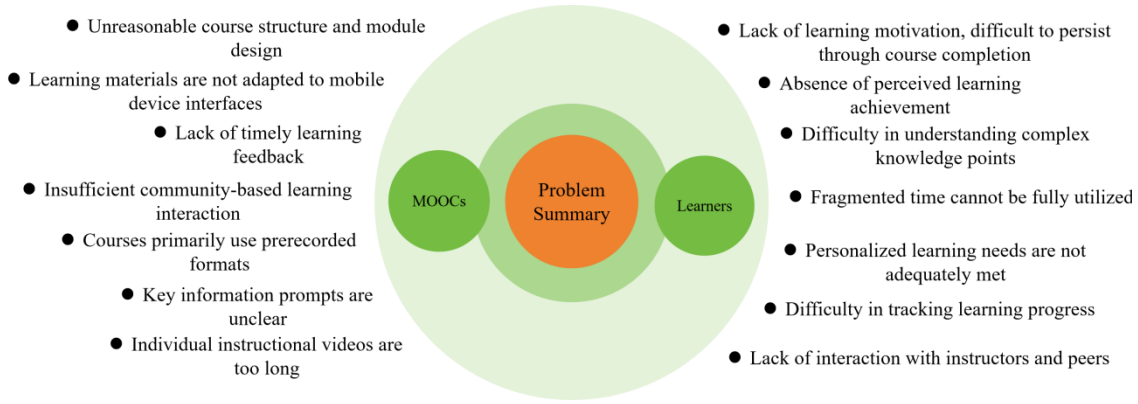

Figure 7 Summary of Current Problems in Chinese MOOCs: A Dual-Perspective View

Figure 7 illustrates that, from the platform perspective, the majority of

existing MOOC products continue to employ the content architecture and interaction logic of the desktop version, merely transferring numerous PDF documents and lengthy video content to mobile devices without adequate optimization for mobile interaction features. The course structure has significant deficiencies, characterized by unnecessarily lengthy modules, inconsistent knowledge distribution, and ambiguous task delineation. Despite certain platforms featuring learner homepages and associated data display functionalities, they exhibit deficiencies in establishing stage goals and facilitating navigation of learning routes, particularly inside university-developed MOOC platforms. Simultaneously, a significant disparity exists in the teacher-to-student ratio, with numerous platforms resorting to the utilization of pre-recorded courses for playback, so diminishing the efficacy of real-time feedback and dynamic assessment in the educational process. Regarding learning interaction, while most platforms have established course forums or communication areas, their design for social functionality significantly lags behind that of mainstream social applications (such as Circle of Friends, TikTok, Little Red Book, etc.), leading to the marginalization of interactive features in the learning process. In actuality, WeChat or QQ groups frequently serve as the primary informal communication channels, but the platform's inherent social system fails to fulfill appropriate academic community roles. Although platforms like Chinese university MOOCs offer relatively open course forums, most MOOC platforms restrict interaction to a singular course context, lacking the development of cross-course and cross-temporal learning communities, which hinders collaborative engagement and sustained interaction among learners.

According to pertinent research (Zhang Jing & Han, 2021), from the learners' perspective, the majority of MOOCs in China predominantly depend on video lectures and passive viewing, which diminishes interactivity and engagement, leading to a superficial learning experience that inadequately facilitates the comprehensive development of intricate knowledge frameworks. While mobile technologies like smartphones facilitate fragmented learning, learning platforms typically lack organizational tools for non-continuous learning periods, hindering the efficient alignment of material pacing with learners' schedules. Moreover, there is inadequate

support for individualized learning trajectories, and platforms frequently lack self-assessment capabilities for learners. They are also incapable of dynamically modifying content difficulty and learning tasks according to learners' knowledge base, learning pace, and behavioral preferences, hence constraining learners' opportunities for individualized adaptation and autonomous decision-making in the learning process. The absence of an efficient feedback mechanism for learning outcomes on the platform hinders learners' ability to gain positive motivation during the educational process, leading to diminished motivation and reduced course perseverance.

OTHER CORE THEORIES SUPPORTING THE RESEARCH

This study is additionally supported by several fundamental theoretical frameworks, alongside the formative assessment theory (Black & Wiliam, 1998) and gamification theory (Deterding et al., 2011). This encompasses constructivist theory, self-determination theory, flow theory, and additional pertinent learning engagement theories, which together offer a thorough framework for comprehending the mechanisms of gamification formative assessment and its influence on learners' sustained engagement in MOOCs.

Constructivist Theory

The constructivism theory, a significant learning theory, was initially introduced by Swiss psychologist Jean Piaget. It underscores that learning is an active process in which learners do not passively absorb information, but instead engage with their surroundings and generate new knowledge from prior understanding. Piaget's cognitive constructivism posits that learners continuously assimilate and adjust to incoming knowledge, therefore refining their own cognitive frameworks (Piaget, 1954).

Learning transcends the mere acquisition of external knowledge; it involves the integration of prior experiences with new information, including engagement and adaptation to the external world. This notion impacts educational theory and is extensively utilized in instructional design. Vygotsky's social constructivism enhances this theory by highlighting the significance of social interaction, language, and culture in knowledge production, especially in cooperative learning and peer interaction in education (Vygotsky, 1978). The concept of the Zone of Proximal Development (ZPD) is a fundamental aspect of this theory, highlighting that learners can exceed their cognitive constraints and progressively enhance their skills through collaboration with others.

The Zone of Proximal Development (ZPD) is a fundamental idea introduced by Vygotsky, highlighting that learners can exceed their cognitive boundaries and attain advanced levels of understanding through collaboration and interaction. ZPD denotes the disparity between tasks that kids can presently accomplish autonomously and those they can execute with assistance. With suitable assistance from educators or peers, learners can engage in this domain and cultivate new cognitive skills. The essence of the ZPD concept underscores the facilitative function of educators and peers in the learning process, particularly when students encounter difficulties and cannot do tasks autonomously. Collaboration and assistance can significantly enhance cognitive growth. Teaching scaffolding is a fundamental method in the implementation of the Zone of Proximal Development (ZPD). Teaching scaffolding denotes the specific assistance offered by educators or peers during the learning process, facilitating learners in surmounting cognitive constraints and progressively tackling more complex tasks when confronted with challenges. Teaching scaffolds not only boost students' skills but also bolster their confidence and passion in learning, so fostering ongoing engagement and profound understanding.

In recent years, constructivism has been extensively utilized in education, particularly in digital learning and adaptive learning systems. The advancement of online learning platforms and educational technology has led to the extensive application of constructivism in the design of online instruction and self-regulated

learning environments. Smith et al. (2019) investigated the influence of constructivism on e-learning, revealing that interactive learning platforms enable students to actively construct knowledge in project-based learning, foster deep learning, and enhance self-regulated learning skills. The utilization of the construction process in digital educational platforms augments students' autonomy in the learning experience and facilitates the establishment of individualized learning trajectories. The design of MOOCs prominently supports constructivist philosophy. Lai and Wang (2021) discovered that the implementation of project-based learning assignments in MOOCs facilitates students' self-reflection and knowledge production, hence enhancing their mastery of complex concepts in self-regulated learning. García-Peñalvo et al. (2020) enhanced the design of MOOC platforms grounded in constructivist ideas, demonstrating that interactive design and immediate feedback facilitate improved learning outcomes by enabling learners to actively construct knowledge. Wang and Zhao (2022) indicated in a study on higher education that constructivism markedly improves students' innovation and problem-solving skills in project-based and self-regulated learning environments, especially within technology courses.

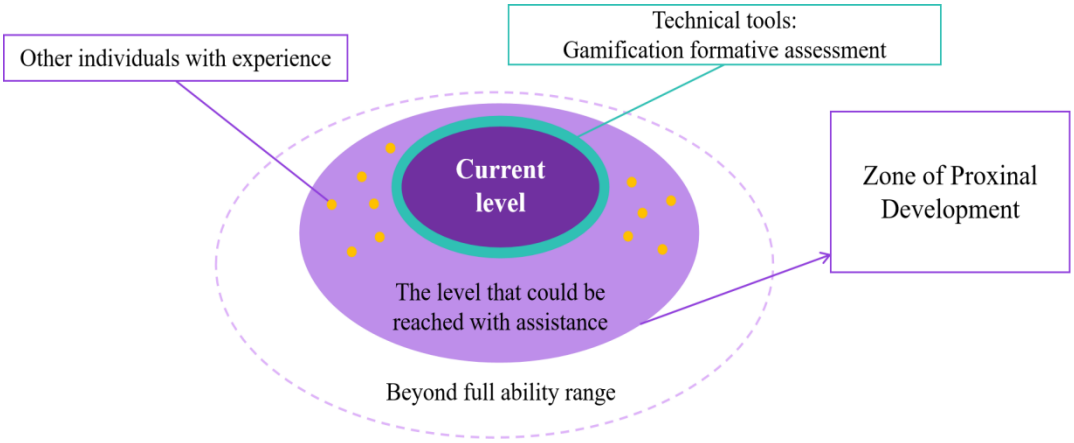

Figure 8 Interactive Schematic Diagram of Gamification Formative Assessment as A Learner Scaffold

This study utilizes constructivist theory to underpin gamification formative assessment, elucidating the interacting dynamics among gamification formative

assessment, learners' psychological mediation, and sustained engagement. Gamification in formative assessment offers constant feedback via self-assessment, ongoing evaluation on MOOC platforms, and peer assessment, so facilitating knowledge creation and acting as a genuine scaffold for learners in this process (as illustrated in Figure 8). From an objective standpoint, gamification in formative assessment aids learners by offering ongoing task challenges and feedback, facilitating cognitive breakthroughs and development within the Zone of Proximal Development, hence advancing learning progress. From a subjective standpoint, learners engage in self-regulation via gamified activities and challenges, consistently enhance their learning tactics, and progressively deepen their comprehension of course material, while also obtaining feedback through peer assessments. They can proficiently build information and progressively attain elevated levels of cognitive development through self-regulation, introspection, and strategic modification without direct teacher supervision. This technique aligns with the ideas of constructivist theory and exemplifies the dynamic function of educational scaffolding. This study indicates that the knowledge production process fulfills learners' fundamental psychological needs, boosts intrinsic motivation, and induces flow experiences, hence fostering their commitment to ongoing learning engagement.

Self-Determination Theory

Self-Determination Theory (SDT), created by Deci and Ryan in the 1970s, is an extensive framework concerning human motivation and personality development. The fundamental principle of Self-Determination Theory (SDT) posits that individuals possess three intrinsic psychological needs: autonomy, competence, and relatedness. Addressing these requirements is intricately linked to an individual's intrinsic drive and self-development (Deci & Ryan, 1985). Since its inception, SDT has been extensively utilized across diverse domains. Within the realm of learning environments and educational design, Self-Determination Theory (SDT) offers a theoretical framework for comprehending and enhancing learner motivation. Ryan and Deci 's research highlights

that when learners experience autonomy, competence, and emotional connections with others, their motivation markedly rises, resulting in enhanced engagement in learning activities (Ryan & Deci, 2017).

Guay et al. (2019) investigated the influence of Self-Determination Theory (SDT) on high school students' motivation, demonstrating that fostering an atmosphere conducive to self-directed learning significantly enhances intrinsic motivation and, consequently, learning results. Research indicates that offering task choices and prompt feedback enhances students' sense of autonomy and competence, hence increasing their likelihood of engaging in learning activities. Kizilcec and Schneider (2020) examined the sustenance of motivation among MOOC participants. Their research indicated that personalized learning paths, tailored feedback, and opportunities for social interaction on learning platforms substantially enhance engagement and completion rates. Wu et al. (2022) developed a self-sustaining gamification learning system grounded in Self-Determination Theory (SDT) to augment students' motivation and performance in online language learning. Gamification features provide pupils with a sense of competence and accomplishment, hence enhancing their perseverance in the learning process.

This study indicates that the absence of external oversight and intrinsic incentive frequently hinders MOOC learners' ability to sustain learning persistence. Self-Determination Theory offers a conceptual framework for comprehending the evolution of motivation within the MOOCs context. Gamification in formative assessment provides learners with liberty and a sense of control in selecting learning tasks. Moreover, ongoing assessment in MOOCs offers prompt feedback and bolsters learners' perception of efficacy. Moreover, gamification components like leaderboards, collaborative assignments, and peer assessments enhance social connections that fulfill learners' requirements for relevance, thus bolstering motivation and sustained engagement. This study's primary theoretical underpinning, Self-Determination Theory (SDT), offers a paradigm for comprehending how gamified formative assessment might mitigate dropout rates in MOOCs, elucidate its underlying mechanisms, and furnish empirical evidence for enhancing online education.

This study highlights the enhancement of learners' intrinsic motivation and suggests gamified formative evaluation as a strategy to decrease the dropout rate in MOOCs. The primary objective is not merely to offer external motivation, but, more significantly, to foster the development of learners' inner motivation. This perspective aligns with the fundamental premise of self-determination theory. This theory posits that while external motivation may enhance learners' engagement temporarily, prolonged reliance on external rewards might foster dependence on reinforcement processes, ultimately undermining learners' autonomous learning capabilities (Ryan & Deci, 2000).

Figure 9 illustrates that self-determination theory conceptualizes motivation as a "self-determination continuum," wherein individuals progressively shift from a state of low self-determination to one of high self-determination. In this process, learners progress from an uninspired state to external regulation, internalized regulation, and identified regulation, ultimately achieving integrated regulation and intrinsic regulation, which signify a highly self-determined learning condition. Self-Determination Theory elucidates the progression of motivation from a wholly unmotivated "non-regulated" condition to a "externally regulated" phase dependent on external incentives (including reward and punishment systems), ultimately advancing to a "internally regulated" state propelled by intrinsic interest, enjoyment, and personal fulfillment (Deci & Ryan, 1985, 2000).

While gamification elements like leaderboards, badges, and reward points can temporarily boost learner engagement and facilitate the shift from unmotivated or externally regulated behavior to a more self-directed learning approach, their primary purpose is to foster the transformation of learning motivation into intrinsic motivation. This study examines the activation of learners' intrinsic motivation and its influence on the sustained learning behavior in MOOCs, framed within gamification formative assessment. By deliberately incorporating gamification into formative evaluation, learners can be progressively directed into an intrinsically motivated learning mode, thereby ensuring sustained engagement in MOOC courses.

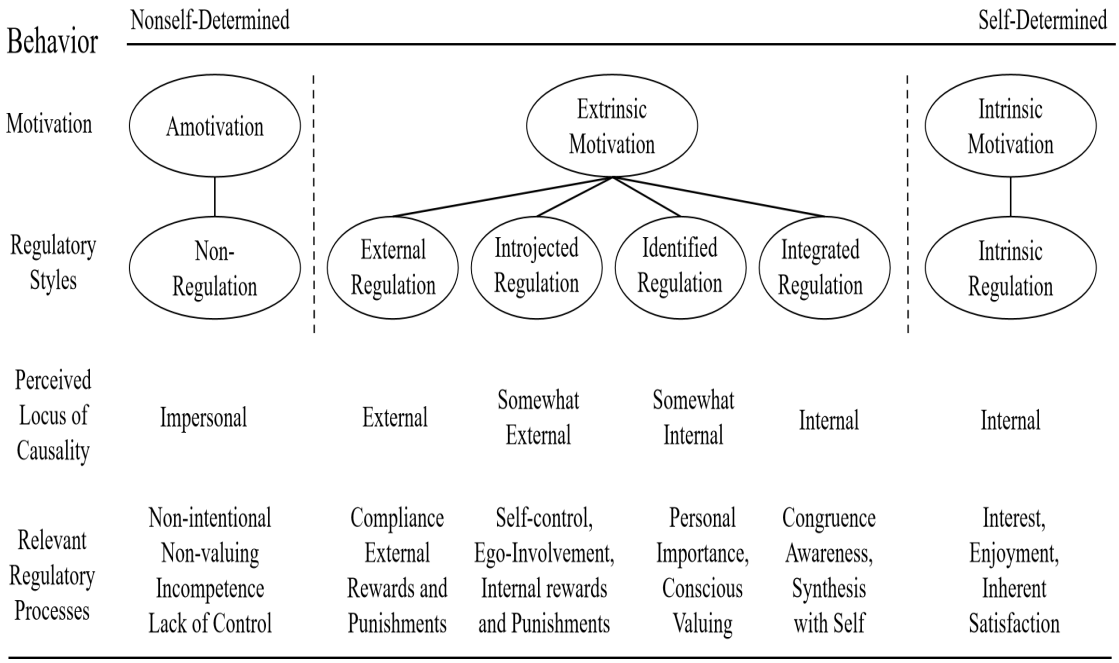

Figure 9 The Self-Determination Continuum Showing Types of Motivation with Their Regulatory Styles, Loci of Causality, and Corresponding Processes

Flow Theory

Mihaly Csikszentmihalyi, an American psychologist, initially introduced the Flow Theory in 1975. This idea characterizes "flow" as a psychological condition, denoting the very enjoyable and completely absorbed state that an individual undergoes when thoroughly involved in an activity. Csikszentmihalyi indicated that when an individual's skill level aligns optimally with the obstacles presented by an activity, they may experience a state of flow. In this condition, individuals get fully engrossed in the task, losing their sense of time, exhibiting heightened focus, and experiencing intrinsic motivation and enjoyment from the activity itself (Csikszentmihalyi, 1990). Navak et al. (2000) classified the flow experience into three stages: antecedents, features, and results, which subsequently developed into the commonly utilized three-stage nine-feature flow experience (refer to Table 1).

Table 1 Three Stages and Nine Characteristics of Flow Experience

The Three Stages and Nine Characteristics of Flow	Antecedent Stage	Clear and specific goals
		Immediate, accurate, and effective feedback
		A match between personal skills and challenges
	Experience Stage	Merging of action and awareness
		High concentration of attention
		A sense of potential control
		Loss of self-consciousness
	Result Stage	Distorted sense of time
		Deep intrinsic involvement

The flow experience is generally categorized into three phases: the antecedent phase, the experiential phase, and the outcome phase. In the preliminary phase, the conditions for achieving a flow state encompass: explicit objectives, indicating that individuals possess a lucid comprehension of the goals and anticipated results of the task; prompt feedback, wherein individuals obtain timely, precise, and constructive feedback throughout the task to evaluate their progression; and an equilibrium between skills and challenges, where a dynamic alignment between task difficulty and the individual's proficiency fosters enduring motivation and engagement. Upon entering the experiential phase, individuals exhibit a fusion of action and consciousness, becoming profoundly engrossed in the activity, characterized by intense focus and a possible sensation of mastery over the process. Ultimately, in the outcome phase, individuals progressively diminish self-awareness, undergo a distortion of temporal perception, and cultivate a profound sense of intrinsic engagement and satisfaction, so creating a robust psychological basis for intrinsic drive and sustained commitment.

Hoffman and Novak (1996) highlighted in their study that the "equilibrium between skills and challenges" is an essential prerequisite for attaining a flow experience. The flow channel model depicted in Figure 10 demonstrates that a joyful and immersed flow state arises only when the task's challenge level aligns with the individual's skill level. When the challenge surpasses an individual's capabilities, it results in anxiety stemming from the difficulty of managing the work. Conversely, when

the challenge is markedly inferior to the individual's ability level, the activity becomes excessively facile, leading to relaxation and adverse emotions of ennui and disengagement.

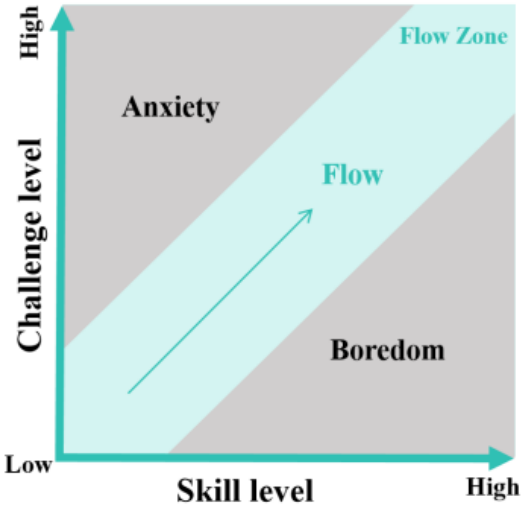

Figure 10 Flow and Flow Zone

In recent decades, flow theory has been extensively utilized in educational and online learning contexts. As digital learning platforms proliferate, researchers consistently investigate the integration of flow theory into online course design to augment learner engagement and boost educational outcomes.

Linnenbrink-Garcia et al. (2020) investigated the correlation between gamification components and the flow experience in online education. Their research indicated that students were more inclined to achieve a flow state in educational settings that integrated hard tasks with fast feedback, leading to enhanced learning experiences and superior academic performance. Wu et al. (2021) developed graded challenge assignments on a MOOC platform to enhance learners' flow experiences. Their studies demonstrated that this strategy markedly enhanced learner retention rates and diminished dropout rates. The study highlighted that flow experience significantly enhances learners' desire to finish online learning tasks, while also increasing their enjoyment and sense of accomplishment.

Bakker et al. (2019) found in a study on occupational skills training that online learning platforms incorporating gamification features and flow experiences improved learners' engagement and sense of achievement upon task completion. This study further substantiated the essential motivational function of flow in intricate learning activities, particularly in long-term educational settings that necessitate sustained concentration and ongoing challenges, wherein flow aids in preserving a high degree of learner engagement.

In the realm of MOOCs, learners frequently encounter challenges or withdraw owing to insufficient immediate feedback and persistent motivation. Flow theory offers a crucial theoretical basis for the creation of gamified formative assessments, significantly improving learners' immersion and sustained engagement.

This study investigates gamification solutions for formative assessment grounded in flow dynamics, with the objective of offering learners tailored challenges and prompt feedback via self-assessment and ongoing formative evaluation. This method allows learners to attain a state of flow during the MOOCs learning experience, cultivating a sense of accomplishment and pleasure. Moreover, peer evaluation, as an advanced implementation of flow theory, not only enhances interaction among learners but also sustains their emotional states inside the "flow channel," preventing anxiety from overly challenging tasks and boredom from insufficient challenges. This thus fosters emotional stability and enduring drive for learning. This project seeks to enhance gamification in formative assessment methods to decrease dropout rates in MOOCs and foster sustained learner engagement and deep learning attainment.

Some Theories Related to Learning Engagement

The Student Involvement Theory, introduced by Astin (1984), is a foundational theoretical framework in the examination of learner involvement. This idea posits that students' engagement in academic and extracurricular activities substantially influences their learning outcomes. Astin characterizes "student engagement" as the

physical and cognitive effort individuals dedicate to their learning experiences, asserting that learning results are more contingent upon the level of student engagement than on external factors like instructional design or institutional settings. Astin categorizes student involvement into five principal dimensions: academic engagement, extracurricular engagement, social engagement, emotional engagement, and work engagement. These characteristics collectively create a comprehensive and multifaceted perspective on learning engagement, transcending the conventional focus on classroom involvement alone. Astin's research underscores the necessity of cultivating an educational environment that fosters students' diverse participation and accentuates the significant impact of multidimensional learning engagement on enhancing learning outcomes.

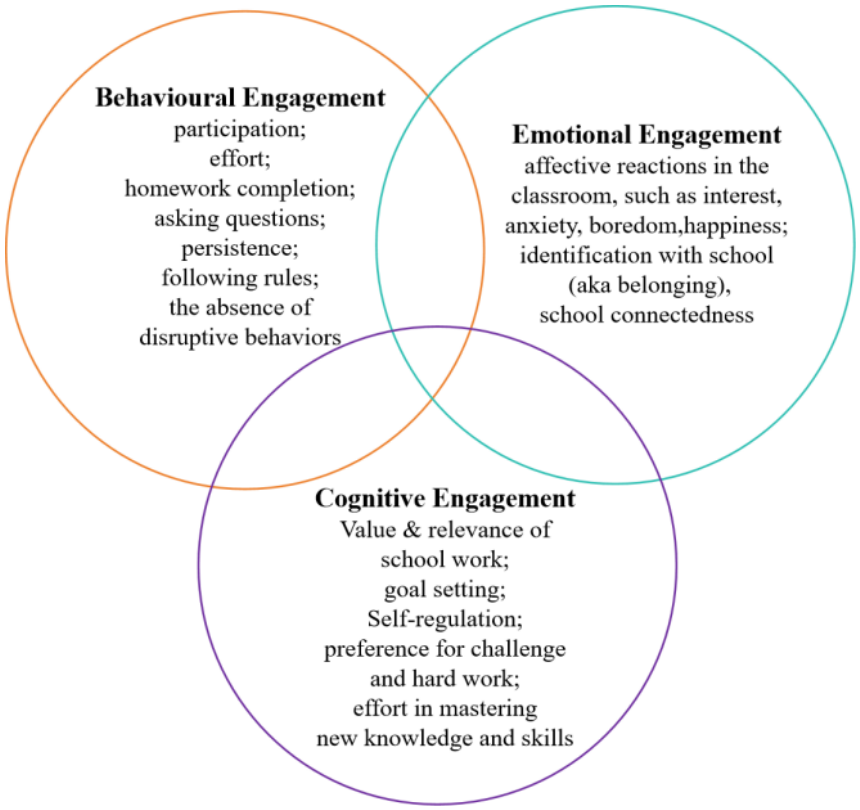

Figure 11 The Construct of Student Engagement (Fredricks et al., 2004)

Fredricks, Blumenfeld, and Paris (2004) introduced the meta-construct of "student engagement," categorizing it into three fundamental dimensions: behavioral

engagement, emotional engagement, and cognitive engagement. This paradigm offers a more extensive theoretical approach for comprehending student participation, emphasizing its multidimensional and dynamic characteristics (as illustrated in Figure 11). Behavioral engagement denotes students' active involvement in educational activities, encompassing task fulfillment, homework submission, and the avoidance of disruptive conduct. It is seen as the most evident manifestation of student engagement and is frequently linked to attendance, classroom performance, and academic success. Furthermore, behavioral engagement highlights students' constructive interactive actions in the educational setting, like actively posing questions and engaging with educators or classmates (Appleton et al., 2008). Emotional involvement pertains to kids' emotional reactions to school, educators, and classmates, encompassing curiosity, worry, boredom, a sense of belonging, value recognition, and emotional attachment. Emotional involvement is a crucial expression of intrinsic motivation and profoundly influences students' learning attitudes and enduring academic results (Luo et al., 2021). Cognitive engagement highlights the cognitive methods and analytical skills that students utilize in the learning process, encompassing self-regulated learning, goal planning, and the dedication to acquiring new knowledge. Cognitive engagement signifies advanced cognitive skills and facilitates pupils' effective assimilation of intricate learning material (Jansen et al., 2020). To enhance the alignment of intervention efforts, Reschly et al. (2014) further categorized the behavioral dimension into two subtypes: behavioral engagement and academic engagement, so rendering the theoretical model more applicable in practical contexts.

In recent years, the student learning engagement framework developed by Fredricks et al. has been extensively utilized in education, particularly in online learning and educational technology research, serving as a crucial instrument for studying learner engagement behavior. Min and Foon (2019) identified that behavioral engagement (e.g., frequency of video viewing, assignment submission), emotional engagement (e.g., learning interest, course satisfaction), and cognitive engagement (e.g., utilization of deep learning strategies) are critical determinants of online learning success in the

context of Self-Regulated Learning (SRL) within MOOCs. The learning engagement of MOOC participants is determined not only by course design but also by their intrinsic motivation and self-regulation skills (Zheng Q et al., 2020). Sun and Chen (2020) discovered in their research on student engagement in blended learning environments that emotional and cognitive engagement are significant predictors of academic performance, whereas behavioral engagement is more influenced by external factors like teacher support and technological resources. These investigations further substantiate the relevance of the approach established by Fredricks et al. in online learning environments and offer empirical evidence for its practical implementation. This study indicates that the participation behavior of MOOC learners is intricate and varied. Utilizing the three-dimensional engagement framework established by Fredricks et al. can effectively elucidate the influence of gamification formative assessment on learners' involvement across many dimensions. The framework exhibits significant flexibility and universality, enabling adaptation to many learning environments, particularly in highly autonomous and open learning contexts like MOOCs, thereby offering researchers a robust theoretical base.

FRAMEWORKS OF THE RESEARCH

Theoretical Framework of the Research

Based on the theoretical research and literature review, a theoretical framework for the research has been developed, as illustrated in Figure 12.

The "Affordance–Psychology–Behavioral Outcomes" model explains the affordances of gamification formative assessment (derived from the concept of ecological psychology proposed by Gibson in 1979, which emphasizes the interaction between actors and objects of action). This mechanism can stimulate psychological

changes in learners (such as motivation, interest, and emotional engagement), which, through internal processes, ultimately lead to behavioral changes (such as higher participation rates and task completion). The model focuses on the psychological mediating mechanisms between gamification formative assessment and learners' sustained participation in MOOCs, providing a theoretical foundation for the construction of the framework.

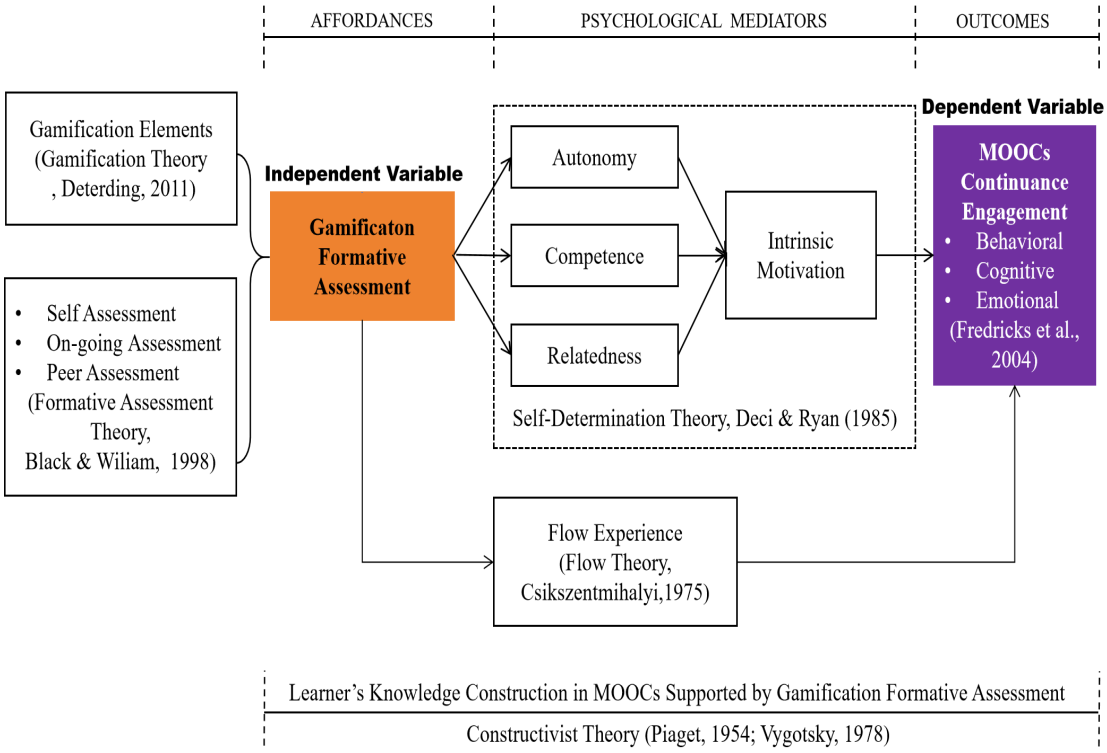

Figure 12 Theoretical Framework of the Research

This framework highlights the uniqueness of the MOOCs teaching environment, integrating various gamification elements such as points, badges, and leaderboards in a reasonable manner, achieving gamification of formative evaluation, and thus constructing an experimental MOOCs learning space. In this space, learners can deeply interact and construct knowledge with themselves, course content, and other learners (Piaget, 1954; Vygotsky, 1978). According to the core viewpoint of Deci and

Ryan's (1985) self-determination theory, this process not only satisfies learners' basic psychological needs (such as autonomy, competence, and relatedness), but also significantly enhances their intrinsic motivation. In addition, gamification formative assessment provides learners with appropriate challenges and immediate feedback, helping them enter a "flow" state (Csikszentmihalyi, 1990), thereby enhancing their learning experience and effectiveness.

To comprehensively evaluate the effectiveness of gamification formative assessment, this study adopted the student engagement meta construct proposed by Fredricks, Blumenfeld, and Paris (2004), and evaluated it from three key dimensions: behavioral engagement, cognitive engagement, and emotional engagement. Through multidimensional comparative analysis, research can more comprehensively reveal the impact mechanism of gamification formative assessment on learners' sustained participation behavior, providing theoretical guidance for optimizing MOOCs.

Provisional Framework of the Research

This book presents a comprehensive framework for gamification in formative assessment, intending to offer an experimentally validated approach for the systematic integration of gamification with formative assessment. This framework seeks to establish a theoretical basis and offer practical direction for forthcoming research and educational practices. This study advances the concept by incorporating gamification and formative assessment within the setting of MOOCs, building on prior research in gamification formative assessment.

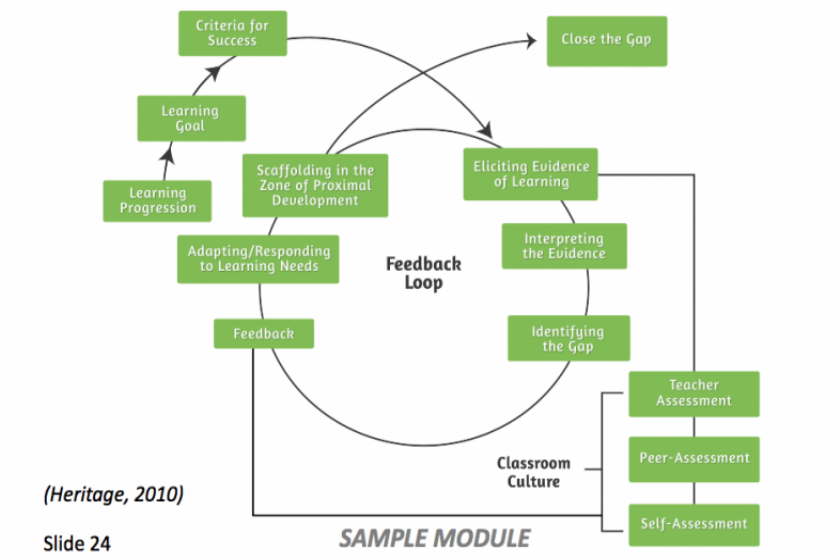

Figure 13 The Process of Formative Assessment (Heritage, 2010)

Heritage (2010) introduced a model for a representative formative assessment process in the monograph "Formative Assessment: Making It Happen in the Classroom," highlighting a dynamic teaching support system driven by learning objectives and focused on feedback loops (see Figure 13). The model initiates with the learning process and objectives, delineates the success criteria, and progressively directs learners towards the anticipated outcomes through the instructional framework inside the "zone of proximal development". Throughout the instructional process, educators must consistently gather learning evidence utilizing several approaches, including teacher evaluation, peer assessment, and self-assessment. Upon elucidating the data and pinpointing deficiencies, they must promptly modify instructional strategies to address students' learning requirements, provide an efficient feedback mechanism, and finally assist learners in bridging the gap. This approach underscores that formative assessment serves not merely as an evaluation of learning outcomes, but also as a pedagogical procedure that actively fosters learning advancement. It considers teacher evaluation, peer evaluation, and self-evaluation as integral to supportive classroom cultures. Through the ongoing collection and analysis of learning evidence, along with feedback and pedagogical frameworks, it assists learners in recognizing discrepancies between their current status and learning objectives, enabling them to modify their learning

strategies and perpetually enhance the learning process. This methodology is primarily dependent on educators and features a complicated evaluation process, which may be inappropriate for extensive online teaching environments like MOOCs. MOOCs prioritize self-directed learning among students and frequently lack the guidance of instructors found in traditional classrooms; hence, the roles of teachers and feedback systems within the framework may be underutilized. This study indicates that combining formative assessment techniques with gamification elements, as outlined in this framework, might improve the interactivity and sustainability of the learning process while preserving the fundamental structure of the original "feedback loop".

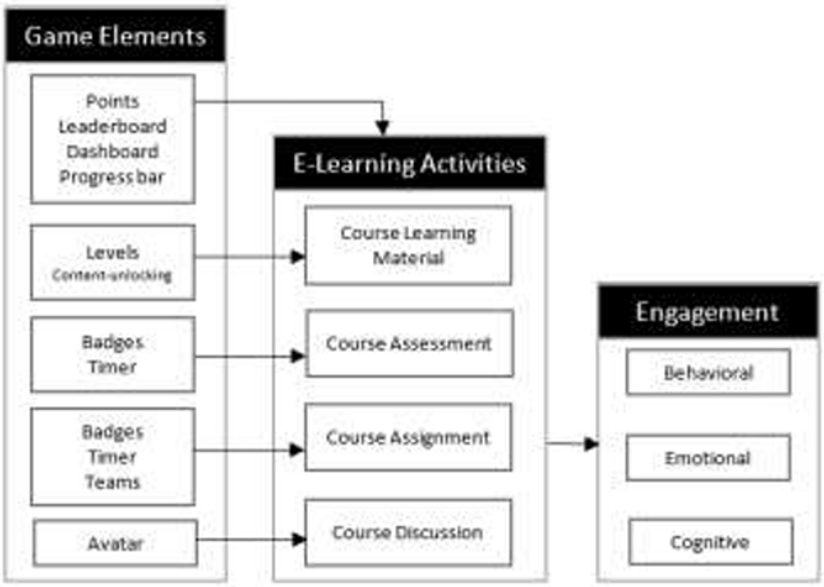

Figure 14 Proposed Engagement Framework for the Gamification of e-learning Systems (Alsubhi et al., 2021)

Alsubhi et al. presented a gamification learning engagement framework for e-learning systems in their 2021 study (refer to Figure 14). This approach seeks to improve learner engagement in online educational settings, hence mitigating prevalent issues of learning loss and course attrition in higher education. The framework comprises three fundamental components: gamification elements, learning activities, and learner engagement aspects. Researchers have delineated ten prevalent game

elements (including points, badges, leaderboards, and progress bars) from existing literature and systematically correlated them with four principal learning activities (learning materials, tests, assignments, and discussions). This has resulted in the establishment of a ternary framework of "game elements, learning activities, and participation factors" to facilitate the design and analysis of gamification strategies within the educational system. This approach utilizes learner engagement variables from three dimensions: behavior, emotion, and cognition as primary evaluation indicators, and assesses its structural validity and practical applicability through expert interviews. This framework offers significant references for educators in implementing gamified learning design regarding structural construction and element alignment.

Nevertheless, it primarily emphasizes the static mapping relationship among game elements, learning activities, and learner participation, failing to capture the dynamic process mechanism of formative assessment characterized by "feedback-driven continuous regulation cyclic promotion." Additionally, it does not address the critical challenges frequently encountered in MOOC teaching environments, including the lack of interaction resulting from asynchronous learning, the high degree of autonomy in learners' educational trajectories, and the constraints on personalized feedback capabilities. This study incorporates the process logic of formative assessment and develops a gamification framework for formative assessment in MOOC contexts, highlighting process coaching and ongoing feedback.

Ahmad et al. (2020) introduced the Game Quiz Formative Assessment Framework (GOFA), illustrated in Figure 15. This paradigm incorporates gamification into formative assessment through testing, converting conventional tests into engaging and interactive learning experiences, offering students prompt feedback and a feeling of accomplishment. GOFA is highly appropriate for evaluative methods reliant on examinations, notably in educational settings that necessitate regular assessments and feedback. This framework employs an adaptive evaluation mechanism to dynamically modify test difficulty according to students' learning performance, allowing learners to encounter difficulties commensurate with their ability levels. The assessment styles and scope of GOFA are notably restricted, primarily concentrating on formative assessment

through examinations, which hampers its applicability to more intricate learning tasks or varied assessment modalities, including project-based and reflective learning. Moreover, while this design might significantly augment students' enthusiasm for test participation, it remains predominantly dependent on external motivational factors.

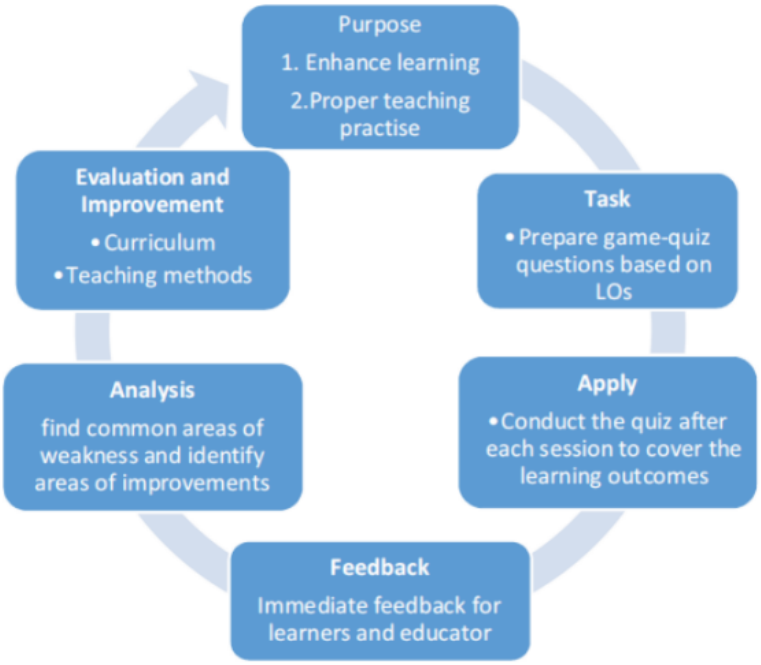

Figure 15 Game-Quiz Formative Assessment Framework (GOFA)

This study presents a "Gamification Formative Assessment Cycle Framework" specifically designed for the MOOCs setting, informed by the literature review and prior research on gamification formative assessment frameworks (see Figure 16). This framework focuses on "learning tasks" and establishes a closed learning loop through the sequence of "Start—Learning task—test assignment—end," highlighting the ongoing cycle and dynamic optimization between learning behaviors and the evaluation process. The framework incorporates a multi-dimensional gamification assessment mechanism, categorized into three primary types: self-assessment, ongoing assessment, and peer assessment. Self-assessment encompasses both the pre-learning and post-learning phases, consisting of "Pre-learning Self-assessment" and "Post-

learning Self-assessment." The former aims to assess learning readiness and identify knowledge and skill deficiencies, whereas the latter concentrates on evaluating learning outcomes, acknowledging strengths and limitations, and enabling the commencement of the subsequent learning cycle. Continuous assessment is integrated at critical junctures within the learning process, encompassing phases such as goal establishment, task implementation, examination completion, and assignment submission. It encompasses capabilities such as creating learning feedback and plans, analyzing progress and optimizing tactics, real-time data monitoring with rapid feedback, and tracking assignment engagement and quiz result analysis, highlighting data-driven and responsive procedures. During the "assignment" phase, the framework incorporates gamified peer assessment mechanisms, such as individual assignment evaluations, collaborative projects, peer grading, and question-and-answer interactions, to enhance student engagement and diversify assessment sources.

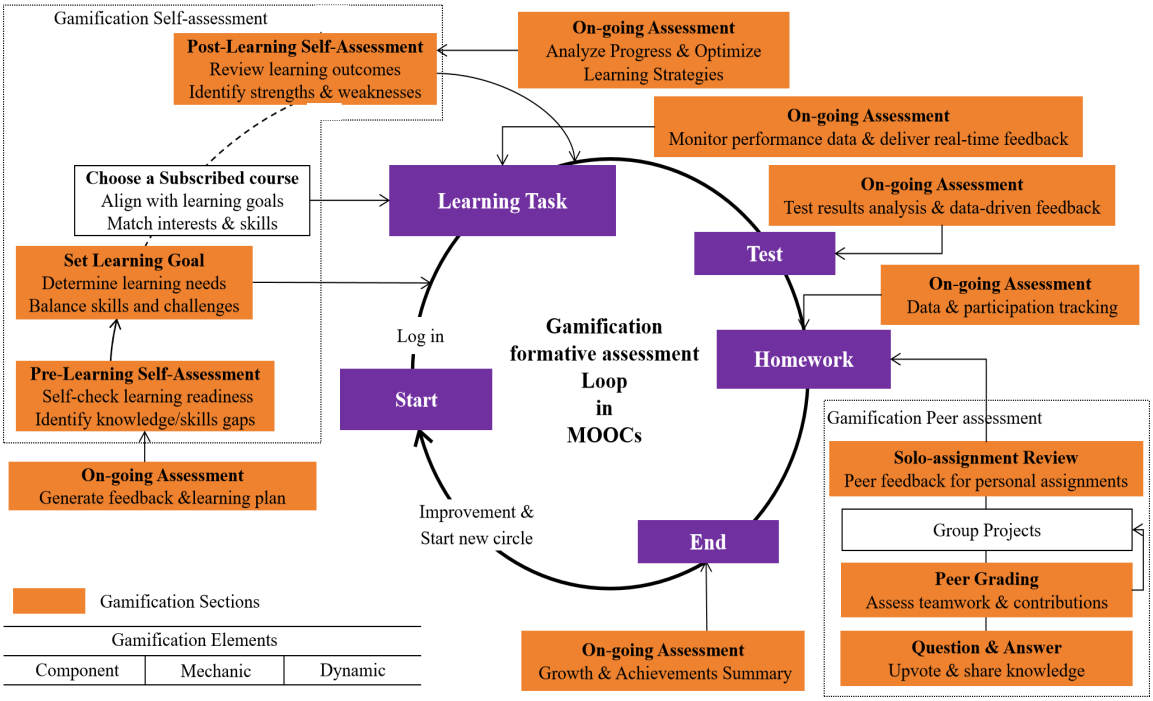

Figure 16 Provisional Gamification Formative Assessment Framework

This framework seeks to advance the learning process towards completion, bolstered by various assessment methods. By incorporating gamification elements into

several assessment modalities, such as self-assessment, formative assessment, and peer assessment. It establishes a formative assessment system that encompasses the full learning process and integrates dynamic regulatory functions. The method enhances the supportive function of assessment feedback in the learning process and, through ongoing strategic direction, facilitates effective self-regulation among learners. Unlike gamification frameworks that prioritize the aggregation of game elements or fixed mappings, the methodology presented in this study emphasizes the ongoing nature of the evaluation process and the flexibility across various assessment formats. It offers a systematic and functional support framework for enhancing assessment processes and maintaining student engagement in the highly independent and asynchronous learning context of MOOCs.

The framework differentiated between non-gamification and gamification elements, highlighting their significance in establishing an engaging and effective MOOCs learning environment.

SUMMARY

In MOOCs education, elevated dropout rates pose a considerable problem, and conventional teaching and assessment methods demonstrate limited efficacy in these contexts, highlighting the pressing necessity for novel evaluation strategies. Studies demonstrate that gamification markedly improves student engagement and maintains motivation, whereas formative evaluation efficiently facilitates learning through comprehensive and prompt feedback. This paper conducts a thorough evaluation of current research on gamification and formative assessment, establishing a theoretical and practical basis for creating a gamification formative assessment framework specifically designed for MOOC contexts. The study also identifies structural constraints and insufficient adaptability in existing gamification formative assessment frameworks inside MOOC environments. Thus, it presents a novel paradigm explicitly tailored for MOOCs.

CHAPTER TWO

DESIGN AND DEVELOPMENT OF "SHIYI · CHUANMEI"

Preparing Content for "ShiYi · ChuanMei"

In the mobile MOOCs learning mode, learners frequently face difficulties due to unpredictable learning settings and restricted durations for sustained learning. Due to the mobile nature of learners, the fragmented and intermittent character of their studies may result in frequent disruptions, adversely affecting the methodical acquisition of knowledge. This is especially apparent in courses necessitating a prolonged commitment, when such discontinuity may readily lead to sentiments of dissatisfaction and despair.

To tackle these problems, the content design of mobile MOOCs must emphasize the modularization and fragmentation of knowledge. Decomposing intricate concepts into manageable segments enables learners to comprehend essential ideas more rapidly, hence improving learning adaptability and convenience (Egloffstein & Ifenthaler, 2023). MOOCs promote the delivery of content via brief films, generally lasting 10 to 15 minutes, facilitating learners' engagement in segmented learning intervals and enhancing overall efficiency.

This study systematically transforms the course "Dissemination of Intangible Cultural Heritage: 30 Typical Cases of Chinese Intangible Cultural Heritage" from traditional classroom content to a MOOC structure optimized for online learning. The course has been restructured as a gamification formative assessment instrument, titled "ShiYi · ChuanMei," incorporating gamification components to augment student

motivation and engagement. The design process focuses on explicit course objectives, highlighting material suitability and presentation to guarantee effective knowledge transfer and favorable learning results.

The main aim of the MOOC is to facilitate students' complete comprehension of the fundamental principles, classifications, and cultural values of China's intangible cultural heritage, while also advancing its diffusion. The course seeks to stimulate students' interest and excitement for this history while enhancing their awareness of its preservation. These objectives direct the selection and integration of content, achieving a balance between academic rigor and engagement. Considering the practical and narrative aspects of intangible cultural assets, the course material incorporates actual instances and cultural narratives to enhance students' comprehension and engagement.

The study team performed a comprehensive assessment of the course's adaptability, confirming its alignment with academic standards and the cognitive requirements of learners from various cultural backgrounds. The study considers the fragmented nature of MOOC learning, improving and optimizing course content accordingly. Conventional classroom instruction is typically protracted and methodical, but online education necessitates simple, succinct content with defined tiers. Each session is meticulously restricted to 15 minutes, concentrating on essential information points and key highlights. An organized and systematic design enables learners to effectively comprehend material within a constrained period.

To augment pedagogical efficacy, multimedia technology is utilized, integrating high-quality films, music, animations, and graphics to deliver course content compellingly. Animations depict intricate technological processes, whereas movies present physical instances of intangible cultural heritage, enhancing learners' educational experiences and cultural immersion.

Finally, to reinforce learning goals and enhance interactivity, the course design integrates diverse forms of interaction and feedback methods. At the conclusion of each lesson, five short-answer questions and one reflection task are provided, assisting students in reviewing and consolidating their knowledge while offering possibilities for practical application. These interactive components not only augment

course appeal but also facilitate self-evaluation through prompt feedback. Tests and assignments, as essential elements of formative assessment, enhance students' comprehension and awareness of intangible cultural heritage conservation, hence intensifying their emotional engagement with the course material.

Instrument Design Interview

To guarantee that the creation of "ShiYi · ChuanMei" corresponds with learners' genuine demands and user experiences, the research team executed a targeted "instrument interview" during the initial design phase. This semi-structured interview sought to obtain profound insights into MOOC participants' experiences and sentiments concerning gamification features, along with their views on evaluative feedback techniques.

The interview outline was developed from an extensive literature research, specifically concentrating on "gamification as a strategy to mitigate dropout rates in MOOCs." It integrated insights from multiple qualitative studies regarding MOOC learners' experiences and feedback preferences. El Said (2017) performed semi-structured interviews with 52 MOOC learners, demonstrating that fast feedback, task optionality, and platform interactivity are essential for maintaining involvement. Topali et al., (2022) emphasized the importance of graphical feedback and well-defined task structures, offering considerable references for the interview questions. While Yıldırım (2020) concentrated on MOOC teachers, his observations about assessment and feedback methods also influenced the formulation of the interview outline.

The interview included a flexible questioning technique, enabling participants to articulate their ideas and recommendations within a structured format. The research initially concentrated on collecting comments regarding prevalent gamification components in MOOC platforms, including point systems, badges, leaderboards, and challenge activities. The research assessed the efficacy of these factors in fostering learning motivation and improving participation through comprehensive discussions.

Students offered comprehensive narratives of their experiences, highlighting both advantages and drawbacks. Some have observed that whereas points and badges enhance short-term motivation, they do not ensure long-term sustainability. Some emphasized the beneficial impact of rankings in promoting collaboration, although voiced apprehensions regarding the anxiety generated by heightened competitiveness. This interview revealed critical challenges and anticipations, providing essential insights for future design enhancement.

Informed by learners' comments, the study analyzed the impact of gamification aspects inside current MOOC environments, identifying potential areas for enhancement. This study elucidated the most enticing parts and how to more effectively connect them with user expectations. Students commonly acknowledged that the integration of "challenging tasks + immediate feedback" substantially improves learning efficacy and success. In contrast, static badges were perceived as less appealing, prompting recommendations for dynamic designs or social interaction features to increase their attractiveness.

The study emphasized learners' perceptions of evaluation feedback systems, contrasting gamification feedback with conventional techniques. The findings revealed widespread discontent with current feedback systems, especially about delays and insufficient diversity. Conversely, learners demonstrated significant interest in gamification feedback methods, asserting that prompt and diverse feedback could augment their sense of engagement and community. Proposed enhancements encompassed the incorporation of emotive design in feedback, the introduction of self-reflection sessions, and the augmentation of clarity via data visualization.

Thematic analysis was utilized to derive essential perspectives and experiences from the interview data. All participant information was anonymised to safeguard privacy, and the content was recorded and transcribed with participants' consent. After several rounds of editing, the data was encoded with NVivo software to identify and summarize key themes.

During the open coding phase, targeted input regarding gamification elements was derived from the interviews. Identified key elements comprised point systems,

badges, leaderboards, challenge tasks, narrative systems, and character systems. Participants saw that point systems can augment short-term motivation by establishing clear objectives, whereas badges function as emblems of accomplishment. Rankings promote engagement but may also generate fear, while demanding tasks, particularly when accompanied by prompt feedback, greatly enhance participation.

In the axial coding phase, the research team categorized learners' feedback into four principal themes concerning gamification in formative assessment: short-term motivation versus long-term impact, the equilibrium between competition and collaboration, the promptness and variety of feedback, and the design of contextually engaging feedback. Explicit motivating aspects may augment short-term engagement; nonetheless, learners underscored the necessity for varied and contemporary rewards to sustain long-term motivation.

The selective encoding phase further consolidated these concepts into two primary design directions: a tension-balanced cooperative competition mechanism and a participation-focused feedback mechanism. This method emphasizes the need to balance incentive with emotional support in competitive settings and highlights the significance of immediate, tailored, and contextual feedback to foster ongoing engagement.

During the design process, it became apparent that several aspects, like points and badges, could diminish in attractiveness over time if not creatively executed. Students proposed preserving their appeal by implementing dynamic designs and fostering increased social interaction, including the sharing of achievements and collaborative group efforts.

The tool design interview provided significant insights for this investigation. The NVivo coding analysis yielded a comprehensive insight into undergraduate learners' preferences regarding diverse gamification features and feedback processes. Informed by the significant acknowledgment of instant feedback and challenge activities, essential gamification components, including point systems, badges, leaderboards, challenge tasks, and immediate feedback, were chosen for the quasi-experimental tool design, including them into formative assessment instruments.

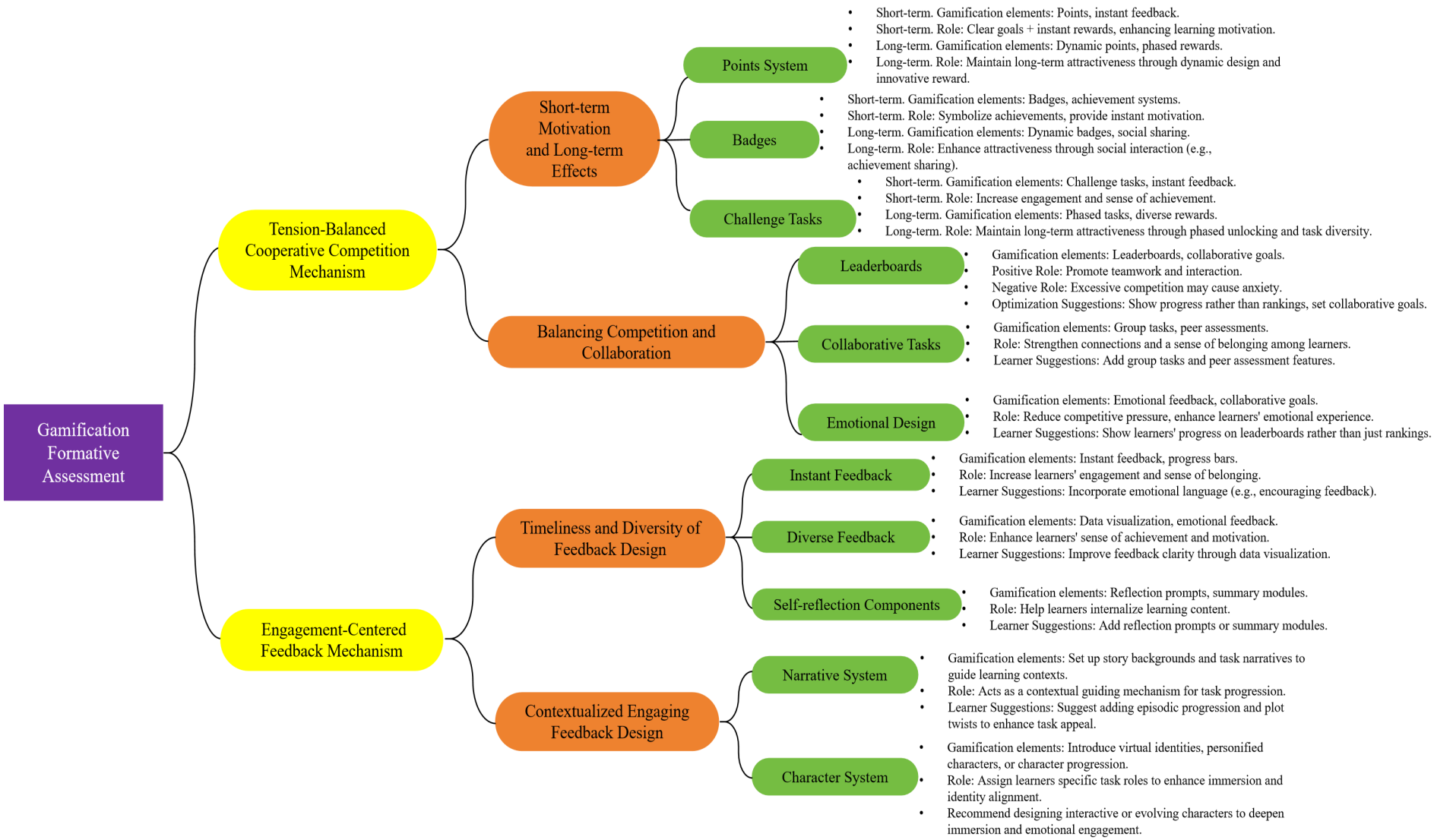

Figure 17 Gamification Design Elements Synthesized from the Instrument Design Interview

This study, informed by interview data, further delineates the learning participation behavior of MOOC learners in a mobile digital environment, classifying it into four primary areas: course selection, learning process, interactive communication, and feedback summary. Examining these elements elucidates learners' fundamental requirements for a fulfilling MOOC experience.

Course Selection

Students need accurate and tailored course recommendations that closely correspond with their present learning requirements, interests, and proficiency levels. They anticipate rapid access to course summaries and essential information, allowing them to validate the validity and relevance of the content through peer feedback within the learning community. This enables learners to effectively evaluate if a course aligns with their personal objectives and expectations.

Learning Process

Throughout their educational experience, learners seek curriculum that can adapt flexibly to diverse learning situations, providing continuity and reducing disruptions. They strive for equilibrium between profundity and engagement in the educational material and evaluations, enhancing the overall process's dynamism and efficacy. Moreover, students anticipate a variety of assessment and feedback instruments that enable them to document and disseminate personal discoveries, enhance their comprehension, and cultivate their critical thinking abilities.

Interactive Communication

Students appreciate prompt and efficient question-and-answer assistance throughout the educational experience, especially when confronting difficult ideas. They desire a sense of belonging within the educational community and seek peer endorsements from individuals on analogous learning trajectories to inspire mutual motivation. Robust interactive communication can markedly elevate learners' motivation and maintain their engagement with MOOC content.

Summary of Feedback

Students desire their advancement to be documented and clearly shown, facilitating a comprehensive comprehension of their educational status. By utilizing visual learning objectives and individualized assessments, they may more accurately assess their results. Students anticipate feedback not only to assess course material but also to offer strategic recommendations for learning techniques and long-term growth, promoting ongoing self-improvement. Numerous individuals contend that constructive competition among peers, along with gamified components such as badges, leaderboards, and character enhancements, can significantly enhance their incentive to continue learning.

Opportunities for the Optimization and Evaluation Design of MOOCs

This analysis reveals multiple potential for improving MOOCs design and evaluation:

- ***Enhancing Learner Engagement and Motivation:*** Elevating learner engagement and maintaining motivation is essential. Visualizing learning progress and employing gamification techniques—such as point systems, badges, and leaderboards—can enhance learners' motivation and foster a greater sense of accomplishment. Furthermore, creating customized learning trajectories and goal-setting functionalities enables learners to adjust their plans according to their interests and advancement, so improving the pertinence and coherence of their education.
- ***Enhancing Learning Content and Interaction Design:*** To effectively cater to mobile learners, course content must be refined for brevity and clarity. For instance, lengthy videos might be segmented into concise modules, so enhancing learning during brief intervals. Moreover, enhancing the interaction experience on mobile devices through the simplification of interfaces and interaction processes guarantees a seamless, fast learning process, hence elevating the entire user experience.
- ***Improving Assessment Functions and Immediate Feedback Systems:***

Enhancing the evaluation functions and real-time feedback systems of MOOCs is crucial for fostering engagement and communication among learners. Incorporating social components—such as learning circles, interactive Q&A forums, and peer assessments—can cultivate a sense of belonging while augmenting interactivity and motivation. Moreover, offering real-time feedback for progress monitoring, along with prompt learning recommendations and responses to inquiries, would facilitate tailored assistance and empower learners to modify their techniques effectively, thereby enhancing educational results.

Design Method of "ShiYi · ChuanMei"

Although gamification in formative assessment within the MOOC context aligns with the design objectives of traditional classroom assessment, it exhibits notable distinctions in application contexts, feedback systems, and participant experiences. The proposed formative assessment tool, "ShiYi · ChuanMei," seeks to augment learning motivation and engagement by including gamification features, hence offering substantial assistance for online instruction in MOOCs.

Design Framework

This study utilized Tan's (2015) seven-step gamification design method as the foundational framework in the design process. Figure 18 illustrates the specific design procedure.

Seven Stages of Gamification Design

1. **Select a Primary Emotion:** Determine the primary feeling to be elicited by the gamified design.
2. **Establish a Gamification Objective:** Guarantee coherence between the aims and educational intentions.
3. **Select a Genre:** Choose the most suitable game style for the educational

context.

4. **Establish the Gameplay:** Formulate comprehensive game regulations and task methodologies.
5. **Define Interaction Model and Social Interaction Mode:** Establish guidelines for interactions between users and the system, as well as among users themselves.
6. **Select a Game Environment:** Identify the setting for the execution of gamified activities.
7. **Craft a Narrative for a Game:** Augment the gaming experience and immersion via narrative.

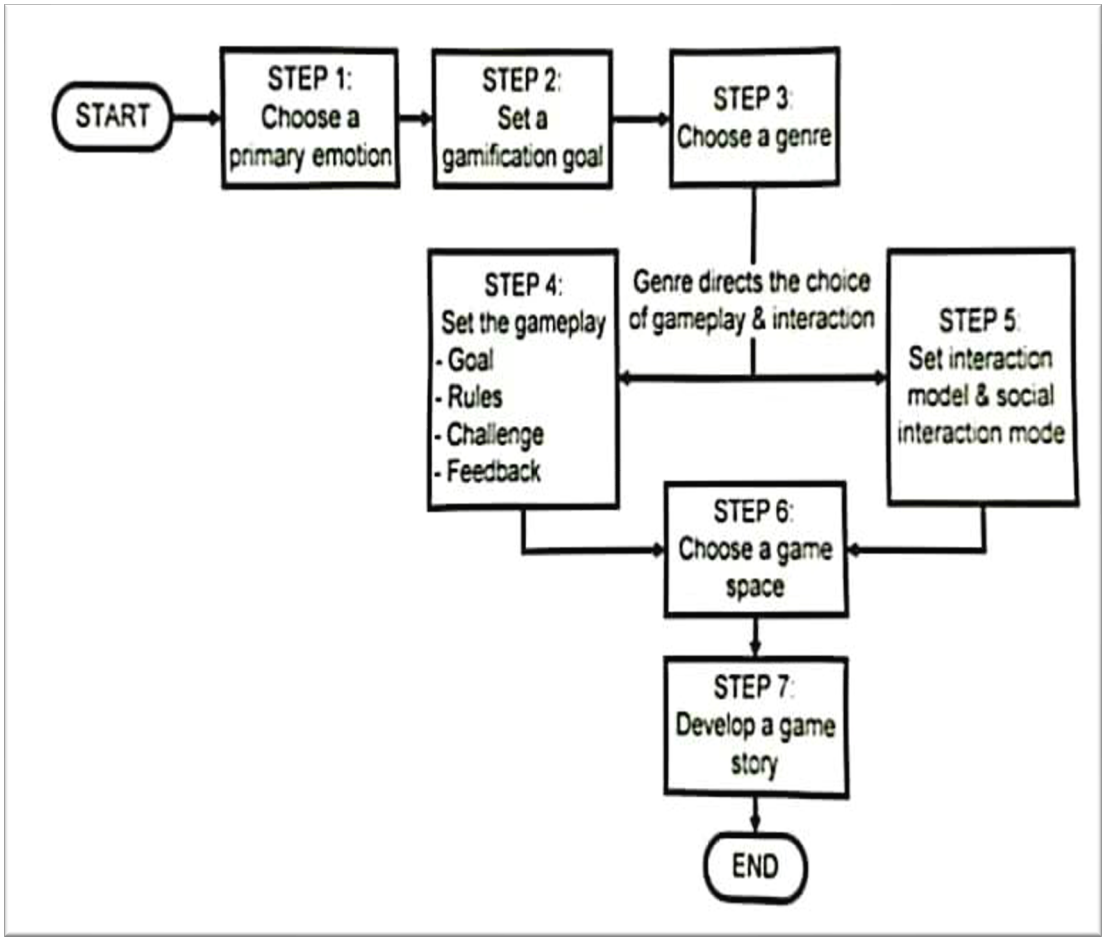

Figure 18 Seven step gamification design method. Tan (2015)

Implementation of the Method

This approach has been effectively implemented in several educational settings. Jalinus et al. (2025) employed it to create a reinforcement learning platform for vocational training, successfully tackling participation challenges and enhancing learners' proficiency levels. Hashim et al. (2025) developed an instructional game utilizing this paradigm, successfully achieving cohesive integration from objectives to game mechanics. Ahmed and Ling (2021) developed a health education application utilizing this strategy, markedly improving user behavior via mobile health interventions. These examples corroborate the method's logic and relevance in many educational contexts.

Gamification Design Document

After completing the instrument interview and gamification methodology research, this study entered the stage of writing design documents. The core task of this stage is to develop a unified and actionable design plan that transforms the complex information collected in the early stages into a practical guide to assist developers of gamification formative assessment tools in efficiently developing and implementing corresponding WeChat mini programs. Gamification Design Document (GDD) is a detailed document used to plan and standardize the application of game design elements and mechanisms in non-gaming contexts, aimed at enhancing user experience, increasing engagement, and achieving other expected goals. This document is not only applicable to the education field, but also widely used in the development process of enterprise training platforms, learning management systems, and health applications.

In the development process of the formative assessment tool for "ShiYi · ChuanMei", this design document serves as the core reference. Its main function is to systematically integrate the multidimensional information collected from previous interviews and method research, and provide a solid framework support for subsequent development through rigorous planning and clear goal setting.

Gamification design documents play a crucial role in the development process of complex systems. For example, Pedreira et al. (2020) proposed a gamified architecture for software engineering that integrates multiple development tools into a unified gamified environment. Research has shown that design documents have indispensable value in coordinating system modules and achieving multifunctional collaboration, especially when faced with complex development requirements, design documents can provide clear guiding frameworks. In addition, Grimm (2022) developed a prototype tool that significantly improves the quality of gamification design through documentation and collaboration mechanisms. This tool not only helps non-professionals intuitively understand the design process, but also optimizes design records through its documentation function, ensuring effective communication between development teams. In the field of education, Gallego Dur á n et al. (2019) proposed an evaluation scale based on game design rules specifically designed to address the challenges faced by non-professionals in using gamification. The study emphasizes that a systematic and traceable design process helps educators and researchers understand the logic of gamification design and enhance the practical effectiveness of gamification activities. This method lowers the entry threshold for gamification and provides more possibilities for users lacking technical background to participate.

This study utilized the gamification design document module tool proposed by Tan (2019). In the development process of the gamification design document (GDD) for "ShiYi · ChuanMei", the seven-step method was used as the core design guidance. By integrating this method into the document writing process, the systematic and logical structure of gamified design is ensured, while also providing a clear path for subsequent development and implementation.

Based on the temporary framework proposed in this study, "surprise" is selected as the core emotion of gamification design, which is one of the seven basic human emotions defined by psychologist Ekman (1992) through cross-cultural research. The reason for choosing 'surprise' is because it has a natural appeal and can stimulate learners' curiosity, which is crucial for maintaining the learning motivation of MOOCs learners. By embedding design elements of unpredictability and discoverability, tools

aim to attract learners' attention and continuously stimulate their willingness to participate throughout the learning process.

In addition, the research defines the gamification goal of this tool as creating a learning experience of "surprise," "connection," and "continuous victory" for learners, thereby helping them maintain their learning state and complete the entire MOOC course. In the gamification design document, the measurement methods for gamification goals were clarified through observable behavior, conditions of attainment, and degree of attainment.

Figure 19 Examples of "New Chinese-Style" Materials

This study determined the appropriate gamification style by analyzing the course characteristics and learner preferences of MOOCs. The game style of "ShiYi · ChuanMei" adopts a "challenge reward" mechanism, combining gamification of learning tasks with real-time feedback. This design enables learners to experience continuous improvement while completing tasks at various stages, thereby maintaining their interest in learning. Given that the course content focuses on intangible cultural heritage, the study chose the popular "New Chinese Style" as the visual style in recent years (as shown in Figure 19) to ensure consistency between gamified presentation and the cultural background of the course. At the same time, in order to cater to the age characteristics and aesthetic preferences of college students, some anime elements have been incorporated into the design. GDD provided a detailed explanation of the reasons

for choosing this style.

GDD provides systematic planning for game rules and task mechanisms, including point allocation rules, level design, and task completion standards. These contents are presented in a modular manner in the document, making it easy for developers to quickly access and apply them during the actual development process.

This study presents a peer evaluation mechanism for learners and develops an interactive model along with a framework for social interaction. The system is engineered to enable various interaction modalities between users and the system, as well as among users, hence enhancing learner engagement and fostering the development of learning communities and knowledge exchange.

Features of Interaction

An integration mechanism for discussion boards has been established to promote active engagement in conversations. The peer evaluation system improves collaboration and engagement among learners. The system has a dynamic feedback mechanism, enabling learners to obtain prompt incentives upon completing assessment assignments. The Gamification Design Document (GDD) offers a detailed account of the design specifications and expected outcomes of the interaction model and social interaction framework.

Selection of the Environment for Gamification Tool Implementation

This study meticulously evaluates the scenario aspects of MOOC learning and learners' usage preferences when determining the implementation environment for the gamification tool. Essential elements encompass the disjointed character of learning duration, elevated mobility, and frequently inadequate interactivity characteristic of MOOC settings. Consequently, significant importance is attributed to convenience, flexibility, and accessibility in the choosing of technology platforms.

Following a comprehensive comparison, the choice was made to create the research tools utilizing the WeChat mini program platform. This decision is influenced by WeChat's vast user base and elevated usage frequency as a predominant social

platform in China, along with its technological superiority and ecological compatibility. The platform provides an effortless user experience that necessitates no downloads and is readily accessible.

The WeChat micro program platform offers significant flexibility in functional design, facilitating personalized design and modular development. Furthermore, it facilitates comprehensive interactive functionalities, including real-time alerts, point rankings, task notifications, peer engagement, and data feedback. These features inherently augment learner engagement, foster ongoing learning practices, and reinforce social connections. By integrating the MOOC into the digital environment utilized by learners, the platform diminishes technical operational demands, while enhancing the accessibility and practicality of formative evaluation. The GDD provides a comprehensive account of the selection of the gamification platform and spatial configurations, delivering explicit direction and strategic assistance for effective development.

Narrative Construction and Engagement

This study established a narrative line that is highly consistent with the course content to enrich the gamification design and enhance learners' immersion in the learning process. This narrative design adheres closely to the central concept of "intangible cultural heritage inheritance," incorporating cohesive stories and character development aspects. The objective is to establish a situational, plot-centric learning environment that enhances engagement and appeal in MOOC education.

As the narrative unfolds, learners engage in a cultural odyssey of "preservation and inheritance," progressively unveiling new layers of material, exploring cultural settings, and fostering character development. This narrative method forges emotional links among the story, educational practice, and course material, offering cohesive logical coherence and substantial assistance for learning activities that may otherwise appear disjointed.

The GDD for "ShiYi · ChuanMei" provides a comprehensive elucidation of the concepts and content pertaining to narrative and character design, aiding developers

in grasping the overarching structure and creative trajectory of the project "Collecting and Transmitting Beauty" (see to Table 2 for specifics).

Table 2. Gamification Design Document of "Shi Yi·Chuan Mei"

Gamification Title	"ShiYi · ChuanMei" ：A Gamification Formative Assessment Tool for Intangible Cultural Heritage MOOCs
Gamification Objective	By incorporating gamification mechanisms such as point-based feedback, emotional expression, avatar progression, blind box rewards, and leaderboards, this tool stimulates learners' intrinsic motivation by fulfilling their psychological needs for autonomy, competence, and relatedness—enhancing MOOCs engagement, formative assessment participation, and cultural identity.
Gamification Goal	Learners are expected to continuously complete course activities, assignments, and formative assessments (self, ongoing, peer) and accumulate points to drive the growth of their avatar until all learning is completed.
Observable Behaviour	● Participate in course audio/video and daily check-ins ● Complete post-lesson quizzes ● Submit assignments ● Engage in self, system, and peer evaluations ● Ask or respond to questions in the discussion forum
Conditions of Attainment	● Complete daily lessons, quizzes, and evaluations as planned ● Finish all 30 course sessions ● Submit no fewer than 10 semi-open personal assignments ● Complete at least 3 group projects
Degree of Attainment	● "On-time" completion earns base points; "timely" within 2 hours earns bonus points ● Assignment scores include base and like-based bonuses ● Answering or engaging with peers earns interaction points and bonus likes
If–Then–Else	If learners complete daily course and evaluation → Then they receive points and a blind box chance Else → All daily points and blind box eligibility are forfeited
How you reward learners	● Course-based rewards: Points are combined into a total used for leaderboard rankings and avatar upgrades, with tiered rewards at course end ● Blind box rewards: Daily task completion grants a blind box draw; earned points can be redeemed for gifts ● Visual feedback: The avatar "Xiao Cheng" evolves with points, unlocking appearances and story chapters; top leaderboard spots receive cultural badges
How you judge players	☑ Penalty： ● If learners fail to complete all learning and assessment tasks on a given day, they forfeit all learning points and blind box eligibility for that day. ● Leaderboard points will not be updated, and avatar progression is paused, forming a soft punitive feedback mechanism.

Play Interaction	☑ Avatar-based & Hybrid： ● Learners enter a narrative-driven gamified learning space through their avatar “Xiao Cheng”; ● Daily engagement is achieved by completing tasks, submitting assessments, and participating in interactions; ● Learners can view their current points, rankings, avatar growth status, and emotional feedback in real time; ● Exploration is enhanced via the blind box mechanism, and feedback is visualized through character evolution; ● In the peer assignment zone, learners can like, comment, and review others' work, fostering social collaboration and learning; ● Learning behaviors are synchronized with cultural storytelling and avatar progression, creating an immersive gamified experience.
Play Challenges & Types of Challenges	The gamification design incorporates challenge mechanisms such as “continuous course completion,” “non-periodic assignment submission” and “sustained point growth” , emphasizing a steady pace with frequent but manageable tasks. ● Knowledge acquisition and processing: Learners must master intangible cultural heritage content and apply it accurately in quizzes and assignments; ● Sustained effort and task persistence: Learners are required to complete daily tasks consistently throughout the learning cycle without interruption; ● Active interaction and community participation: Learners are encouraged to engage in peer assessment, liking, commenting, and teamwork to foster a lightweight social learning community.
Play Choices	Although daily tasks are mandatory, learners have autonomy in choosing course difficulty levels aligned with their abilities, selecting from multiple semi-open assignment topics, and deciding their submission timing. They may also choose whether to engage in peer interaction, such as liking others’ work, posting reflections, or asking and answering questions.
Play Control	The system enables learners to independently set their learning goals, select course difficulty levels, and manage their task pace (e.g., completing tasks at any time during the day). Learners can adjust their learning paths and emotional states in response to real-time feedback, and after completion, they can access personalized information such as rankings, self-assessment history, and avatar growth status.
Gamification Pacing	The gamification pace is tightly aligned with the MOOCs course schedule, adopting a “daily update + staged progression” model. New course tasks are released daily, triggering achievement feedback and avatar growth milestones, matching the pacing requirements of educational intervention designs.
In-game Movement & Gamification Platform	Operated via the WeChat Mini Program interface, using touch and swipe-based controls. ☑ Digital ☑ Online ☑ Moblie（WeChat Platform）
Story and Narrative	Concept Statement：This is a story about the growth of Xiao Cheng. He hails from Chenghua Village, a place rich in intangible cultural heritage craftsmanship. As traditional skills decline over time, he embarks on a journey to preserve these precious cultural memories, aspiring to become a new-generation inheritor of intangible cultural heritage.

General presentation of MOOC contents	ACT Pre-Class Preparation: Through Xiao Cheng's backstory and task introduction, learners conduct a self-assessment and choose an appropriate difficulty level. ACT In-Class Progression: Learners study content and take quizzes, receiving ongoing feedback. Upon completing tasks, they earn points and unlock a blind box draw. ACT Post-Class Extension: Learners submit assignments, engage in peer reviews, write reflection logs, and view performance data. Once milestone scores are met, Xiao Cheng's appearance and title evolve, and learners receive rankings and honorary badges accordingly.	
Specific Presentation of Learning Contents	What is the players' goal ?	To complete the "ShiYi·ChuanMei" course tasks, accumulate points through continuous learning, promote the growth of the virtual avatar Xiao Cheng, and ultimately develop both knowledge and identification with intangible cultural heritage.
	What do players need to know ?	Learners need to understand the course content (e.g., paper-cutting, Peking opera), the platform's usage, participation in formative assessment (self, ongoing, peer), the point system rules, and the avatar progression pathway.
	What do players want to know ?	Learners typically care about their task completion and point status, how to level up their avatar and unlock new appearances, how to improve their leaderboard ranking, how to earn blind box rewards, and how they compare and interact with peers.
	What do you want players to feel ?	The goal is for learners to experience fulfillment of basic psychological needs and immersion through the narrative and gamified formative assessment system, thereby triggering intrinsic motivation and sustaining task persistence and goal orientation in MOOCs learning.
Three level of emotional design	Visceral Level: The Chinese-style UI and animated avatar "Xiao Cheng" create a cultural atmosphere that stimulates learners' intuitive interest and sensory appeal. Behavioral Level: Through task adaptation, real-time feedback, and a point-growth system, learners are encouraged to form regular learning habits and maintain consistent participation. Reflective Level: Through modules such as pre-task self-assessment, reflection logs, peer interaction scoring, and ongoing feedback, learners are guided to reflect on their learning rhythm, knowledge acquisition, and participation. This enhances their metacognitive awareness and emotional regulation, supporting sustained engagement and achievement orientation in the MOOC environment.	

In Search for Suitable Gamification Maker

This study identifies Piggyback Network as a comprehensive digital technology service platform that consolidates many professional service providers in information technology, encompassing software engineers, UI designers, and both front-end and back-end developers. Their considerable expertise in digital product development and cross-industry project execution has proved indispensable.

Benefits of Collaboration

The partnership with Piggyback Network offers numerous benefits, notably their robust technical support, resource integration, and effective cost management. This assistance is essential for educational experimental initiatives functioning with constrained financial resources. The platform's wide market experience and comprehensive user input have allowed the development team to gain a deeper understanding of customer requirements, hence ensuring the project's quality, advancement, and cost management. This collaboration enabled the effective creation and introduction of the "ShiYi · ChuanMei" WeChat mini-program.

Team Structure

The "ShiYi · ChuanMei" mini-program development team of two software engineers and one UI designer from Piggyback Network.

Front-End Developer A:

- Educational Background: Bachelor's degree in Computer Science and Technology from a university specializing in science and engineering.
- Experience: More than six years in front-end development, with a focus on WeChat mini-program development and modular architecture utilizing JavaScript and Vue frameworks. A has engaged in the design and iterative development of several educational and public welfare mini-program initiatives.
- Responsibilities: Developing user-facing interfaces, executing interaction logic, integrating front-end and back-end data connections, and generating visual components. A facilitated seamless functionality and effective information access for users on the

WeChat platform, enhancing the user experience.

Back-End Developer B:

- Educational Background: Master's degree in Software Engineering from a reputable university.
- Experience: Extensive in system architecture design and database development, fluent in Node.js, Python, MySQL, and MongoDB.
- Responsibilities: Managing data processing and business logic on the server side, encompassing user identity management, tracking learning task completion, and overseeing formative assessment data. B also played a role in refining system interface performance and formulating data security measures, hence improving overall operational efficiency and security.

UI Designer C:

- Educational Background: Bachelor’s degree in Digital Media Design from the School of Art and Design at a comprehensive university.
- Experience: Extensive involvement in user interface and interaction design for cultural digital products, demonstrating proficiency in visual style enhancement and user experience optimization.
- Responsibilities: Defining the comprehensive UI aesthetic and graphical interface design for the WeChat mini-program. C incorporated the project's cultural style into the design of icons, color palettes, page layouts, and interactive animations. C created visual representations of tale characters, improving functionality and enriching the cultural ambiance, thereby reinforcing the course themes and gamification assessment framework.

Development Procedure

During the project's first phase, researchers conveyed development needs pertaining to course content, assessment configurations, and learner interactions via several video conferences grounded on preliminary design documents (GDD). Comprehensive dialogues with engineers and designers centered on the design philosophy and intricate functional specifications pertaining

to gamification logic, feedback systems, and user interface design.

Following the clarification of work assignments and timetables, the official creation of the "ShiYi · ChuanMei" WeChat mini-program began. During the development phase, researchers sustained continuous communication with developers concerning interaction experience, interface design, and functional execution. Significant attention was directed towards the cultural significance of content delivery and the practical modification of gamification components. The UI design sought to harmonize with the course's aesthetic while enhancing interface functionality for user intuitiveness and an engaging environment.

Ethical Considerations

In compliance with ethical review standards, the identities of the three technical staff members engaged in the system development have been anonymized. Their efforts have been important in establishing a strong and engaging learning experience via the "ShiYi · ChuanMei" mini-program.

GAMIFICATION FORMATIVE ASSESSMENT OF “SHIYI · CHUANMEI”

Design of Gamification Self-assessment

Self-assessment is a systematic evaluation process from the perspective of learners, which can reflect their cognition of their own learning abilities and their internal emotional experiences, such as feelings and experiences in MOOCs learning. Self-assessment is an important component of self-directed learning and plays a crucial role in enhancing the interaction between learners and MOOCs platforms. This study set up a self-assessment section before the start of each lesson, and learners can choose the corresponding difficulty level of the content based on the assessment results. This design not only helps students match learning content that is more suitable for their own level, but also enhances the personalization and sense of participation in the learning process.

Boud (1995) pointed out that clear goals are the foundation of self-assessment, and gamification goal setting can provide clear path planning, making it easier for learners to

understand and achieve their goals. In the first stage of self-assessment, this part allows learners to set specific learning goals for the day. These goals are presented in the form of gamification task cards, with different cards representing differentiated learning difficulties and corresponding rewards. Learners can choose the challenge difficulty based on their personal situation. This design aims to help learners gain flow experiences through moderately difficult learning tasks (Csikszentmihalyi, 1990), thereby enabling them to be more focused on the learning process and perceive continuous progress.

Figure 20 Login Interface Design of the "ShiYi · ChuanMei"

Figure 20 shows the launch and login interfaces of the WeChat mini program, featuring a ink style background and a simple icon layout that echoes the theme of intangible cultural heritage focused on in the course, enhancing the visual cultural affinity. The interface design emphasizes the intuitiveness of operation, avoids complex interaction steps, and reduces the threshold for first-time use. The color scheme and font selection refer to the "New Chinese" design style, enhancing visual recognition and cultural atmosphere, creating a good first impression for subsequent MOOC learning. The system uses anonymous login design, with the student ID as the unique identifier for learners to log in.

Clarifying learning goals and tracking learning progress can effectively enhance learners' intrinsic motivation and sense of participation. Hattie and Timperley (2007) pointed out that incorporating gamification elements into self-assessment tools can significantly enhance learners' engagement, while also improving their self-awareness and learning motivation. In the self-assessment process of this module, the system designed interactive gamified tests to assist learners in completing visually rich self-assessment questionnaires and providing feedback on the assessment results through a dynamic scoring system.

Before and after each class, the system will prompt learners to evaluate their current emotional state, learning progress, and satisfaction level. The system compares and tracks these self-assessment data horizontally and vertically, allowing learners to observe changes in their own state over time. This reflective process enhances learners' self-awareness, helps them to have a clearer understanding of their learning path, identify strengths and weaknesses in learning, optimize learning strategies, and improve overall learning outcomes (Nicol&Macfarlane Dick, 2006).

In addition, considering that self-assessment is essentially a continuous learning behavior, this module is designed to support learners in continuously conducting self testing and strategy adjustments throughout the entire MOOCs learning cycle. This cyclical self-evaluation mechanism helps maintain learners' long-term engagement and supports the dynamic improvement and continuous optimization of their learning strategies.

After logging in, the "ShiYi · ChuanMei" mini program provides learners with daily course content and pre class self-assessment functions, guiding them to complete state adjustment and task planning before learning (see Figure 21). The system has an adaptive learning mechanism that allows learners to choose from three difficulty levels: Easy, Middle, and Difficulty, in order to match their learning ability with the expected challenge level. Before the formal start of the learning task, the system pushes the "Daily Readiness Reflection Sheet" to learners in a gentle dialogue through the guiding language of narrative characters, guiding them to actively review their learning performance and gains from the previous day, evaluate personal satisfaction, and express their psychological expectations and motivation levels for the challenging task of the day. Through daily self-assessment and goal setting, learners can activate their self-monitoring awareness, adjust their learning pace and strategy choices, and provide personalized prerequisites for subsequent learning paths, achieving a dynamic balance between

ability development and goal achievement.

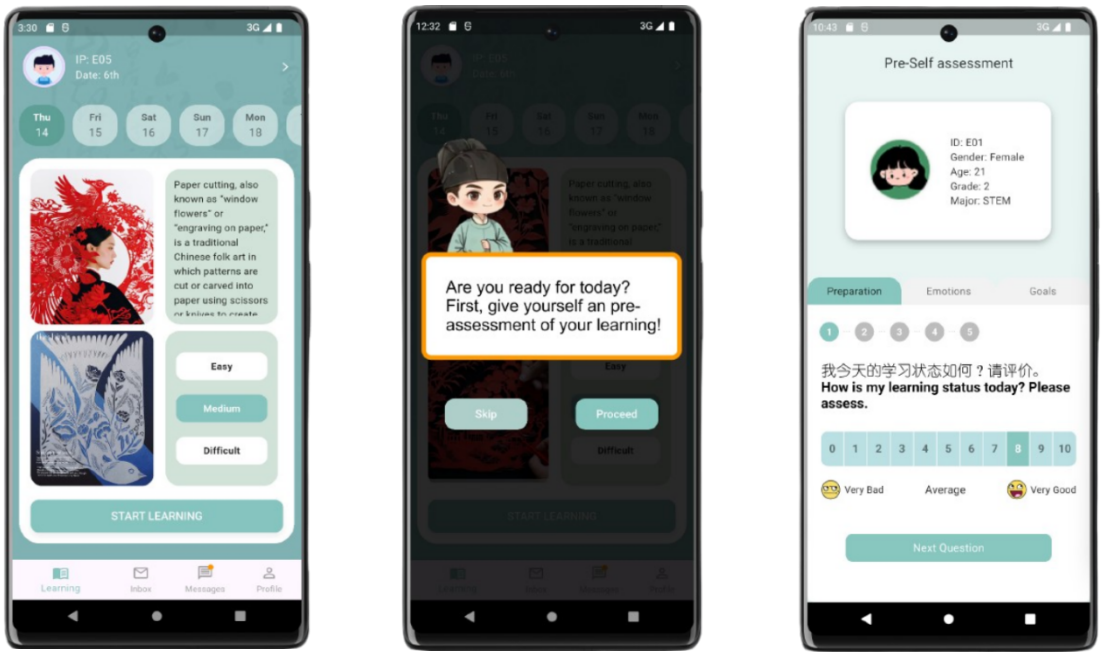

Figure 21 Pre-Learning Self-Assessment Design of the "ShiYi · ChuanMei"

Emotional assessment is also an important component of learners' self-assessment. This module adopts a gamification "Emotional compass" design, using cartoon style emoticons to guide learners to pay attention to and label their own emotional states at three key time points: "before learning", "during learning", and "after learning". This design aims to enhance learners' perception of emotional changes and use emotions as important reference clues to regulate learning pace. Through concise interactive methods, learners can express their emotions without the need for language input, which not only reduces the threshold for use but also enhances the fun and participation in the interaction. In the personal homepage, the system records learners' emotional annotations at different stages in chronological order and presents their changing trends through dynamic charts. This data-driven emotional visualization design helps learners to more intuitively perceive the dynamic changes in their own emotions, identify potential emotional fluctuations during the learning process, and further engage in self reflection and strategy adjustment based on the completion of learning tasks, thereby achieving more effective self-regulation in both cognitive and emotional dimensions (see Figure 22).

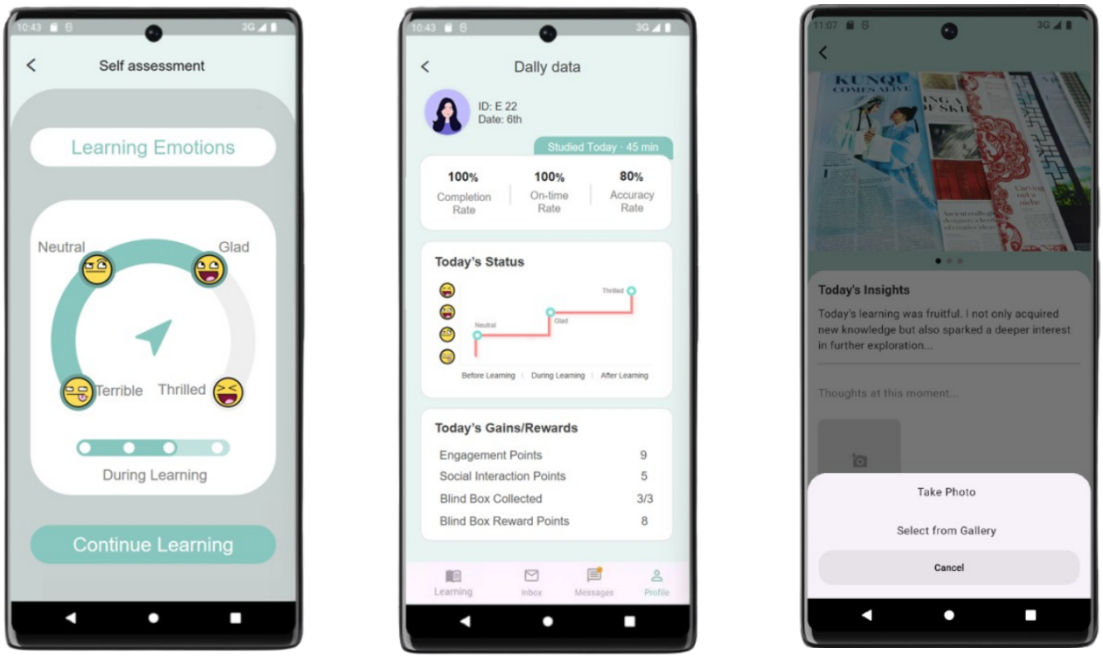

Figure 22 Emotional Self-Assessment and Reflection Log Design of the "ShiYi · ChuanMei"

In addition, as a classic educational tool for recording and analyzing individual learning and growth processes, the core value of learning reflection logs lies in helping learners deeply understand their own learning experiences, difficulties, and progress through writing and reflection. Through this reflective mechanism, learners are able to identify their own learning styles, perceive emotional changes, and gain improvement insights after completing their studies (Brown & Glover, 2022). To enhance learners' sense of reflection, participation, and willingness to express themselves, this module draws on the social function of WeChat's "Moments" and designs a publishing style sharing mechanism to encourage learners to publicly display their learning experiences in the form of text, images, or phrases, promoting feedback and dialogue among peers. This design not only promotes collaborative interaction among learners, but also contributes to the realization of knowledge sharing and the construction of a learning community on the "Picking up and Spreading Beauty" platform. Through multi-dimensional functional integration, the self-evaluation module significantly enhances learners' engagement and motivation, providing more comprehensive support for MOOCs learning (see Figure 22).

Design of Gamification On-going assessment

In traditional classroom teaching, on-going assessment is primarily implemented through teacher-led diversified evaluation activities. Specifically, teachers integrate various forms such as in-class quizzes, assignment critiques, and classroom discussions to construct a multidimensional evaluation system. Within such instructional contexts, these assessment activities typically adhere strictly to a predetermined course schedule, requiring students to complete corresponding assessment tasks at fixed time points, thus exhibiting strong structural and synchronous characteristics. In contrast, on-going assessment in MOOCs environments presents markedly different features. It is often realized through intelligent assessment tools provided by MOOCs platforms, which not only effectively substitute for certain evaluative functions traditionally performed by teachers but also leverage technological advantages to deliver immediate and accurate feedback. Learners can autonomously decide when to participate in assessments according to their personal learning pace and time management, resulting in an unprecedented level of flexibility and personalization in the assessment process. This innovative mode of assessment offers dual advantages: on one hand, it significantly improves the efficiency of assessment activities; on the other, it provides a practical solution for personalized learning support in large-scale online education settings, achieving a balance between "scale" and "individualization."

In-class quizzes and after-class assignments are two typical forms of on-going assessment. In-class quizzes serve as immediate diagnostic tools, with the core function of dynamically monitoring learners' comprehension and mastery of current knowledge points during the instructional process. They help learners promptly identify cognitive biases and knowledge gaps in their learning, while also providing instructors with reliable data for adjusting teaching strategies and designing personalized tutoring plans. After-class assignments, on the other hand, offer opportunities for extended assessment. They not only allow learners to apply and practice knowledge, promoting the consolidation and deep internalization of classroom learning during extracurricular time, but also serve to objectively evaluate students' self-directed learning abilities and their understanding and transfer of knowledge.

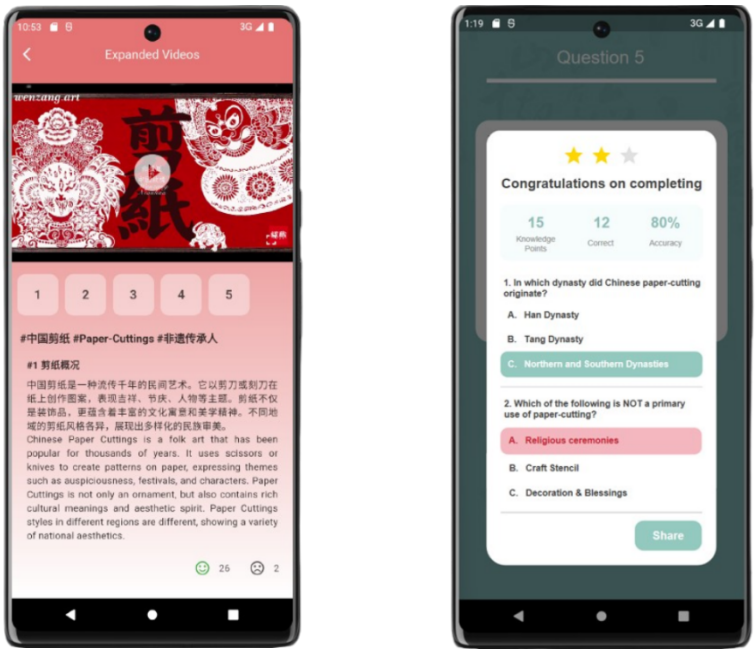

Figure 23 In-Class Quiz Design for On-going Assessment in the "ShiYi · ChuanMei"

In this study, on-going assessment integrated both in-class quizzes and after-class assignments. After completing the day's course content, the system automatically launched an in-class quiz, with questions matched to the learner's selected difficulty level and composed of five multiple-choice questions. Upon completion, following the submission of the randomized quiz, the system activated a gamification on-going assessment feature. This function provided immediate feedback based on the learner's accuracy and knowledge mastery, converting the quiz scores into corresponding academic points. These points helped learners monitor their learning progress and optimize their learning strategies. The after-class assignments adopted a semi-open task format, encouraging learners to engage in diversified creative extensions based on the day's intangible cultural heritage content. These tasks included collecting and publishing related cultural products, practicing intangible heritage skills, or using technological means for secondary creations. The module recorded the frequency of assignment submissions and publications, and these data were also incorporated into the academic points system (see Figure 23), which was used to track learners' participation and daily achievements. Moreover, the system allowed learners to compare their personal learning data against the overall learning

objectives, helping them identify their position within the broader learning path. In the personal homepage of the "ShiYi · ChuanMei" mini-program, the personal data statistics function provided a detailed analysis of various learning indicators, including total study time, task completion efficiency, accumulated academic points, and leaderboard rankings. These visualized statistical data helped learners intuitively and comprehensively understand their learning performance.

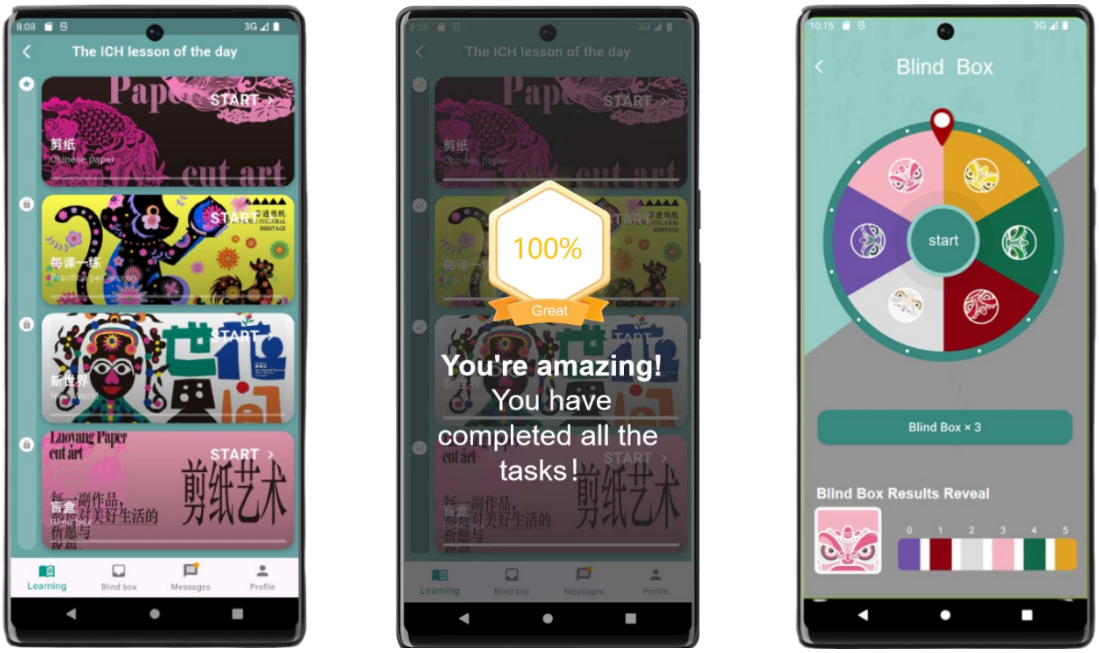

Figure 24 Progress Bar Design and Blind Box Reward Design in the "ShiYi · ChuanMei"

To enhance the sense of structure, progress, and sustained motivation of learning tasks, the "ShiYi · ChuanMei" mini program incorporates various gamification design elements into the learning path. Firstly, the system has set up a visual progress bar and course unlocking mechanism on the "Today's Collection" page, guiding learners to complete tasks in the set order and monitor their personal learning progress in real time, enhancing the stage and sense of achievement of tasks. Learning tasks need to be gradually unlocked according to the preceding content, creating a challenging and progressive learning rhythm. After completing all learning tasks, the system immediately presents a full screen feedback interface, displaying completion

rates and learning duration in the form of badges, accompanied by encouraging language to enhance learners' self-efficacy and positive emotional experiences. To further enhance participation enthusiasm and daily check-in motivation, the system introduces a "blind box reward" mechanism: learners who complete the daily learning tasks within the specified time will have the opportunity to draw blind boxes. The blind box interface adopts a rotary interactive design, combined with culturally rich icon elements, making the reward process more interesting and visually attractive. Each draw can also earn corresponding 'blind box points', which can be used to obtain badges and redeem rewards, forming a gamification learning loop that combines instant feedback and delayed incentives (see Figure 24).

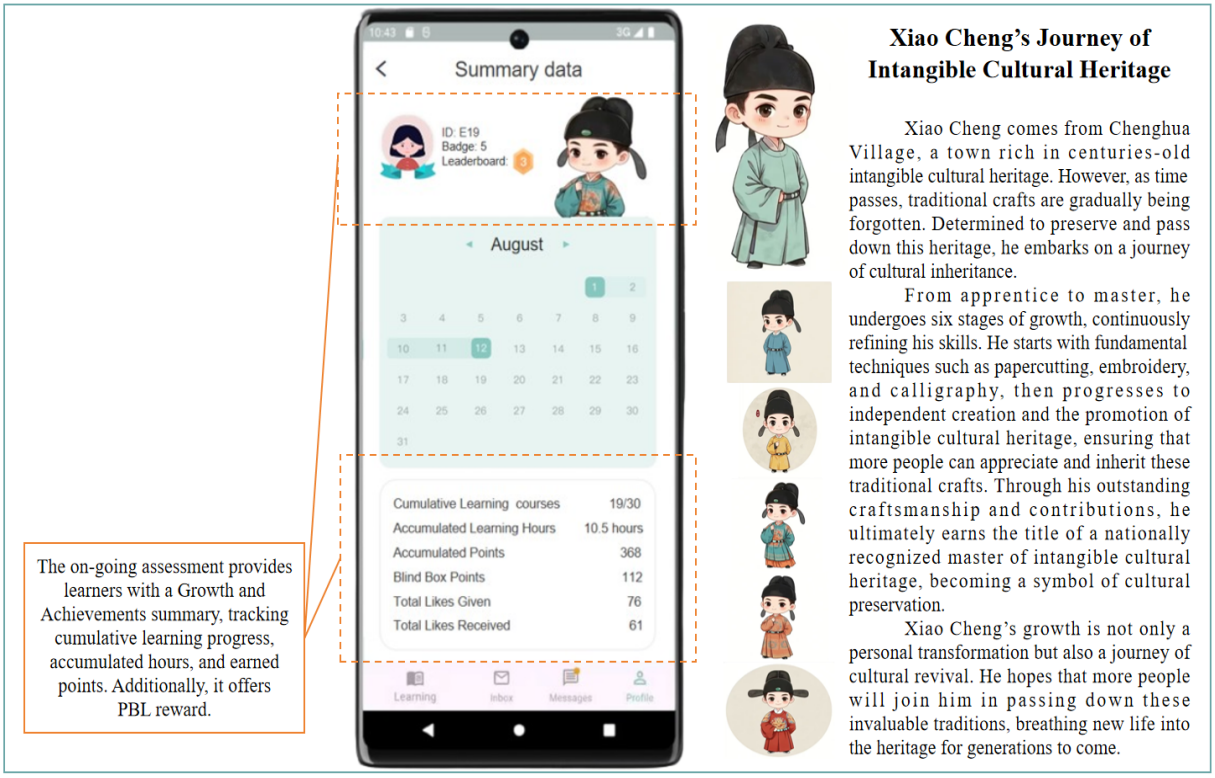

Figure 25 Virtual Character Growth and Narrative Interaction Design in the "ShiYi · ChuanMei"

As shown in Figure 25, the virtual character growth mechanism is another important gamification design in "ShiYi · ChuanMei". This study sets up a virtual character "Xiao Cheng" representing intangible cultural heritage inheritors, whose growth path is dynamically linked to

the real learning behavior of learners on the platform. The system displays multidimensional data of learners on their personal homepage, including cumulative learning days, total learning time, accumulated points, and likes and interactions, comprehensively recording their learning progress and participation performance. When learners complete course tasks, participate in project quizzes, or engage in peer interactions, the system will correspondingly increase their score performance. The accumulation of points will promote the phased growth of "Xiao Cheng" in skill levels, appearance, and storyline. This gamification design deeply integrates learning behavior with the process of developing virtual characters, providing learners with visual growth feedback. It not only enhances the sense of goal and achievement in the learning process, but also brings emotional connections through character immersion, allowing learners to experience continuous improvement of their own abilities while promoting character growth. In the gamification narrative experience, learners gradually establish a sense of identity and willingness to participate in the inheritance of intangible cultural heritage.

Design of Gamification Peer assessment

Peer assessment is an important component of formative assessment, which allows learners to evaluate and provide feedback on their peers' homework or performance. This process usually includes the following steps:

Homework submission: After completing designated assignments or projects, learners submit them to teachers or online platforms.

Task allocation: The system randomly assigns the homework to other students for evaluation, and the allocation method can be a combination of platform automatic distribution or learner self claimed mode.

Evaluation feedback: Reviewers rate peer assignments based on pre-set evaluation criteria and provide constructive improvement suggestions.

Feedback integration: Teachers or platform systems summarize the evaluation results of all parties and generate comprehensive learning analysis reports based on self-evaluation and peer evaluation data.

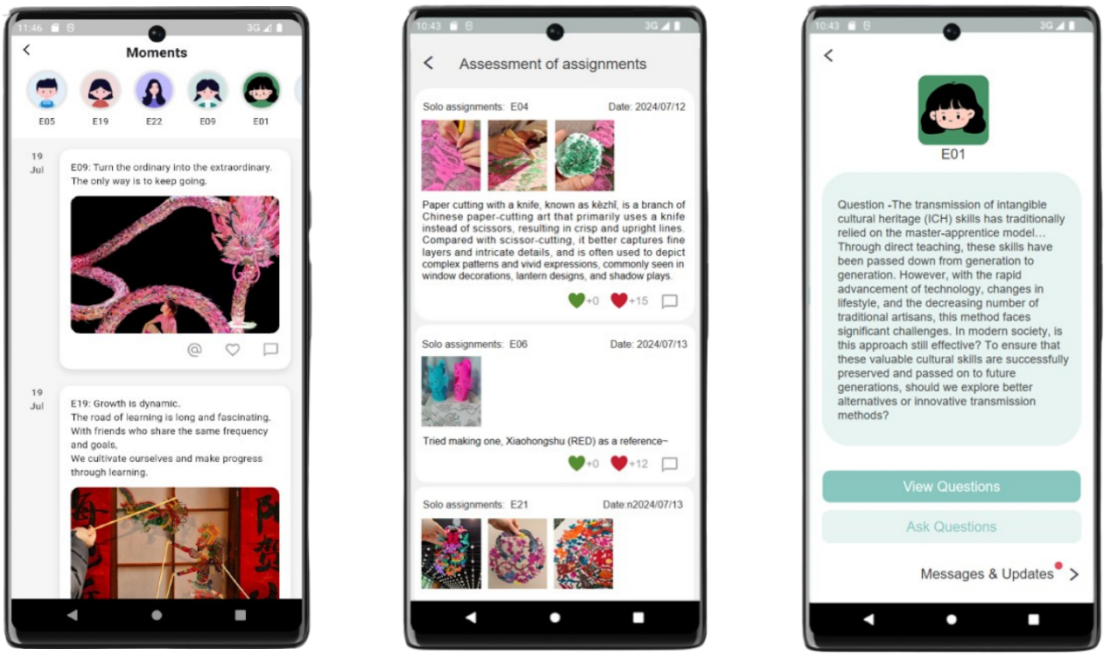

Figure 26 Peer Assessment Design in the "ShiYi · ChuanMei"

In this study, the peer assessment module of the "ShiYi · ChuanMei" mini-program innovatively adopted a design model similar to the WeChat Moments feature, integrating gamification elements to enhance learner engagement and interactivity. Learners could not only upload their after-class assignments and learning logs to the "virtual Moments" space within the mini-program but also browse and evaluate content posted by other learners, participating in interactive discussions through the commenting function. For example, after completing an assignment, learners could post it to the mini-program's Moments space, where other users could provide different levels of "likes" based on preset assignment evaluation criteria, while also sharing emotional responses and learning insights. This design not only fostered positive interactions among learners but also provided timely peer feedback.

To reinforce this gamification interaction experience, the module incorporated a points system to track and record peer assessment activities. Specifically, the ongoing assessment module automatically monitored and recorded the number of likes received and given by learners. These data provided learners with immediate feedback on their social participation and the popularity of their assignments and were linked to the points system’s interaction scores. The

accumulation of likes and corresponding points served as a direct reflection of learners' activity levels and performance within the course, encouraging continuous improvement and proactive participation, thereby promoting a positive cycle of autonomous learning.

In addition, this design allowed learners to view their overall performance data within the virtual Moments space, including total number of likes received, assignment popularity scores, and comparisons with other learners. The ongoing assessment module also recorded and displayed peer assessment data, providing learners with real-time feedback (see Figure 26).

Based on the results of the instrument interview, "ShiYi · ChuanMei" was designed a score ranking module, which dynamically sorts based on learners' score performance. The ranking list uses layered medals to identify different rankings, and combines the "My Ranking" positioning function and daily update mechanism to visually present learners' current scores, rankings, honors, and other information. This gamified design enhances interactive feedback and group comparison during the learning process, helping learners to clearly recognize their relative position in the learning group and stimulate their learning motivation through moderate competition and achievement guidance (see Figure 27).

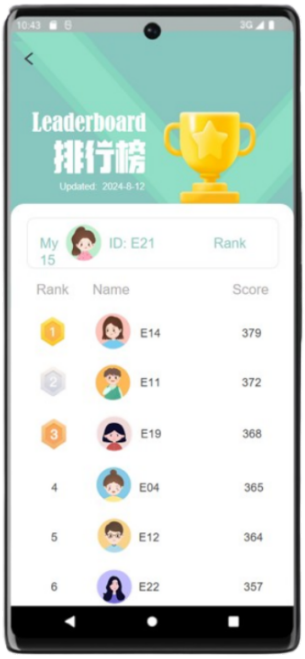

Figure 27 Leaderboard Design in the "ShiYi · ChuanMei"

VALIDITY AND RELIABILITY OF “SHIYI · CHUANMEI”

Content Validation by Interviewing Culture Expert

In order to ensure that the content design of "ShiYi · ChuanMei" meets the basic requirements of intangible cultural heritage education, this study invited cultural expert researcher Meng to conduct expert validity verification on the reliability and effectiveness of the course content. Researcher Meng is a researcher at the Fujian Provincial Political Consultative Conference Cultural and Historical Research Institute and an expert at the Minjiang Cultural Think Tank. She has been engaged in research related to intangible cultural heritage for a long time and has published multiple cultural monographs such as "Centennial Tea Port" and "Fuzhou in Homesickness". She has profound theoretical literacy and practical experience.

The content verification process adopts expert interviews to obtain professional feedback from Researcher Meng on the "ShiYi · ChuanMei" content part in a semi-structured interview format. The interview questions mainly revolve around the following aspects:

Basic information introduction: Introduce the background and research objectives of the "Collecting Heritage and Spreading Beauty" project to content experts, clarify the learning objects and design intentions of the course;

Relevance, clarity, and comprehensiveness of content: Evaluate whether the content design accurately conveys the core values of intangible cultural heritage, including whether the displayed intangible cultural heritage content is true, accurate, and in line with current academic consensus; Whether the content expression is clear, whether it covers the expected teaching materials, and whether it is suitable for the cognitive characteristics of college students;

Structure and Design of Tools: Evaluate whether the overall content structure and design logic of the mini program meet the needs of educational dissemination, including whether the logical relationships between content modules are clear and whether they can effectively guide learners to engage in orderly learning and interaction;

Overall evaluation and improvement suggestions: Invite experts to provide comprehensive evaluations of the overall content module and design, and provide targeted optimization suggestions to enhance the scientific and educational effectiveness of the tool.

Researcher Meng fully affirmed the performance of the "Collecting Heritage and

Spreading Beauty" project in terms of content design, believing that the project effectively integrates the core elements of intangible cultural heritage and gamified design concepts, and has significant cultural and educational value. Based on the interview framework, she provided the following specific feedback and suggestions:

Add multimedia courseware. Although the existing text-based course content design is relatively complete, she suggests adding multimedia courseware such as audio and video to adapt to the preferences of different learners. This not only enhances interactivity and fun, but also allows learners to understand the content more intuitively.

Adjust the structure and interface. The overall structure of the mini program is clear, the user interface is friendly, the course content is well organized and rich, and it can effectively guide learners to participate in content learning. But she pointed out that making some minor adjustments would help further optimize the user's navigation and interaction experience.

Instructions for using the enhancement tool. She suggested adding explanatory content to specific modules in the evaluation tool and highlighting operation icons in each section, so that learners can quickly understand and efficiently use the relevant functions.

According to the feedback from Researcher Meng, the research team has optimized and adjusted the design of the "ShiYi · ChuanMei" content module, including refining the description, classification, and presentation of intangible cultural heritage content to better align with educational goals and further enhance the learner experience.

Design Validation by Interviewing Design Expert

To ensure the effective application of gamification principles and compliance with the requirements of modern human-computer interaction design and intangible cultural heritage education in the design of the "ShiYi · ChuanMei" WeChat mini program, this study invited Associate Professor Wang from Fuzhou University to conduct design validity and reliability verification. Associate Professor Wang specializes in human-computer interaction design, persuasive design, and design expression techniques. He has rich research experience in the fields of human-computer interaction and gamification design. He has published academic papers such as "Exploration of Design Methods for Intangible Cultural Heritage Products" and "Review of Persuasive Design Research", and has won the Excellent Designer Award at the

"2022 7th Strait Cup Design Competition". He has a solid theoretical foundation and practical expertise.

Design validation was conducted through expert interviews, using a semi-structured interview method to obtain professional feedback from Associate Professor Wang on the design of "ShiYi · ChuanMei". The interview questions focus on the following dimensions:

Basic information: Explain to design experts the research background and objectives of "ShiYi · ChuanMei".

Effectiveness of gamification elements: Evaluate the rationality and attractiveness of gamification mechanisms such as mini program point systems, achievement rewards, virtual character growth, and leaderboards, and determine whether they effectively stimulate user participation and enhance interactive immersion.

Consistency of Interface Design Aesthetics: Testing whether the interface design conforms to the theme of intangible cultural heritage, whether the visual representation can attract target users (university students), and whether the interface style remains consistent.

Interaction Logic and User Experience: Analyze whether the interaction logic of the mini program follows gamification design principles, whether the operation process is smooth and intuitive, and whether the functional design can effectively guide learners to complete tasks.

Overall evaluation and suggestions: Obtain overall opinions on the gamification design and implementation of mini programs, and collect optimization suggestions to enhance the learner experience and educational value.

Associate Professor Wang evaluated the design of "ShiYi · ChuanMei" as complete and effective, fully affirming its excellent application of gamification principles—successfully stimulating learners' interest and promoting the dissemination of intangible cultural heritage. At the same time, he pointed out that the design has significant advantages in integrating gamification mechanisms with intangible cultural heritage education. He puts forward the following specific suggestions for gamification design and learner experience:

Gamification elements: The existing system of points and reward mechanisms can effectively drive users to complete learning tasks. It is recommended to add personalized reward content to further enhance users' sense of engagement and achievement.

Virtual character growth design: The current growth mechanism is well connected to the user's learning progress, and it is recommended to enhance the immersive experience through

animation or visual prompts to strengthen dynamic feedback.

The aesthetic consistency of interface design: The overall interface design is more in line with the theme of intangible cultural heritage, but he suggests strengthening the traditional cultural elements that young people love on the homepage to better attract users' attention.

Page layout optimization: Especially in the design of task completion feedback pages, more layered visual presentations (such as color changes or special effects) can be used to enhance the immediacy and satisfaction of rewards.

Interaction logic and user experience: The overall task operation process is clear, but for more complex tasks (such as open-ended learning tasks), it is recommended to provide step-by-step guidance to improve user understanding and operational convenience.

According to an interview with Associate Professor Wang, this study optimized the gamification design and interactive functions of "ShiYi · ChuanMei". The adjustments include enhancing dynamic feedback during the growth process of virtual characters, enriching personalized reward mechanisms, improving the visualization of learning and growth, strengthening guidance for complex tasks, and further enhancing the compatibility between interface design and intangible cultural heritage themes. These improvement measures have effectively enhanced the gamification experience and cultural dissemination effect of the mini program.

Course Validation by Interviewing Education Expert

In order to ensure the rationality and effectiveness of the gamification education design of the WeChat mini program "ShiYi · ChuanMei" in supporting the educational goals of intangible cultural heritage, this study invites Associate Professor Yang from Fujian Normal University to verify the reliability and validity of its design. Associate Professor Yang holds a PhD in Education, with research expertise in modern educational technology, educational game design, and development. He has published multiple academic papers, such as "Balancing cognitive complexity and gaming level: Effects of a cognitive complexity based competition game on EFL students' English vocabulary learning performance, anxiety and behavior (2020)" and "Developing a gamified artificial intelligence educational robot to promote learning effectiveness and behavior in laboratory safety courses for undergraduate students (2023)". In

addition, he has also hosted multiple related projects such as "Research on Teaching Innovation Models and Evaluation Methods under the Background of Intelligent Technology Integration in Fujian Province". Associate Professor Yang has a profound theoretical foundation and practical experience in educational technology and information technology, providing support for this verification work.

This study conducted design validation through expert interviews and used a semi-structured interview method to obtain professional feedback from Associate Professor Yang on the design of "ShiYi · ChuanMei". The interview questions focus on the following dimensions:

Basic information: Explain to experts the research background, objectives, and design framework of "Collecting Heritage and Spreading Beauty" to ensure that experts understand its educational application context.

Effectiveness of gamification education design: Evaluate specific gamification education applications such as mini program points system, virtual character growth, task modules, and reward mechanisms to determine whether they promote knowledge transfer and skill development, and effectively motivate learners to continue participating in MOOCs learning.

Integration of teaching content and gamification elements: Examining the degree of integration between course content and gamification design elements, analyzing whether gamification features have a positive effect on the educational goals of MOOCs, ensuring a balance between fun and cognitive load, and avoiding interference or increasing the burden on learners.

User engagement and learning behavior promotion: Evaluate whether gamification mechanisms enhance learners' autonomy and motivation, guide active exploration, and support differentiated learning rhythms and personalized needs.

Overall evaluation and suggestions: Conduct a comprehensive evaluation of the gamification design and educational value of mini programs, and propose optimization suggestions.

Associate Professor Yang recognizes the application of gamification educational design in "ShiYi · ChuanMei", pointing out that it effectively integrates gamification mechanisms with intangible cultural heritage education. He appreciates the program's rich content, clear educational goals, and excellent performance in task driven design and incentive mechanisms.

Based on the interview framework, he proposed the following specific suggestions:

Task difficulty: Some tasks are relatively simple and may be difficult to maintain the interest of high-level learners. Suggest designing multi-level difficulty tasks and adding an "adaptive task" function to dynamically adjust the challenge level based on learner performance, thereby enhancing the sense of achievement and engagement.

Integration of teaching content and gamification elements: Although educational content is closely integrated with game mechanisms, it is recommended to further optimize the presentation of knowledge points and enhance the sense of scene and immersion in the learning process.

Learner participation and learning behavior: Introducing a visual feedback function for learning behavior to enhance the interaction and emotional connection between virtual characters and learners, allowing learners to intuitively understand their learning progress and knowledge coverage, thereby enhancing their sense of participation and achievement.

Ensure that the use of gamification elements maintains a balance between fun and cognitive complexity, avoiding the impact of excessive consumption of cognitive resources on learning efficiency.

Enhance features to meet diverse user needs: To meet the diverse needs of users, he suggests developing auxiliary features such as collaborative learning tasks or group competition modes to enhance interaction and teamwork among learners.

According to Associate Professor Yang's professional feedback, this study further optimized the gamification educational design of "ShiYi · ChuanMei". The adjustments include: strengthening the adaptive design of phased reward mechanisms and task difficulty, enhancing the integration of educational content and gamification elements, optimizing the presentation and feedback of knowledge points, and introducing collaborative learning modes to enrich the learning experience. These adjustments significantly enhance the applicability and learner experience of the mini program in gamification education design.

Second Round of Expert Validation

After completing the first round of expert validation, this study proceeded with a second round of expert review to continuously ensure the overall quality of the developed

gamification formative assessment tool in terms of academic validity, user applicability, and operational feasibility. In the first round, three experts from different fields—namely course content, game design, and educational technology—were invited to provide evaluation feedback. Their assessments focused on specific aspects such as the appropriateness of the tool's content, the rationality of the gamification design, and the effectiveness of its educational functions. Based on the feedback received, the research team synthesized five core evaluation dimensions: content appropriateness, rationality of gamification elements, usability, technical feasibility, and educational effectiveness. A systematic evaluation framework for the second round of review was developed accordingly.

Following adjustments and refinements based on the first-round suggestions, and considering the complexity of gamification formative assessment tools, this study implemented a second round of expert validation by inviting doctoral students in relevant fields to serve as expert reviewers and pilot testers. A total of ten individuals participated in this round, including both PhD and PhD candidates. Among them, eight PhD candidates specialized in areas such as educational technology, gamification instruction, psychology, computer science, and cultural communication. To ensure a multidisciplinary perspective, two engineering PhD were also included. All reviewers possessed solid academic research backgrounds, and some had published in related fields. They were well qualified to conduct in-depth evaluations of the tool’s design rationality and practical applicability. In addition to serving as expert reviewers, they also acted as pilot testers by personally interacting with the tool and providing user-centered feedback based on their experience.

These doctoral participants assessed the face validity of the optimized gamification assessment tool across five key dimensions and provided acceptance decisions. The five dimensions included: surface representation alignment—whether the content presentation visibly corresponds to assessment goals; natural integration of gamification—whether the design and presentation of game elements are coherent, appropriate, and contextually aligned with the learning environment; operational intuitiveness—whether the interface layout and functional flow are clear and easy to use; technical smoothness—whether the tool performs reliably and renders visuals without technical barriers; engagement induction—whether the tool effectively stimulates learner engagement (see Appendix 5 for expert reviewer profiles and scoring forms).

The second round of expert review utilized a 5-point Likert scale to evaluate each

dimension. Results showed that the doctoral participants generally accepted and endorsed the tool's gamification design, affirming its effectiveness in meeting learners' psychological needs and enhancing motivation and flow experiences. The optimized real-time feedback system was found to significantly improve user interaction. However, some tasks were noted to require further adjustment to maintain an appropriate level of cognitive load. Reviewers reported a smooth interactive experience, with gamification features (e.g., task challenges, reward mechanisms) deemed attractive, and the UI design recognized for its aesthetic appeal and usability, contributing to sustained learner engagement.

By integrating expert evaluations with user experience data analysis, the optimization process of the gamification formative assessment tool was rendered more robust and evidence-based. The interdisciplinary backgrounds of the ten doctoral participants ensured the academic representativeness of the validation panel. Data analysis indicated that expert feedback had reached a saturation point (i.e., no new insights emerged from additional participants), thus confirming that the number of reviewers met the research requirements. Consequently, their feedback was adopted as the final basis for optimizing the experimental tool.

Official Validation for Publication at WeChat App

Before the official launch of the mini program, this research project passed the official review of the WeChat platform, confirming its compliance with WeChat's technical specifications and content standards. Firstly, the development team registered a mini program account on the WeChat public platform and submitted relevant qualification materials for identity authentication to ensure that the project subject has legal operational qualifications. Subsequently, the development team submitted the code and functionality of the mini program to the WeChat platform for strict technical review. WeChat has conducted a comprehensive evaluation of the functionality, user experience, and security of the mini program to ensure that it meets the platform's technical standards and security requirements.

During the review process, WeChat platform reserves the right to propose necessary adjustments or modifications to the development team to address potential technical issues or content non compliances. After review, "ShiYi · ChuanMei" was finally approved by the WeChat platform and officially launched for operation. Afterwards, the development team continued to

maintain and update the mini program to ensure its continued compliance with WeChat platform standards and meet user needs.

The official certification of WeChat not only ensures the reliability of the mini program in terms of quality and security, but also enhances its credibility among users. Given the authority and large user base of the WeChat platform, authenticated mini programs often have higher user trust and usage rates. This certification process is of great significance for ensuring the high-quality and standardized operation of MOOC based mini programs.

TESTING QUESTIONNAIRE FOR QUSIA-EXPERIMENT OF GAMIFICATION FORAMATIVE ASSESSMENT

The purpose of designing a test questionnaire in this study is to measure the changes in cognitive and emotional engagement of participants before and after experimental intervention. The investment in these two dimensions is crucial for understanding the sustained learning behavior of MOOC learners, reflecting their level of psychological effort and emotional connection in learning tasks. Unlike observable behavioral inputs such as task completion rate and login frequency, cognitive and emotional inputs are internal processes that cannot be directly measured through external behavior. Therefore, effective measurement tools are needed to capture changes in these internal psychological dimensions.

Sources of Items for the Cognitive Engagement and Emotional Engagement Scales

a) **Review of Research on the Measurement of Cognitive Engagement and Emotional Engagement**

Cognitive engagement refers to the psychological effort and strategies that learners invest in learning activities. According to the definitions provided by Fredricks et al. (2004) and Reeve (2012), cognitive engagement encompasses several key dimensions: autonomy, goal setting and competence, the value and relevance of learning tasks, self-regulation, effort, and the balance between skills and challenges. These dimensions collectively reflect learners' planning abilities, degree of investment, and adaptability within learning tasks, which are critical for deep

learning and sustained engagement. For example, Reeve (2012) emphasized that autonomy is a significant driving force of cognitive engagement, greatly influencing the degree of learners' psychological involvement; while Pintrich and De Groot (1990) pointed out that self-regulation and goal setting are essential mechanisms promoting learners' use of cognitive strategies.

In contrast, emotional engagement refers to learners' emotional responses and attitudes toward learning activities, including interest, enjoyment, sense of belonging, as well as negative emotions such as stress and anxiety (Reschly & Christenson, 2012; Skinner et al., 2008). The study by Fredricks et al. (2019) demonstrated that emotional engagement plays an important role in enhancing learners' sense of belonging and connectedness within the learning environment. Similarly, Pekrun et al. (2002) found that positive emotions (such as interest and enjoyment) significantly enhance learning motivation and engagement levels, whereas negative emotions (such as anxiety and stress) may interfere with learners' attention and persistence.

Although the importance of cognitive and emotional engagement has been widely recognized in academia (Guo et al., 2023; Wu et al., 2023), current measurement methods still face notable limitations and practical inconveniences, thus hindering theoretical advancement and practical application. Through a literature review across multiple academic databases including Scopus, Web of Science, CNKI, Elsevier ScienceDirect, and Google Scholar, this study found that existing measurement tools for online learning have yet to fully capture the unique patterns of engagement in MOOC environments—a view also echoed by Deng et al. (2020). Moreover, many studies still rely on behavioral indicators to measure cognitive engagement (Brinton et al., 2016; Hew et al., 2018). Other research employs content analysis or coding techniques: Atapattu et al. (2019) and Zhou & Ye (2020) utilized manual coding and traditional machine learning methods to detect learners' emotional and cognitive indicators in MOOCs. Chen, Ouyang, and Jiao (2022) applied content analysis to examine cognitive engagement in collaborative writing tasks. Wen (2021) developed a coding scheme based on the ICAP framework, using video coding to identify cognitive engagement. However, such methods are time-consuming and prone to sample imbalance issues. Although advanced deep learning-based natural language processing (NLP) models like BERT have achieved breakthroughs in text classification with high recognition accuracy (Devlin et al., 2019), their application requires substantial technical knowledge in computer science, which makes them difficult to adopt widely in educational research.

Some studies have explored the development of scales measuring cognitive and emotional engagement. Vongkulluksn et al. (2022) developed and validated the Cognitive Engagement Technology Scale. Heddy et al. (2018) created a scale to assess students' cognitive engagement during conceptual change learning processes, aiming to understand their cognitive investment when encountering new concepts or correcting previous misconceptions. This scale included dimensions such as motivational engagement, cognitive strategy use, metacognitive regulation, and emotional responses. Yaghoubisharif et al. (2023) developed a Social and Cognitive Engagement Scale for online STEM courses, covering five core dimensions: course knowledge, accessibility, connectedness, interactivity, and metacognitive regulation. Deng et al. (2020) developed the MOOCs Engagement Scale (MES), which included behavioral, cognitive, emotional, and social dimensions; however, its cognitive engagement section primarily focused on information searching and repetitive learning, lacking measures of higher-order cognitive strategies.

In recent years, the measurement of learners' emotional engagement has also attracted increasing attention from researchers. Ba and Hu (2023) highlighted that emotional engagement can be assessed by examining students' positive and negative emotions, their responses to learning challenges, and their sense of belonging, often through advanced techniques such as wearable devices. Petričević et al. (2016), in their study "Development and Validation of the Academic Engagement Scale (AES)," proposed the measurement of negative emotional engagement but primarily focused on emotional stress and anxiety, without fully considering the role of positive emotions in promoting learning engagement. Fujiwara (2020) developed a school engagement scale for junior high school students, emphasizing that emotional investment in the school environment and learning, such as feelings of interest and belonging, are key manifestations of emotional engagement. In the MES developed by Deng et al. (2020), emotional engagement mainly measured "interest" and "enjoyment," without delving into other emotional states such as anxiety, tension, or immersion. Parkins et al. (2024) developed the Sensory Emotional Engagement Checklist (SEE-C), proposing that emotional regulation, social interaction, and context adaptation are three important dimensions for emotional engagement measurement. Based on these prior studies, this study recognizes that the stability and applicability of emotional engagement measurements in MOOCs learning environments still require further optimization.

Given the existing structural ambiguity and fragmented tools for measuring cognitive and emotional engagement in MOOCs environments, this study, based on an extensive literature review, used retrieval results as references for item inclusion or exclusion. Four well-established measurement tools with high theoretical alignment and broad empirical support were comprehensively adopted: the Basic Psychological Need Satisfaction and Frustration Scale (BPNSF), the Intrinsic Motivation Inventory (IMI), the Flow State Scale (FSS), and the Self-Regulated Learning Questionnaire (SRLQ). This selection was grounded in the conceptual frameworks of cognitive and emotional engagement proposed by Fredricks et al. (2004) and Reeve (2012). Item-by-item comparison revealed that the dimensions and items contained within these scales adequately cover key aspects of cognitive engagement such as "value and relevance," "goal setting," "self-regulation," "challenge and effort," as well as core elements of emotional engagement, including "emotional responses during class, such as interest, anxiety, boredom," and "sense of belonging and relatedness." Together, these instruments form a comprehensive framework for assessing learners' psychological needs, intrinsic motivation, and flow experience, offering valuable insights into the internal mechanisms underlying learning engagement in MOOCs environments.

BPNSF Scale. The Basic Psychological Need Satisfaction and Frustration Scale (BPNSF), developed by Chen et al. (2015), measures the extent to which learners' three core psychological needs—autonomy, competence, and relatedness—are satisfied or frustrated. In recent years, the BPNSF scale has been widely used to investigate how the satisfaction of psychological needs within learning environments promotes learning motivation and sustained engagement. For instance, He et al. (2020) found that satisfying learners' psychological needs significantly enhances their cognitive and emotional engagement, while the frustration of these needs may lead to burnout and emotional distress.

IMI Scale. The Intrinsic Motivation Inventory (IMI), originally proposed by McAuley et al. (1989), is designed to assess multiple dimensions of intrinsic motivation, including interest/enjoyment, perceived competence, effort/importance, perceived control, and perceived value/usefulness. Recent studies have confirmed the continued applicability of the IMI in evaluating learning motivation and engagement. Deci and Ryan (2019) affirmed its validity, and recent studies have shown that dimensions such as interest and perceived value accurately reflect changes in learner motivation within gamified or technology-enhanced learning environments

(Chen et al., 2020; Schweder & Raufelder, 2022).

Flow Scale. The Flow Scale, developed by Jackson and Marsh (1996), measures various dimensions of flow experience, including challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration, sense of control, loss of self-consciousness, time transformation, and autotelic experience. Recent research has further validated the scale's effectiveness in assessing immersive experiences across different fields. The study by Nakamura and Csikszentmihalyi (2014) also supported its broad applicability.

In addition, this study noted during the literature review process that previous research has proposed various variables related to learning engagement, such as course accessibility, sense of connectedness, and anxiety. However, most of these variables semantically fall within the measurement dimensions covered by the three aforementioned scales. Therefore, to avoid structural redundancy and content overlap, this study introduced additional items only when they provided semantic novelty or theoretical supplementation, and conducted linguistic localization and moderate reorganization of existing items to improve the adaptability and operability of the measurement tools. For example, since cognitive engagement is widely recognized in the academic community to include elements of self-regulation, this study selected specific items from the Self-Regulated Learning Questionnaire (SRLQ) developed by Pintrich et al. (1991) to enhance the comprehensiveness, accuracy, and validity of the measurement. Only those items highly relevant to the context of this study were selected.

b) Evidence of Reliability, Validity, and Applicability for the Source Scales

In recent years, the Basic Psychological Need Satisfaction and Frustration Scale (BPNSF) has been widely used to assess the satisfaction and frustration of individuals' basic psychological needs, with its reliability and validity confirmed across various contexts. A study on the Arabic version of the BPNSF scale demonstrated excellent model fit for the six-factor structure (CFI = 0.95, RMSEA = 0.04) and high internal consistency across dimensions, with Cronbach's α values ranging from 0.75 to 0.91, indicating stable measurement performance across all dimensions (Zayed et al., 2021). Research on the Norwegian version further confirmed its strong structural validity, with Cronbach's α values for the six dimensions all exceeding 0.80. Additionally, the scale showed high validity in predicting individuals' life satisfaction and

psychological well-being (van der Kaap-Deeder et al., 2022). Another study conducted among Polish occupational groups also found that the six-factor model demonstrated good internal consistency, with Cronbach's α values ranging from 0.78 to 0.88 and McDonald's omega values all above 0.80, further validating the scale's reliability and stability (Szulawski et al., 2021).

As a classic tool for assessing intrinsic motivation, the Intrinsic Motivation Inventory (IMI) has demonstrated sound reliability and validity across various domains in recent years. Haerens et al. (2022) verified the structure and internal consistency of the IMI in the context of physical education, with all dimensions achieving Cronbach's α values above 0.70, indicating high internal consistency, while confirmatory factor analysis (CFA) further supported its structural validity. Morin and Ling (2023), in their study on high school students, also confirmed the IMI's strong predictive validity in relation to motivation and learning behavior, with subscale Cronbach's α values ranging from 0.73 to 0.86. Furthermore, Sheldon et al. (2021) conducted a cross-cultural study using multi-sample validation and found that the IMI maintained strong cross-cultural equivalence across different cultural contexts, with fit indices (e.g., CFI and RMSEA) meeting high standards of model fit.

The Flow State Scale (FSS) is a widely used psychometric tool for assessing individuals' flow experiences across various activities. In recent years, numerous studies have continued to validate its reliability and validity in diverse contexts, confirming its applicability and effectiveness across different populations. For example, Ottiger et al. (2024) developed and validated a rehabilitation-specific version of the Flow State Scale (FSSRT) to assess flow experience in stroke patients. Results indicated that all subscales achieved Cronbach's α coefficients above 0.80, demonstrating strong internal consistency, while confirmatory factor analysis supported its structural validity and confirmed its model fit within rehabilitation settings. Fang et al. (2023) revised the Dispositional Flow Scale (DFS) based on video game experiences and validated it among university students. Their findings showed Cronbach's α values between 0.85 and 0.90 across dimensions, indicating high consistency. Both exploratory and confirmatory factor analyses (EFA and CFA) further supported its structural validity and its effectiveness in assessing flow experience in gaming contexts.

The Motivated Strategies for Learning Questionnaire (MSLQ), as a classical instrument for evaluating learners' motivation and learning strategies, has been widely used in academic research, with its reliability and validity continuously confirmed in various studies. Liu

et al. (2023) examined the applicability of the MSLQ in online learning environments and found that all subscales demonstrated Cronbach's α coefficients exceeding 0.75, indicating high internal consistency. CFA further confirmed its structural validity, supporting its use in virtual learning contexts. González et al. (2022) validated the MSLQ in the context of STEM education to evaluate its effectiveness in predicting motivation and learning behaviors among high school students. Their results showed Cronbach's α coefficients ranging from 0.78 to 0.87 across dimensions, demonstrating good reliability. Structural equation modeling (SEM) further confirmed its predictive validity regarding academic performance.

Scale Reorganization

In order to adapt to the MOOCs learning environment and meet the needs of experimental intervention in this study, the dimensions of the BPNSF, IMI, and FSS scales were reasonably reorganized to focus on the core features of cognitive and emotional engagement. Although this study is based on the Self Determination Theory (SDT) and Flow Theory, there are intersections and overlaps between many psychological concepts. To avoid content redundancy and repetition, this study reorganized the scale based on its specific characteristics. The selected dimensions and their setting criteria will be explained below.

a) Dimensions of Cognitive Engagement

Cognitive engagement primarily reflects learners' mental investment, metacognitive awareness, and goal-directed behaviors during learning activities. After the restructuring of the scale, cognitive engagement is conceptualized as encompassing the following dimensions:

Dimension 1: Cognition of Autonomy. Autonomy plays a crucial role in cognitive investment, representing learners' sense of control and choice over learning tasks. A strong sense of autonomy fosters self-directed learning and enhances intrinsic motivation (Skinner et al., 2008; Ryan & Deci, 2017). In MOOCs, where external supervision is limited, learners' self-regulation of their learning paths is a core factor in maintaining engagement.

Dimension 2: Cognition of Competence. Learners' belief in their ability to successfully complete tasks enhances their level of cognitive engagement. A strong cognition of competence supports goal-directed behaviors and helps learners overcome learning challenges (He et al.,

2020).

Dimension 3: Cognition of Goals. This dimension assesses learners' ability to align their goals with their perceived competence. Clear learning goals and an understanding of task requirements are fundamental to cognitive engagement.

Dimension 4: Cognition of Effort. Effort reflects the time, concentration, and cognitive resources learners invest in tasks. It is a key external indicator of engagement, with higher levels of effort generally associated with deeper immersion and greater persistence in learning (Fredricks et al., 2019).

Dimension 5: Cognition of Value. When learners perceive the relevance of tasks to their personal goals, they are more likely to allocate cognitive resources and adopt adaptive strategies. This dimension examines how the perceived meaningfulness of a task influences sustained engagement and cognitive effort (Eccles & Wigfield, 2020).

Dimension 6: Cognition of Self-Regulation. Self-regulation refers to learners' ability to plan, monitor, and adjust their learning strategies based on task complexity and progress. High levels of self-regulation are associated with deeper cognitive processing and sustained engagement, especially in self-directed learning contexts (Zimmerman, 2002).

These dimensions collectively construct the measurement framework for learners' cognitive engagement. For example, cognition of value and competence reflect the degree of learners' task focus and adaptability to task significance and difficulty, both of which play key roles in predicting cognitive engagement (Lo, 2024).

b) Dimensions of Emotional Engagement

Emotional engagement focuses on learners' emotional experiences and connectedness during the learning process, reflecting their sense of belonging to the learning environment, positive emotional responses, immersive experiences, and the degree of interaction with peers. In MOOCs environments, which lack face-to-face communication, these factors are particularly critical for maintaining emotional engagement (Hew & Cheung, 2014). After the restructuring of the scale, emotional engagement is conceptualized as encompassing the following dimensions:

Dimension 1: Perceived Sense of Belonging. As a core dimension of emotional engagement, the sense of belonging reflects whether learners perceive themselves as integrated members of the MOOCs learning community. Studies have shown that a strong sense of

belonging enhances learning motivation and persistence by providing emotional security and social support (Ryan & Deci, 2017). When learners view themselves as valuable members of the learning community, they are more likely to form emotional bonds with the learning content and their peers.

Dimension 2: Perceived Affective Reactions. This dimension encompasses learners' enjoyment, interest, and emotional feedback regarding MOOCs learning activities. Positive emotional experiences (such as excitement and satisfaction) are closely linked to higher levels of engagement and sustained motivation (Fredricks et al., 2019). In contrast, negative emotions such as boredom, anxiety, or excessive stress may hinder emotional engagement. While moderate challenge can stimulate motivation, prolonged stress or tension may reduce learners' willingness to engage actively (Rani, 2025).

Dimension 3: Perceived Immersion. Emotional engagement is also influenced by the degree of immersion, referring to learners' level of concentration on learning tasks. The deep experience of "losing track of time" is a hallmark of the flow state, which simultaneously enhances both emotional and cognitive engagement (Csikszentmihalyi, 1990). In MOOCs, immersion plays a critical role in sustaining learners' attention and long-term commitment.

Dimension 4: Perceived Interactive Connections. This dimension highlights the emotional value of peer interactions within the MOOCs environment. Social engagement, including peer learning support and meaningful collaboration, fosters trust and mutual understanding, thereby reinforcing emotional engagement. Research has shown that learning interactions not only promote knowledge exchange but also enhance emotional well-being, persistence, and a sense of community identification among learners (Hew & Cheung, 2014).

These dimensions together construct the measurement framework for emotional engagement, encompassing positive/negative emotional states, social connectedness, and immersive learning experiences. Among them, perceived sense of belonging and perceived affective reactions capture learners' emotional feedback, while perceived immersion and perceived interactive connections reflect the depth of emotional involvement during the learning process. This multidimensional framework provides a comprehensive understanding of how learners form emotional connections with MOOCs.

SUMMARY

This book summarizes the design, development, and validation process of the gamification formative assessment tool for “ShiYi · ChuanMei”, with a focus on how to integrate gamification strategies in the MOOCs learning environment to support learners' continuous participation and improve learning outcomes. The study first completed the conceptual design of the evaluation tool, including content preparation, interview design, gamification design document preparation, and selection of the development team, laying a solid foundation for the successful implementation of the tool.

At the functional level, this book provides a detailed introduction to the design logic of the three core modules: self-assessment, on-going assessment, and peer assessment. These modules incorporate gamification elements aimed at enhancing the motivation, immersive experience, and engagement of MOOCs learners. Subsequently, multidimensional verification work was carried out, including content verification, design verification, and course verification, and official certification was obtained through the WeChat platform to ensure the standardization of the mini program in terms of technology and content. These verification steps provide strong support for the scientific reliability and applicability of the evaluation tool.

In addition, this book also introduces the measurement methods of cognitive and emotional participation, reorganizes the dimensions of the scale based on the theoretical framework, and uses the Delphi method to organize multiple rounds of expert consultations to ensure the validity and reliability of the scale. In the end, the "Collecting Heritage and Spreading Beauty" assessment tool achieved a deep integration of cultural, educational, and technological elements, providing a solid research tool for exploring the impact of gamification formative assessment on the sustained learning of MOOCs.

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Gamification in Formative Assessment Design (GAM-FAD)

eISBN 978-629-7673-87-5

UCSI Press