

The Effect of Gamification on Metacognitive Strategy Development in University Students

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Keywords: Gamification, Metacognitive strategies, University students, Learning motivation, Self-regulated learning

Summary:

This research studies the effect of gamification on the development of metacognitive strategies among university students. The traditional teaching methods focus mainly on memorization, but in many classrooms, this method does not always help students to regulate, control, and evaluate their learning. So, to change this, metacognitive strategies are used, which are very important to help learners to plan, monitor, and assess their understanding, i.e., by using the technique of gamification.

The researcher used a quasi-experimental design that included two groups: control and experimental groups of students. One group was taught using gamified activities, while the other group used the traditional teaching method. The sample consisted of forty students from the College of Chemical Engineering, divided equally. Then a metacognitive questionnaire and an achievement test were used before and after the experiment, which lasted six weeks.

The results of the pre-test were equal in both groups, which means the students had a similar level before the experiment. The post-test results showed a clear improvement in the experimental group. Students who learned through gamification revealed a higher motivation level, better metacognitive strategy use, and their academic performance improved.

The findings suggest that using gamification can be an effective teaching method in university education because it encourages many things like active learning, increasing learning engagement, and finally helping students become more responsible for their learning .

CHAPTER ONE

Introduction

1.1 Background of the Study

Currently, education has shifted its methods from memorization-based learning to thinking-based abilities (Mayer, 2009). Researchers emphasize that students should learn how to manage their own learning, not just receive information (Pintrich, 2002). To achieve this goal, learners should use metacognition. Flavell (1979) described metacognition as the ability to think about one's own thinking, including planning, monitoring, and evaluating the learning process.

Students who use these metacognitive strategies will be able to understand their strengths and weaknesses and try to improve their academic performance (Zimmerman & Schunk, 2011). However, in many university classrooms, traditional teaching methods are still used, which depend on explaining and memorizing, which, consequently, limits active learning (Mayer, 2009). As a result, students may not control their own learning or solve problems independently.

To solve this problem, one modern method is gamification. Gamification means using game elements in educational situations, these may be things like points, levels, rewards, badges, and competition. According to Kapp (2012), gamification can increase students' engagement and make learning more enjoyable. When students feel engaged and motivated, they become more active and interested in the lesson (Deci & Ryan, 1985).

Also, in the gamified learning environments, feedback and clear goals are provided, which help students think about their learning. These processes reflect self-regulated learning, where students plan, monitor, and evaluate their own work

(Zimmerman & Schunk, 2011). Also, social interaction and feedback further support their learning development (Vygotsky, 1978).

1.2 Problem of the Study

The majority of university students face a lot of difficulties in managing their learning process, and they often lack good planning and good evaluation skills (Pintrich, 2002). In the past, traditional teaching methods focused on information delivery rather than focusing on cognitive development (Mayer, 2009). Therefore, the researchers investigate that modern methods such as gamification are necessary to reach the goals of development (Deterding, 2011).

1.3 Objectives of the Study

This study aims to achieve the following objectives:

1. To examine the effect of gamification on the development of metacognitive strategies.
2. Comparing gamified learning with the traditional teaching method.
3. To measure students' ability in planning, monitoring, and evaluation.
4. To explore whether gamification improves academic achievement.

1.4 Research Questions

The study attempts to answer the following questions:

1. Does gamification improve metacognitive strategies among university students?
2. Is there a difference between gamified learning and traditional learning?
3. Does gamification lead to better academic performance?
4. Do students become more self-regulated when gamification is used?

1.5 Hypotheses

The study tests the following hypotheses:

1. There is no significant difference between the experimental and control groups in the pre-test.

2. There is a significant difference between the experimental and control groups in the post-test in favor of the experimental group.
3. Gamification has a positive effect on the development of metacognitive strategies.

1.6 Significance of the Study

The most important aspect of this study is to highlight the importance of gamification and metacognitive strategies in improving learning outcomes and, consequently, student engagement (Kapp, 2012; Zimmerman & Schunk, 2011).

1.7 Limits of the Study

These limits should be considered when interpreting the results. So the study is limited to university students in one college, which is the Chemical Engineering College, and to one academic semester and one subject.

CHAPTER TWO

Literature Review

2.1 Introduction

This chapter investigates the previous research related to gamification and metacognitive strategy development. It examines concepts such as gamification, motivation, metacognition, and self-regulated learning, then shows the relationship between gamified learning and students' thinking skills. By reviewing these concepts, the present study came up with the premise that modern teaching methods can improve students' ability to monitor and control their own learning.

2.2 Using Gamification in Education

Gamification is a concept that refers to the application of game elements in educational contexts to increase motivation and engagement (Kapp, 2012; Deterding, 2011). The main goal is to enhance participation and create interactive learning environments. So gamification has some key elements, including:

- Awarding points for correct responses.
- Providing badges or recognition for achievements.

- Progression through levels to indicate learning advancement.
- Offering rewards for participation and performance .
- Encouraging friendly competition among students .
- Giving immediate feedback to guide improvement .

Research assures that combining these elements creates a more engaging and dynamic learning environment. When students have the motivation to achieve higher levels or earn rewards, they turn to be more active learners and tend to develop stronger problem-solving and reflective skills(Mayer, 2009). The technique of gamification has been successfully applied across various disciplines, which include languages, sciences, engineering, and mathematics.

2.3 Motivation's Role in Learning

Studies assure that motivation significantly affects the learning process, by influencing attention, persistence, and performance. Deci and Ryan (1985) distinguished between two types of motivation:

- Intrinsic motivation: Learning driven by personal interest or enjoyment.
- Extrinsic motivation: Learning influenced by external rewards or consequences.

Gamification can support both types of motivation (Kapp, 2012). Students may enjoy the challenge itself while engaging in learning activities, simultaneously seeking rewards such as points or badges. Those motivated students seem to be more likely to employ such strategies that increase understanding and retention, and directly link motivation to metacognitive strategy use.

2.4 Metacognition

Metacognition refers to an individual's awareness and control of their own cognitive processes (Flavell, 1979). It involves both concepts :

1. Knowledge about cognition: Understanding how one learns and which strategies are the most effective.
2. Regulation of cognition: Actively planning, monitoring, and evaluating one's learning processes.

To be more effective learners, they must utilize metacognitive strategies. Students must identify areas of difficulty, correct their mistakes, and modify their approach without relying on the teacher (Pintrich, 2002).

2.5 Metacognitive Strategies

Metacognitive strategies are those techniques that learners use to manage their own learning. Zimmerman (2011) outlined three main types:

1. Planning: by setting their own learning goals, selecting appropriate strategies, and organizing their time before beginning any task.
2. Monitoring: can be done by checking their comprehension and progress during the learning process, such as reviewing their answers with peers or asking the teacher to clarify questions.
3. Evaluation: This can be done by assessing their performance after completing their tasks to identify the strengths and weaknesses and how they can improve themselves.

So students who often employ these strategies prove to have better academic outcomes because they consciously control their learning rather than passively just receive information.

2.6 Self-Regulated Learning

When students take responsibility for their own education, set goals, use strategies, and evaluate their outcomes, they become more effective learners (Zimmerman & Schunk, 2011). Based on reflection and feedback, metacognition is the central point to self-regulation, because it enables students to adjust their own behavior.

The learning environments that use gamification support self-regulation by providing the following :

- Clear learning objectives and firm rules
- Immediate feedback on current performance
- Chances for students to monitor and evaluate their progress
- Motivational rewards and challenges (Bandura, 1986; Vygotsky, 1978).

Using these elements will actively engage students to learn effectively and to plan their learning, monitor, and adjust their aim, and become responsible for their own learning(Kapp, 2012).

2.7 Gamification and Metacognitive Strategies

Gamification technique encourages students to think in a critical way, considering their own learning. In the gamified tasks, learners must plan how to earn points or complete challenges. Also, they monitor their own performance while doing tasks, and finally evaluate outcomes to adjust their method.

These actions are the main processes of metacognition. Active learning that is used in gamified contexts promotes students' attention, problem-solving, reflection, and self-control, which are all important for developing metacognitive strategies (Mayer, 2009). Consequently, this gamified learning is necessary to raise students' metacognitive abilities more effectively than traditional and passive teaching methods.

2.8 Previous Studies

Many studies show the link between gamification, metacognition, and academic performance:

- Kapp (2012) found that gamification increases engagement and enhances learning outcomes by motivating students.
- Zimmerman (2011) states that students who practice metacognitive strategies achieve higher academic results.
- Deterding (2011) demonstrated that gamification promotes active participation and sustained attention.

Previous experimental research shows that in gamified classrooms, students often have better self-regulation, higher motivation, and improved task performance compared to those in traditional settings. So the findings indicate that gamified learning can support the students' metacognitive strategies, leading to more effective and autonomous learning.

CHAPTER THREE

Methodology

3.1 Introduction

This chapter explores the methods and procedures that are used to investigate the effect of gamification on the development of metacognitive strategies among the University of Technology's students. Research design, participants, instruments, experiment procedures, and statistical methods are adopted to analyze the data. The study used an experimental approach to compare the traditional teaching methods with gamified learning.

3.2 Research Design

The present study used a quasi-experimental design with two groups: an experimental group and a control group. The purpose of this research design was to measure the effect of gamification on students' metacognitive strategies by comparing the two groups before and after the experiment. It helps the researcher to determine whether the improvement in students' performance is caused by the teaching method or not.

The experimental group was taught using gamification, while the control group was taught using the traditional teaching method. Both groups were given a pre-test before the experiment and a post-test after the experiment.

Table (3-1) Research Design

Group	Pre-test	Teaching Method	Post-test
Experimental	Pre-test	Metacognitive strategy (Gamification)	Post-test
Control	Pre-test	Traditional method	Post-test

3.3 Participants

The participants of the study were students from the College of Chemical Engineering at the University of Technology. The total number of students was forty.

The students at issue were divided into two equal groups: 20 students in the experimental group and 20 students in the control group.

3.4 Instruments of the Study

Two instruments were used in this study to collect the data: the Metacognitive Strategy Questionnaire and the Achievement Test. These instruments were used before and after the experiment to measure the development of metacognitive strategies and academic performance.

3.4.1 Metacognitive Strategy Questionnaire

The questionnaire was used to measure the level of students' metacognitive strategies. It was adapted from previous studies by (Zimmerman & Schunk, 2011; Pintrich, 2002), with some modifications to fit the purpose of the present study.

The questionnaire measures several aspects of metacognition, including: Planning, Monitoring, Evaluation, Self-control, and Motivation

The questionnaire contains 20 statements, and students respond using five likerate scale : (Strongly agree ,Agree , Neutral, Disagree, Strongly Disagree)

Then, the obtained scores of the questionnaire were calculated to determine the level of metacognitive strategy use before and after the experiment.

3.4.2 Achievement Test

To measure students' academic performance, the researcher uses an achievement test that includes questions related to the experimental lessons. This test was used as a pre-test before the experiment and a post-test after the experiment.

Where the pre-test was used to make sure that the two groups had the same level before the experiment, whereas the post-test was used to measure the students' improvement after using gamification.

3.5 Validity of the Instruments

Validity means that the instrument measures what it is supposed to measure. To ensure face validity, the questionnaire and the test were exposed to specialists in education and psychology to check the clarity of the questions and their suitability

for measuring metacognitive strategies. So, after reviewing, some items were modified.

3.6 Reliability of the Instruments

Reliability means that the instrument gives consistent results when it is used more than once. To check the reliability of the questionnaire, Cronbach's Alpha was used. The results were 0.82, which is considered acceptable. This means that the questionnaire was reliable.

3.7 Gamification Usage

The experimental group was taught using gamification technique. Several game elements and ways were included in the lessons to increase motivation and participation, such as (points for correct answers, badges for good performance, showing students' levels of their progress, rewards for participation, creating competition, immediate feedback, and finally encouraging group challenges) .

The design of those gamified activities was based on the ideas of Deterding (2011) and Kapp (2012). Those activities helped students to practice metacognitive strategies during learning. They either worked individually or in groups to complete their tasks and earn points.

During the lessons, students were required to plan their own work, then check their answers and correct their mistakes, if any, and finally evaluate their performance .

3.8 The Procedure

The experiment was done in six weeks. First, the pre-test was given to both groups, and then the same teaching was given to both groups. Then, gamification was given to the experimental group, while a traditional method was used with the control group. Finally, the post-test was administered to both groups. Then the obtained results were analyzed statistically.

Statistical Methods

The researcher used mean, standard deviation, and t-test to analyze the data. The t-test was used to compare the experimental group and the control group, and the pre-test and post-test results.

The level of significance was 0.05. So, if the calculated value is found to be greater than the table value, the difference is considered significant.

CHAPTER FOUR

Results and Discussion

4.1 Introduction

In this chapter, the results of the experiment that was conducted are going to be shown, which is the effect of gamification on the development of metacognitive strategies among university students. The data from the pre-test, post-test, and questionnaire were analyzed by using suitable statistical methods. The results of both experimental group and control group are compared in order to determine whether gamification had a significant effect on students' performance. Then the findings are discussed in relation to the theoretical background and the related previous studies.

4.2 Pre-Test Results

The purpose of the pre-test is to make sure that the two groups have a similar level before using the experiment, so the pre-test was given to both the experimental group and the control group.

Table (4.1) : Pre-test scores of experimental and control groups

Group	Number	Mean	Std. Deviation
Experimental	20	62.10	5.20
Control	20	61.75	5.80

The obtained mean scores of the two groups are very close, which shows that there was no difference between the two. This means that the two groups have the same

level. Therefore, the first hypothesis, which states that there is no significant difference between the two groups in the pre-test.

4.3 Post-Test Results

After six weeks of teaching using gamification to the experimental group and traditional methods to the control group, the post-test was given in order to measure the effect of the teaching method used.

Table (4.2) : Post-test scores of experimental and control groups

Group	Number	Mean	Std. Deviation
Experimental	20	82.40	4.30
Control	20	68.25	5.10

The results show that the experimental group achieved higher scores than the control group. This indicates that gamification improved students' level more than those who learned through the traditional method. The mean scores of the experimental group suggest that gamification had positively affected students' learning and metacognitive strategies.

4.4 T-Test for Post-Test

A t-test was used to determine whether the difference between the two groups is statistically significant.

Table (4.3) : T-test results for experimental and control groups

Group	Mean	t-value	Sig
Experimental	82.40	5.12	0.05
Control	68.25		

Results show that the calculated t-value is higher than the value required at the level of significance (0.05). This means that the difference between the experimental and control groups is statistically significant. Therefore, the second hypothesis is

accepted, which states that there is a significant difference between the two groups in the post-test in favor of the experimental group.

Which means that gamification improves students' performance more than the traditional teaching method.

4.5 Results of the Questionnaire

A metacognitive questionnaire was used to measure students' ability in planning, monitoring, evaluation, and motivation.

Table (4.4) : Questionnaire mean scores

Group	Pre-test	Post-test
Experimental	60	85
Control	61	69

The obtained results show that the experimental group improved more than the control group after the experiment. Students who learned through gamification showed that they were using metacognitive strategies more compared with those who learned through the traditional method. This means that gamification increases academic performance and helps students develop better learning strategies.

4.6 Discussion of Results

The obtained results of the current study show how gamification had a positive effect on the development of metacognitive strategies. It shows that students in the experimental group were more active during the lessons because the gamified activities kept them alert all the time to gain rewards, create competition, and receive immediate feedback. All these elements encouraged students to pay attention to their performance and try to improve their results.

This obtained result was explained by Flavell (1979), who argued that metacognition develops when students become aware of their thinking. In our gamified lessons, students needed to check their answers themselves, correct mistakes, and try different strategies to gain points. All these actions required

planning, monitoring, and evaluation from students, which are the main parts of metacognitive thinking.

The results obtained also agree with Zimmerman (2011), who stated that self-regulated learning depends almost entirely on the use of metacognitive strategies. Students in the experimental group had to plan their work to complete tasks successfully, and then they had to monitor their progress to reach higher levels. So, their ability to control their learning improved.

In addition, the findings support the ideas of Kapp (2012), who stated that gamification increases motivation and engagement. When students feel engaged and interested in the lesson, they become more willing and active to participate and work harder. This motivation helps them use better learning strategies and achieve higher scores.

4.7 Explaining the Experimental Group Improvement

We can explain several factors which are: gamification made the lessons and students' participation more interesting and active, where feedback was given immediately. Also, students worked in groups and discussed answers between them, where competition encouraged students to gain rewards which then increased motivation. So all the above factors helped students to think more about their learning process, which led them to develop their metacognitive strategies.

4.8 Comparison with Previous Studies

All the findings of this study are consistent with previous studies showing that gamification enhances more motivation and engagement (Kapp, 2012; Deterding, 2011).

They also align with the research that indicates that metacognitive strategies improve academic achievement (Pintrich, 2002; Zimmerman & Schunk, 2011).

4.9 Chapter Summary

The results show that there was no difference between the two groups before the experiment, but a clear difference emerged after gamification. The experimental group achieved higher post-test scores and demonstrated better use of metacognitive strategies. This, in turn, indicates that gamification is an effective

modern teaching method that can help university students to become more active, motivated, and able to control their learning.

CHAPTER FIVE

Conclusion and Recommendations

5.1 Introduction

This chapter presents the study's conclusion and recommendations based on the results of the experiment. By comparing two groups, one taught using gamification and another taught using the traditional method, the study investigated the effect of using gamification on the development of metacognitive strategies. Based on the statistical analysis explained in Chapter Four, conclusions are made.

5.2 Conclusions

Based on the results of the experiment, the study came up with the following conclusions :

1. Gamification has positively affected the development of metacognitive strategies. There were differences between students who learned through gamified activities and those who learned through the traditional method; the difference was a better ability in planning, monitoring, and evaluating their learning.
2. Both groups had a similar level at the beginning of the experiment , which makes the results more reliable. So, there was no significant difference between the experimental group and the control group before the experiment.
3. The experimental group achieved higher scores in the post-test, which means that gamification improved students' performance. So, there was a significant difference between the two groups after the experiment.
4. Gamification strategy increased students' motivation and participation. Students were more active during the lessons because the activities included points, rewards, and competition.
5. Gamification strategy helped students become more responsible for their learning. They plan their work, check their answers, and evaluate their results to succeed in the gamified activities and gain points.

6. Metacognitive strategies showed improvement in academic achievement. Students who used planning, monitoring, and evaluation were able to understand the lessons better and obtain higher scores.

These conclusions supports Flavell, Zimmerman, and Kapp's ideas, who assert that metacognition, self-regulated learning, and motivation are very important in the learning process. Also, they confirm that motivation plays a key role in learning success (Deci & Ryan, 1985) and that gamification enhances engagement and performance (Kapp, 2012).

5.3 Recommendations

The researcher, after obtaining the results, suggests the following recommendations:

1. Teachers should use a variety of gamification strategies in university classrooms to increase students' motivation and participation.
2. Educational programs should include such activities that help students develop metacognitive strategies like planning, monitoring, and evaluation.
3. Universities should provide courses for training teachers on how to use modern teaching methods, including gamification.
4. Students should be encouraged to take responsibility for their learning instead of depending only on the teacher, i.e. student-centered classrooms.
5. Gamification can be used with different subjects, like science, engineering, and other fields.
6. Learning environments should be reliable and should include activities such as feedback, rewards, and challenges to make learning more interactive.

5.4 Suggestions for Future Research

Future researchers may study the following topics:

- The effect of gamification on critical thinking in university students
- Gamification and communication or speaking skills to secondary school students
- The effect of gamification on online learning

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أثر استخدام أسلوب التلعيب على تطوير استراتيجيات ما وراء المعرفة لدى طلاب الجامعات

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الكلمات المفتاحية: التلعيب، استراتيجيات ما وراء المعرفة، طلاب الجامعات، دافعية التعلم، التعلم الذاتي

الملخص:

تدرس هذه الدراسة أثر استخدام أسلوب التلعيب على تنمية استراتيجيات ما وراء المعرفة لدى طلاب الجامعة. تركز أساليب التدريس التقليدية بشكل أساسي على الحفظ، ولكن في كثير من الأحيان، لا يسهم هذا الأسلوب في تمكين الطلاب من تنظيم تعلمهم والتحكم فيه وتقييمه. لذا، ولتغيير هذا الواقع، تُستخدم استراتيجيات ما وراء المعرفة، التي تُعدّ بالغة الأهمية لمساعدة المتعلمين على التخطيط لفهمهم ومراقبته وتقييمه، وذلك باستخدام أسلوب التلعيب. استخدم الباحث تصميمًا شبه تجريبي شمل مجموعتين: مجموعة ضابطة ومجموعة تجريبية. دُرست إحدى المجموعتين باستخدام أنشطة التلعيب، بينما دُرست الأخرى بالطريقة التقليدية. تألفت العينة من أربعين طالبًا من كلية الهندسة الكيميائية، تم تقسيمهم بالتساوي. ثم استخدم استبيان ما وراء المعرفة واختبار تحصيلي قبل التجربة وبعدها، والتي استمرت ستة أسابيع.

كانت نتائج الاختبار القبلي متساوية في المجموعتين، مما يعني أن الطلاب كانوا على مستوى مماثل قبل التجربة. وأظهرت نتائج الاختبار البعدي تحسنًا واضحًا في المجموعة التجريبية. أظهر الطلاب الذين تعلموا باستخدام أسلوب التلعيب مستوى أعلى من الدافعية، واستخدموا أفضل لاستراتيجيات ما وراء المعرفة، وتحسنوا في أدائهم الأكاديمي.

تشير النتائج إلى أن استخدام التلعيب قد يكون أسلوبًا تعليميًا فعالًا في التعليم الجامعي، لأنه يشجع على العديد من الأمور، مثل التعلم النشط، ويزيد من تفاعل الطلاب مع عملية التعلم، ويساعدهم في النهاية على تحمل مسؤولية تعلمهم.