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Research on Game-based Teaching of History Subject to Promote the Adolescent Metacognitive Ability

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Abstract. Nowadays, the rise of streaming services has changed the way teenagers access entertainment content. At the same time, the aesthetic taste of young people has changed greatly, which requires classroom learning to integrate new elements to adapt to the psychological needs of current young students, so as to improve the overall effect of the classroom. it's crucial to innovate educational approaches, and game-based teaching has a large potential. This study is designed to explore the application of game-based teaching in the field of history, and to deeply research using the case of Chinese historical figure Zhang Jian. Through questionnaire and research analysis of adolescent students, it explores the impact of game-based teaching on their learning history. According to the study, through game-based teaching, students' interest in Zhang Jian and related historical events has significantly increased, and they know more about the historical knowledge. Moreover, game-based teaching also promotes the cultivation of students' teamwork and problem-solving abilities. Overall, this study concludes that: Game-based teaching significantly advances the learning of history among young people, providing feasible innovative approaches for educational practice.

Keywords: Game-based teaching; Metacognition ability; Teenagers; Discipline of history.

1. Introduction

Currently, students always keep silent in their classroom. Notably, students' negative silence often causes a "silence" in the classroom. It fails to ensure the quality of classroom teaching and couldn't form a positive interaction between teachers and students, which isn't a successful sign of teaching failure [1].

The students negatively keep silent in the classroom for many reasons. From the perspective of teachers, whether the teachers treat students with an equal attitude, whether the teaching content is too easy or difficult, and whether the teaching methods are too rigid and arbitrary can all affect whether students enter negative silence. Therefore, teachers not only need to construct their teacher identity through discourse [2]. Through Classroom Questioning, Teacher-student communication, Interaction, and Dialogue are conducted to stimulate students' Learning Motivation [3].

Nevertheless, from the perspective of students, the exercise of educational freedom is an objective need. Educational freedom indicates that education cannot suppress the personalized and autonomous development of students, providing them with ample opportunities for their thoughts and speech expression. In response to issues like scattered attention and habitual silence, only educational freedom is highlighted it's not enough to break the inevitable demand of student classroom silence [4]. The essence can be observed through phenomena: Traditional education lacks interest and goes against the aesthetic preferences of current and future adolescent students, thus losing its appeal to students. This requires teachers to adapt to students' new aesthetic needs and reconstruct classroom teaching methods.

Game-based teaching provides the possibility of reference for changing the situation of adolescent students in free and silent classrooms. Game-based teaching meets the youth aesthetic characteristics

and performance, utilizing their inclination towards digital entertainment to design learning processes that are more in line with game modes and attract their interest. Meanwhile, game-based teaching also integrates classroom knowledge into teaching., it innovates a teaching approach that can alleviate classroom silence, and stimulate students' learning motivation and participation by increasing fun, introducing competition and reward mechanisms, and other means. Based on "educational practice", emotional understanding is formed through practice and elevated to theoretical rationality, which is concretized into practical rationality that guides practice in practice [5]. Game-based teaching is innovative and interesting, which cultivates students' enthusiasm through game elements, integrates theoretical knowledge into practical operations, and ultimately circulates it in practice, thus significantly guiding and improving educational practice.

As a result, based on the relevant theories of gamification teaching, this study will analysis on Game-based teaching of history subjects to promote adolescent metacognitive ability through the experiment on the theme of "The Promotion of Historical Figure Zhang Jian on Middle school students' Learning ability".

2. Theoretical Foundation

2.1. Situational Cognitive Theory

It's a cognitive psychology theory that focuses on studying the cognitive processes and behaviors of individuals in specific contexts. This theory focuses on how individuals perceive, understand, remember, and solve problems in different contexts. [6]. This theory emphasizes the influence of context on cognitive processes. Different situations may trigger different cognitive strategies and behavioral patterns, therefore specific situations help understand an individual's cognitive process. Situational cognitive theory emphasizes the dynamism and plasticity of cognitive processes. Individuals may adjust their cognitive activities like attention, memory, and problem-solving strategies to adapt to the current environment when facing different situations.

2.2. Metacognition Theory

It's a theory about the cognition of the cognitive process itself in the cognitive process. It involves the individual's cognition of their cognitive activities, thinking processes, learning strategies, and problem-solving abilities. Metacognition is a cognitive process in which individuals consciously monitor and regulate their own cognitive processes.

Flavell considers that metacognition includes "metacognitive knowledge" and "metacognitive experience". This means that metacognition involves not only an individual's knowledge of their own cognitive processes, but also their perception and understanding of cognitive experiences [7].

According to Brown, metacognition is a model that combines motion and stillness, consisting of two parts: the static part of cognitive knowledge and the dynamic part of cognitive regulation [8]. This emphasizes the dual nature of metacognition, which includes both knowledge about cognitive processes and regulation and control of cognitive processes [8]. According to research results of Wang, Haertel, and Walgerg, among the 28 factors that affect student achievement, metacognition is considered one of the most important abilities that affect student learning outcomes. This indicates that metacognition plays a crucial role in learning and achievement [9].

Game-based teaching models often include tasks, challenges, and feedback mechanisms, which help cultivate students' metacognitive knowledge of task requirements and challenges. Students may need to continuously monitor their cognitive processes and adjust their learning strategies during the game, which can help develop metacognitive knowledge [10]. Game-based teaching provides opportunities for students to actively participate and regulate learning, which is crucial for developing metacognitive regulation abilities [11].

Game-based teaching often allows for personalized learning paths, taking into account the learning differences of different students. Personalized teaching can be conducted based on students' metacognitive level, learning style, and interests, thereby promoting their growth of metacognitive abilities.

3. Method

3.1. Research Approach

It sets multiple questions, which cover student grades, historical elective status, and understanding of Zhang Jian and his national salvation measures, thereby understanding the characteristics and cognitive level of the student population. By analyzing the results of the questionnaire, the level of understanding and expanded learning needs of different student groups towards Zhang Jian and his national salvation measures were revealed.

The authors use statistical tools, including SPSS software, to conduct reliability, linear regression, validity analysis, Analytic Hierarchy Process (AHP), chi-square test, and Pearson correlation, to verify the reliability and effectiveness of questionnaire survey data, and to explore the impact of different factors on students' understanding of Zhang Jian's industrial initiatives. Through the AHP, it implemented weight analysis on factors such as textbooks, extracurricular reading, visiting learning, and exchange learning, revealing the relative importance of each factor in students' understanding of Zhang Jian's industrial initiatives. Pearson-related visual analysis provides an intuitive visual representation for understanding the relationships between different variables. Based on the results of the questionnaire and empirical analysis, it has drawn conclusions on the impact of Zhang Jian and his national salvation measures on the student population, the urgency and necessity of expanding learning, the rationality of cultural and tourism learning models, and the emphasis on the development of history teaching models, providing strong data support for relevant educational reforms.

Through analyzing the specific impact of Zhang Jian and his national salvation measures on the student population, various factors and interrelationships in actual situations were revealed. By analyzing detailed case studies from multiple dimensions such as students' grade level, historical elective situation, and level of understanding, the case analysis method can provide more specific and profound contextual information, enabling researchers to understand more about the students' attitudes and cognition towards Zhang Jian. Throughout the research process, the application of case analysis method helps to combine theory with practical situations, providing deeper and more practical insights into the research problem.

3.2. Research Object

This study targets middle school students, with 46.4% of middle school students and 53.6% of high school students completing the questionnaire. The promotion significance of game methods for young children has been studied and explored by multiple scholars, but the research focuses on the adolescent group, namely middle school students.

3.3. Questionnaire Distribution and Recovery

The questionnaire was distributed 230 times, with 215 valid responses and an effective rate of approximately 93.5%. There were 196 responses, with a response rate of 85%.

3.4. Questionnaire Design

The idea of the questionnaire design is to investigate students' preferences for learning subjects, learning content, learning methods, etc. based on the research topic. It is not a single choice of liking or not liking gamified learning methods, but to provide multiple options, so as to conclude that game-based teaching has certain advantages and significance. By investigating various aspects of learners and the knowledge they receive, and combining and analyzing the results of the two, the authors can

determine from multiple perspectives whether game-based teaching can supplement and assist the problems and influencing factors in adolescent learning.

The questionnaire includes the level of interest of students in the history subject and gamified teaching methods, factors that students consider to affect their own learning, learning methods commonly used by students, which teaching methods students are more interested in, how they learned about Zhang Jian, and some basic information surveys. The questionnaire design utilized a logical model to separately study and analyze the causal relationships between influencing factors, while also using statistical models for data analysis to elaborate the conclusions.

4. Research Results

4.1. The Influence of Zhang Jian and His National Salvation Measures on Different Student Groups

Around this theme, a total of three questions will be set: ① Your grade level ② Are you taking history as an elective course ③ Do you understand Zhang Jian and his measures to save the country?

Table 1. Grade of sample

Option	Senior One	Senior Two	Senior Three
Your grade	12.5%	15%	72.5%

As indicated by Table 1, it shows that the student population participating in the questionnaire survey is composed of high school seniors, with a relatively small proportion of high school freshmen and sophomores but still maintaining a reasonable stock. The number of students who choose history is roughly the same among the student population, providing a feasible target for investigating the influence of Zhang Jian and his national salvation measures among different student groups.

4.2. The Urgency and Necessity of Expanding Learning on Zhang Jian and His National Salvation Measures

Regarding this topic, there are two questions: ① What are the sources of your understanding of Zhang Jian and his national salvation measures? ② Do you think it's essential to expand the learning of Zhang Jian's national salvation measures under the new college entrance examination model the student responses are shown in Table 2.

Table 2. Sample related knowledge of the channel

Option	What are the sources of your understanding of relevant knowledge
Textbook	96.88%
Extracurricular Reading	46.88%
Visiting and learning experiences in tourism, museums, etc	31.25%
Communicate and learn with teachers, elders and classmates	43.75%
Others	3.13%

Table 3. The sample's recognition of the subject

Option	Do you think it is necessary to expand the learning of Zhang Jian's national salvation measures under the new college entrance examination model
Yes	94.74%
No	5.26%

As indicated by Table 3, it shows that up to 96.88% of students understand the source of relevant knowledge from textbooks, while only 31.25% of students use visiting and learning experiences such as tourism and museums as sources of understanding. This to some extent reflects the completeness of high school history textbooks, but also exposes the lack of vividness and interest in historical learning using Zhang Jian's national salvation measures as an example. 94.74% of students are eager to expand their knowledge under the new college entrance examination model.

4.3. Emphasis on the Development of History Teaching Models

The authors need to set one question around this topic: ① What factors do you think affect your history learning?

Table 4. Sample the factors that affect the subject

Option	What factors do you think affect your history learning
Personnel interest	82.5%
Compilation of teaching materials	47.5%
Teaching method	62.5%
Teacher teaching	70%
Examination stress	40%
Others	0%

As indicated by Table 4, it shows that the factors that significantly influence students' history learning are personal interests and teacher teaching. It is not difficult to find that cultivating students' enthusiasm for history learning under the new college entrance examination model should start from interests, build a learning model based on vivid explanations in textbooks, and expand on research on cultural and tourism interests, form a two-way synergy, and promote the innovative development of history education.

4.4. Spss Analysis and Demonstration

Table 5. Cronbach reliability analysis

Name	Correction Item Total Correlation (CITC)	Deleted α Coefficient in the item	Cronbach α coefficient
Textbook	0.374	0.732	0.703
Extracurricular Reading	0.899	0.304	
Visiting and learning experiences in tourism, museums, etc	0.103	0.785	
Communicate and learn with teachers, elders and classmates	0.912	0.273	
Standardized Cronbach α coefficient: 0.692			

According to Table 5, the reliability coefficient value is 0.703, which is greater than 0.7, indicating that the reliability quality of the research data is good. Overall, it indicates that the reliability quality of the data is high and can be used for further analysis.

Table 6. Linear Regression Analysis Results (n=100)

	Unstandardized coefficients		Standardized coefficients	*t*	*p*	Collinearity diagnosis	
	B	Standard error	*Beta*			VIF	Tolerance
Constant	0.008	0.069	-	0.123	0.903	-	-
Textbook	0.409	0.075	0.411	5.436	0.000**	1.304	0.767
Extracurricular Reading	0.097	0.066	0.097	1.466	0.146	1.000	1.000
Visiting and learning experiences in tourism, museums, etc	0.466	0.075	0.468	6.228	0.000**	1.292	0.774
Communicate and learn with teachers, elders and classmates	0.134	0.067	0.134	2.000	0.048*	1.031	0.970
R 2	0.585						
Adjustment R 2	0.567						
F	*F (4,95)=33.442,p=0.000*						
D-W Value	2.305						
Dependent variable: Do you understand Zhang Jian's industrial initiatives and his entrepreneurial spirit							
* p<0.05 ** p<0.01							

As shown in Table 6, the regression coefficient value of the textbook is 0.409 (t=5.436, p=0.000<0.01), which means that the textbook will have a significant positive correlation with your understanding of Zhang Jian's industrial initiatives and his entrepreneurial spirit.

The regression coefficient value for extracurricular reading is 0.097 (t=1.466, p=0.146>0.05), which means that extracurricular reading will not have an impact on your understanding of Zhang Jian's industrial initiatives and entrepreneurial spirit.

Table 7. Validity Analysis Results

Name	Factor load coefficient		Commonality (common factor variance)
	Factor 1	Factor 2	
General secretary's speech	0.765	-0.190	0.622
Enterprise propaganda	0.073	0.977	0.959
Journals	0.959	0.187	0.956
Museum/exhibition	0.965	0.110	0.943
New media (Wechat public account and other platforms)	0.959	0.177	0.951
Feature root (before rotation)	3.423	1.007	-
Variance explanation rate % (before rotation)	68.470%	20.144%	-
Cumulative variance explanation rate %(before rotation)	68.470%	88.614%	-
Feature root (after rotation)	3.362	1.069	-
Variance interpretation rate %(after rotation)	67.239%	21.375%	-
Cumulative variance explanation rate %(after rotation)	67.239%	88.614%	-
KMO value	0.810		-
Barth spherical value	620.940		-
df	10		-
p value	0.000		-
Remarks: If the numbers in the table have colors Blue indicates that the absolute value of the load factor is greater than 0.4, and red indicates that the commonality (common factor variance) is less than 0.4.			

As shown in Table 7, validity research is used to analyze whether the research item is reasonable and meaningful. Factor analysis is a data analysis method used for validity analysis, which comprehensively analyzes indicators such as KMO value, commonality, variance explanatory rate value, and factor loading coefficient value to verify the validity level of the data. The KMO value is used to determine the suitability of information extraction, the commonality value is used to exclude unreasonable research items, the variance explanatory rate value is used to indicate the level of information extraction, and the factor loading coefficient is used to measure the correspondence between factors (dimensions) and items.

The values of corresponding commonalities of all the items are above 0.4, indicating that information on the items can be extracted effectively. In addition, with a KMO value of 0.810, which is greater than 0.6, the data can effectively extract information. In addition, the variance explanatory rates of the two factors were 67.239% and 21.375%, respectively, and the cumulative variance explanatory rates after rotation were 88.614%>50%. This indicates information on the items can be drawn efficiently.

Table 8. AHP Analytic Hierarchy Process Results

Item	Feature vector	Weight value	Maximum eigenvalue	CI value
General secretary's speech	0.931	18.615%	5.000	0.000
Enterprise propaganda	0.887	17.749%		
Journals	0.952	19.048%		
Museum/exhibition	0.996	19.913%		
New media (Wechat public account and other platforms)	1.234	24.675%		

Table 9. Cross (Chi Square) Analysis Results

Title	Name	Whether from Nantong, Jiangsu (%)		Total	$\chi 2$	*p*
		0.0	1.0			
Do you understand Zhang Jian's industrial initiatives and his entrepreneurial spirit	0.0	45(86.54)	5(10.42)	50(50.00)	57.853	0.000**
	1.0	7(13.46)	43(89.58)	50(50.00)		
Total		52	48	100		
* p<0.05 ** p<0.01						

As shown in Table 8 and Table 9, it can be seen that using chi-square test (cross analysis) to study the differential relationship between whether you are a native of Nantong, Jiangsu and whether you understand Zhang Jian's industrial initiatives and his entrepreneurial spirit. From the above table, it can be seen that: The sample of Jiangsu Nantong people showed significant differences ($p<0.05$) in your understanding of Zhang Jian's industrial initiatives and entrepreneurial spirit.

As Figure 1 shows, Nantong, Jiangsu or not shows a significant 0.01 level ($chi=57.853$, $p=0.000<0.01$) in the understanding of Zhang Jian's industrial initiatives and entrepreneurial spirit. By comparing the percentage differences, it can be seen that the proportion of choosing 0.0 for 0.0 is 86.54%, which is significantly higher than the proportion of choosing 1.0, which is 10.42%. The proportion of choosing 1.0 is 89.58%, which is significantly higher than the proportion of choosing 0.0, which is 13.46%.

In summary, people can know, that there are significant differences in whether the sample is from Nantong, Jiangsu, and whether people understand Zhang Jian's industrial initiatives and entrepreneurial spirit.

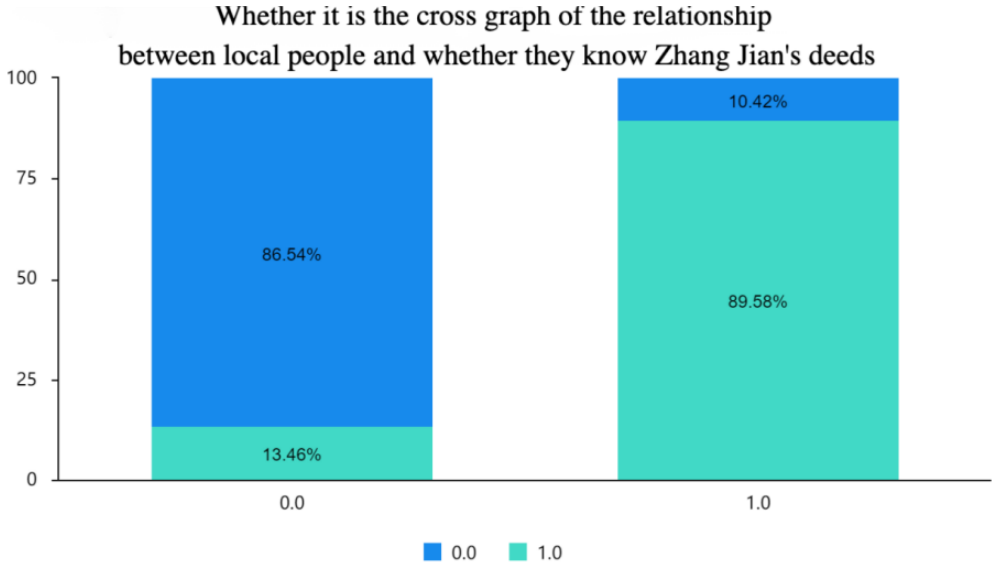

Figure 1. Cross analysis diagram

Table 10. Pearson Correlation

		Do you understand and highly recognize Zhang Jian's industrial spirit
Do you understand the spirit of Zhang Jian industry	Correlation coefficient	0.345*
	p value	0.015
	Sample size	49
Have you participated in any relevant lectures on Zhang Jian's industrial spirit	Correlation coefficient	0.672**
	p value	0.000
	Sample size	49
* p<0.05 ** p<0.01		

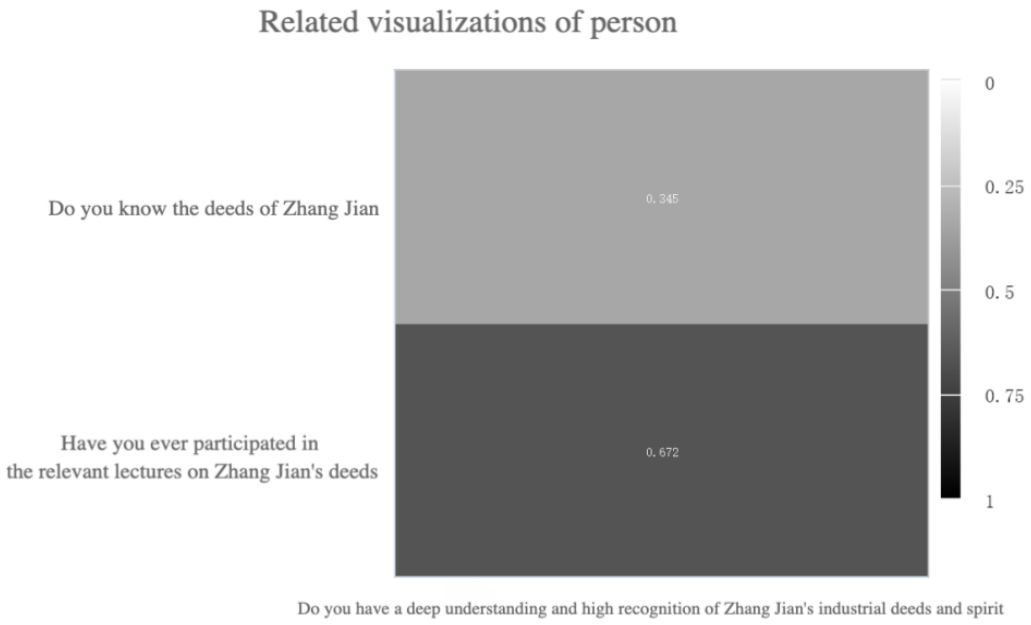

Figure 2. Related visualization of person

As Table 10 shows, based on the survey analysis of 50 respondents, people found that: The correlation coefficient between "understanding Zhang Jian's spirit" and "deep understanding and high identification" is 0.345, while the correlation coefficient between "whether one has participated in relevant lectures" and "deep understanding and high identification" is 0.672, significantly greater than 0.345.

As Figure 2 shows, both "understanding" and "participating in lectures" can have a positive impact on "profound understanding and high recognition". However, the correlation coefficient of 0.672 for "participating in lectures" indicates a strong positive correlation between "participating in lectures" and "deeply understanding and highly identifying".

4.5. Analysis Conclusion

In the SPSS analysis of students' understanding of Zhang Jian, the reliability coefficient value is 0.703, which is greater than 0.7, indicating that the reliability quality of the research data is good and can be used for further analysis. The regression coefficient value of the textbook is 0.409 (t=5.436, p=0.000<0.01), indicating that the textbook will have a significant positive correlation with whether students understand Zhang Jian's industrial initiatives and his entrepreneurial spirit. The teaching method of textbooks also involves the level of acceptance and interest of students, which in turn affects the learning effectiveness.

80% of the students in the questionnaire are interested in learning about history, and 85% are interested in integrating history learning into game modes. This reflects that the development and promotion of gamified learning modes meet the needs of middle school students, and this combination of game fun and knowledge learning has also attracted some students who were originally not interested in learning this subject, prove that this method has a certain effect on stimulating students' interest in learning.

In the survey of students on which form to combine with teaching, 80.79% of students chose interactive games and 65.56% chose animation. This data indicates that students are more inclined towards interesting, vivid, and interesting teaching methods. Compared to traditional lecture teaching, critical thinking, problem-solving, creativity, active learning, collaboration, and teamwork skills have become very important parts of talent cultivation in the 21st century. The key to cultivating these abilities for students is to enable them to participate in teaching, which is also in line with the method that students choose to be more inclined towards interactive games. The teaching method of interactive games provides opportunities for students to participate and regulate learning, and as per theoretical foundations, this is crucial for developing metacognitive regulatory abilities.

In the research on the factors that self consider to affect their own learning, the number of students who believe that personal interests have an impact on their own learning is the highest, accounting for 82.5%, followed by teacher factors and teaching methods, each accounting for 70% and 64.5%. This data indicates that the learning effectiveness of students in a certain subject is most associated with their personal interests. Based on the previous few questions, students show great interest in incorporating subject knowledge into games, and this method can enable students to actively participate in teaching activities and become active creators rather than passive receivers. Integrating subject knowledge into game modes is also a novel teaching method that can enhance the interaction between students and teachers, thereby increasing expectations for teachers. Game-based teaching methods can meet the most important factors that affect student learning, satisfy students' interest in learning, choice of teaching methods, and attitude towards teachers, thereby promoting student learning outcomes.

Based on the above survey data results, it shows that among the factors that can affect student learning, learning interest is positively correlated with teaching methods, with the greatest impact. The data shows that students show great interest in the combination of knowledge and interactive games, and can even attract students who are not originally interested in the subject. Therefore, teaching knowledge through games is feasible and has practical significance.

5. Teaching Cases

As Figure 3 shows, this teaching case sets the following objectives: Understand Zhang Jian's life, deeds, and historical background, enhance students' interest and understanding of historical knowledge, and cultivate their teamwork and problem-solving abilities. By introducing gamification elements such as role-playing, task challenges, and puzzle-solving, students will participate in the game with different historical character identities. The implementation steps include the introduction stage, role allocation, task challenges, and puzzle analysis to gradually guide students to delve deeper into the history of Zhang Jian. Through experiments, we have observed that students exhibit higher levels of participation and learning interest in game-based teaching They have deeply understood Zhang Jian's historical status and influence through role-playing, and have significantly improved their teamwork and problem-solving abilities. In teaching reflection, we believe that game-based teaching can stimulate students to participate in the study of history and provide a more interactive and interesting learning experience. Therefore, game-based teaching has potential educational value in the field of history, which can improve students' learning outcomes and subject literacy levels.

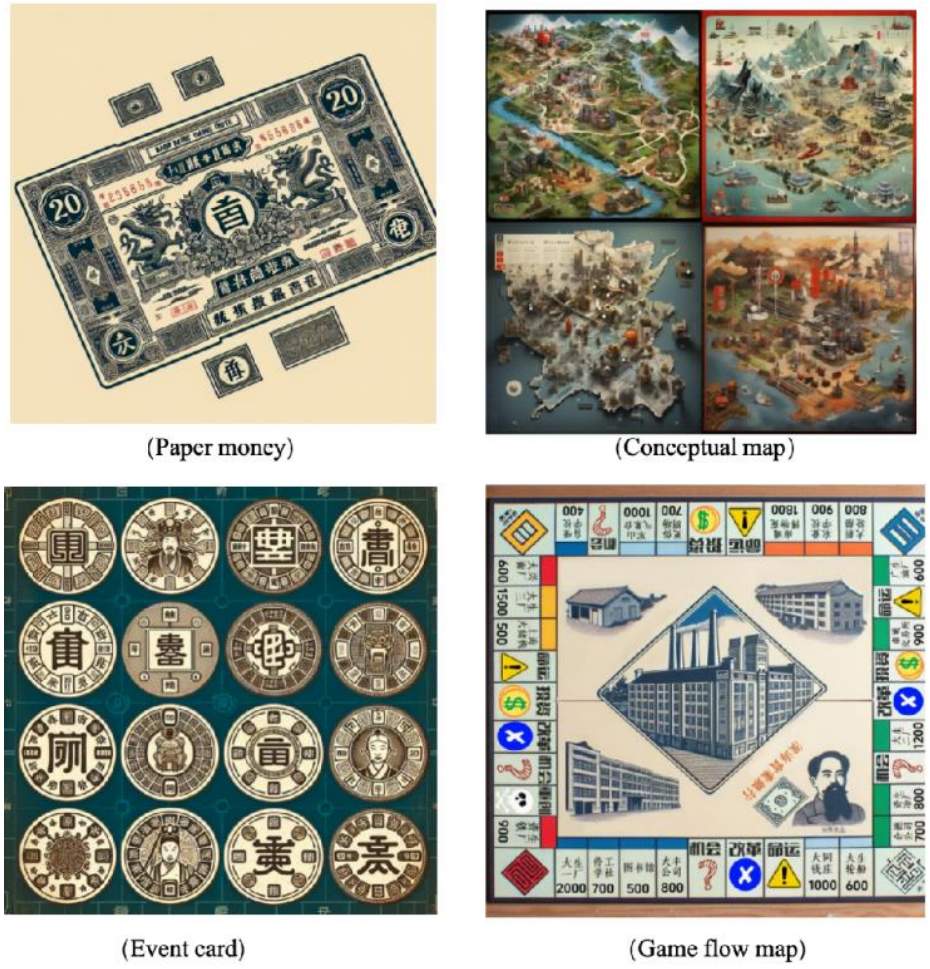

Figure 3. Teaching case design schematic diagram

6. Conclusion

Through this research, it proves that under the background of the development of the Internet and the media society, students' learning methods and required abilities are undergoing tremendous changes. The traditional one-way teaching method is no longer able to meet diverse learning needs, leading to frequent "silence" among students in the classroom. Faced with the challenge of constantly innovating teaching methods, game-based teaching has emerged. By setting game tasks, rules, and roles, game-based teaching presents learning content in an entertaining way, which can stimulate students' interest in learning, promote interaction and cooperation, break the traditional phenomenon of the "silent classroom", and achieve the integration of education and entertainment. Students participate in teaching through interactive games, cultivating their skills in critical thinking, problem-solving, creativity, active learning, collaboration, and teamwork, achieving a combination of knowledge and understanding, theory and practice, and promoting the development of metacognition among young people.

However, game-based teaching still faces many challenges in practical application, such as how to balance gamification and education, how to apply gamified teaching to different disciplinary fields or special groups, and the limitations of technology, resources, and other aspects that game-based teaching may encounter in practical application.

Therefore, future research can be conducted from the following aspects: First, exploring the application effects of game-based teaching in different disciplinary fields, so as to provide useful references for teaching in different disciplines; Secondly, exploring its application effects in specific groups (such as special education schools, rural schools, etc.), in order to provide a reference for educational equity and the balanced distribution of high-quality educational resources; Finally, focus

on the impact of game-based teaching on students' psychology, emotions, and other aspects to ensure that it does not have a negative impact on their mental health while improving their classroom participation.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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