

## A Conceptual Framework for Evaluating the Effectiveness of Robotic Game Approaches to Motivation and Performance in Geography

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**Abstract.** A conceptual framework for evaluating the effectiveness of robotic game approaches to motivation and performance in geography. In 2017, the standard secondary school curriculum (KSSM) replacing the previous curriculum was introduced as a continuation of curriculum changes in the 21st century. However, these changes still make Geography a compulsory subject for middle and upper secondary subjects. As a result of this change, fewer schools in Malaysia offer geography in the upper middle class and if so, the choice is given to middle school students. This situation is especially critical as most Geography teachers still practice conventional teaching methods in the classroom. The implication is that students are less motivated to study Geography and this phenomenon has also influenced their geographical achievement. Therefore, various 21st century teaching methods have been introduced in classroom learning and facilitating activities. One of the things that started to catch the attention of teachers was the game method. This is because the use of the game approach as a teaching tool has a positive impact on students' engagement and motivation to learn geography. However, unlike in Malaysia, the game's approach has been less widely introduced, especially in geography learning and facilitation in secondary schools. This is due to the lack of appropriate resources and the ability of teachers to apply the skills in learning and facilitating. Therefore, this conceptual framework was developed to evaluate the effectiveness of using a robotic game approach in improving student motivation and achievement in secondary school.

**Keywords:** *gamification, motivation, achievement, geography, robotic game*

**Abstrak.** Kerangka konseptual untuk mengevaluasi efektivitas pendekatan robotic game terhadap kinerja dalam geografi. Tahun 2017, kurikulum Sekolah Menengah Standar (KSSM) yang menggantikan kurikulum sebelumnya diperkenalkan sebagai kelanjutan dari perubahan kurikulum abad ke-21. Namun demikian, perubahan ini tetap menjadikan Geografi sebagai mata pelajaran wajib bagi mata pelajaran menengah ke atas. Sebagai akibat dari perubahan ini, lebih sedikit sekolah di Malaysia yang

menawarkan geografi di kelas menengah ke atas dan jika demikian, pilihan diberikan kepada siswa sekolah menengah. Situasi ini sangat kritis karena sebagian besar guru Geografi masih mempraktikkan metode pengajaran konvensional di kelas. Implikasinya adalah siswa kurang termotivasi untuk mempelajari ilmu geografi dan fenomena tersebut juga mempengaruhi pencapaian geografi mereka. Oleh karena itu, berbagai metode pengajaran abad 21 telah diperkenalkan dalam pembelajaran di kelas dan kegiatan fasilitasi. Salah satu hal yang mulai menarik perhatian para guru adalah metode permainan. Hal ini dikarenakan penggunaan pendekatan permainan sebagai alat bantu pengajaran berdampak positif terhadap keterlibatan dan motivasi siswa dalam belajar geografi. Namun, tidak seperti di Malaysia, pendekatan permainan kurang diperkenalkan secara luas, terutama dalam pembelajaran geografi dan fasilitasi di sekolah menengah. Hal ini disebabkan kurangnya sumber daya yang sesuai dan kemampuan guru dalam menerapkan keterampilan dalam pembelajaran dan fasilitasi. Oleh karena itu, kerangka konseptual ini dikembangkan untuk mengevaluasi keefektifan penggunaan pendekatan permainan robotik dalam meningkatkan motivasi dan prestasi siswa di sekolah menengah.

**Kata kunci:** *gamifikasi, motivasi, prestasi, geografi, robotic game*

## **Introduction**

The industrial revolution (IR) took place in the late 18th century leading to major changes in agriculture, manufacturing and transportation that had a significant impact on the socioeconomic and cultural life in Britain (Breschi et al., 2000). These changes are expanding throughout Europe and North America all over the world through a process known as industrial revolution 4.0 (Cantwell & Lammarino, 2001). The emergence of the fourth industrial revolution has impacted and reshaped the economy, social and education in line with the need for teaching and learning to achieve this revolution (Shakir, 2018). Education has been a key element in the supply of skilled workers who are the driving force behind artificial intelligence (Shakir, 2018). This affects the use of artificial intelligence products in the classroom for early exposure to students. One of the most used artificial intelligence products is robots, which is a machine for facilitating human use in many fields such as Engineering, Computer Science and Science.

The development of technology in the field of technology has a direct impact on the educational system today, especially in the use of teaching and learning media materials. Education media has been accepted as one of the approaches to achieving educational goals that reflect the National Philosophy of Education and the Vision of

Education (Simon 2006). The challenge lies ahead for educators in the quest to generate quality human capital in the current globalization. The pursuit of technology-related knowledge and skills is a must-have for educators in preparation for dealing with students who may be the future scapegoats. Mastery in education technology is a fundamental requirement for educators in this information technology age to emerge as a relevant teacher in the education field (Abdullah et al., 2009).

The use of robots in the learning process often involves games and educators began to come up with ideas for developing robot-based activities in learning processes involving the subjects of Mathematics, Science and Engineering. Game concept is a new idea that leads to the education system to enable students to always be motivated to explore the content through the mechanical and dynamic concepts involved in the game process (Shakir et al., 2018). Robot integration as a real object in the game began to be introduced in the 21st century and became a new learning technique that teachers could explore as the dominant robotics technology developed over the centuries (Reich-Stiebert & Eyssel, 2015). The use of game robots in learning processes is guided by the latest technology to improve the quality of education by attracting students' motivation for mastery of learning content (Petre & Price, 2004; Metta et al., 2010) to keep pace with the development of the fourth industrial revolution (Sung et al., 2009). This is because students can learn the technical elements involved with robots and mastery of content through games designed by teachers (Shakir et al., 2018).

As such, educators - teachers should be more creative in creating learning situations that appeal to students' acceptance of a particular subject. For example, teachers may try to use robotic technology in teaching that is now widely used in other subjects such as Mathematics, Science and Engineering (Yussof 2009). Typically, the use of these robots in teaching and learning will be more playful or gamified (Challinger, 2005). Interestingly, through the concept of the game, students' motivation to explore the content is enhanced because of the application of mechanical and dynamic concepts to the game (Losup & Epema, 2014). In addition, the use of this robot not only enhances

student motivation, but it also engages students in the pursuit of a topic or content (Metta et al., 2010; Petre & Price, 2004).

### *Gamification of the 21st century learning trend*

The development of gamification began to be realized in mid-2010 when the video game industry began to be popularized to this day. The concept of gamification has long been introduced by bringing a new term that is more versatile and widely used in various fields including business, marketing, military, and internet networking. Gamification has dominated the field of marketing (Hamari et al. 2014; Huotari & Hamari 2012; Van Grove 2011). as a measure to increase product sales, attract customers, soft skills, cultivate awareness and improve the performance of an organization (Furdu et al. 2017). It is estimated that approximately 70% of the 2000 organizations worldwide have at least one gamification application in 2014 (Khaleel et al. 2016) through the websites facebook, ebay, amazon and others. At the same time, gamification is also used in education by incorporating game elements to ensure learning remains active (Furdu et al. 2017; Yoon et al. 2014) and stimulate student interest. Therefore, the focus of gamification in this writing is concentrated in the field of education.

Gamification is basically making a non-playing activity a play activity. Formal human activities in the education sector are called serious games or serious games. Serious games or instructional games introduced through Games Based Learning (GBL) are usually implemented in learning and are intended to provide training. The approach or technique of the game introduced is an effort to improve the quality of education and transform students in the learning perspective. Games in education can be run at any time learning in or out of the classroom. Through a playful approach, indirectly can give students exposure that learning is not only focused on teacher presentation in the classroom only but can be learned on its own in a more entertaining and useful form. However, games in learning are designed to be appropriate and more specific (Mostowfi et al. 2016) with objectives learning to be achieved.

### **A Study Of The Geography Teaching Approach**

Geography is a widely studied discipline of space and environment organization that involves interrelationships and interactions between humans and humans, humans with the environment and between environmental components at the local and global level (Ministry of Education Malaysia, 2017). One of the major issues of Geography subjects in Malaysia is the low academic achievement of students (Mohd Faris et al. 2013; Singh 2017) and is sometimes a very tedious and difficult subject to study (Singh, 2015). In addition, recent trends show that the number of students taking Geography subjects at the high school level is decreasing as students are not interested and motivated to study Geography (Singh et al. 2018). This situation has encouraged the development of various studies conducted to increase student interest in Geography in Malaysia and abroad. For example, Ferry Hisham (2014) conducted a multimedia effectiveness study to increase indigenous students 'interest in Geography, finding that multimedia users have successfully attracted native students' interest in Geography. Overseas studies conducted by Hikari Dwi (2018) and Cho, D., & Chun, B. (2019) also conclude that the use of ICT elements can increase student interest in Geography subjects.

In addition, a study conducted by Arumugam (2006) found that the Animation and Interactive Map approach successfully generated interest, reduced cognitive load and curiosity among students. The study also suggested the use of software such as animated and interactive maps in the high school PDPc Geography (Arumugam, 2006). Although there are studies that focus on designing appropriate designs for developing game-based Geography learning, there are no actual studies that use robot games in teaching and learning Geography subjects. The study conducted by Khairuddin et al. (2017) focuses more on design discussions appropriate to game-based learning or better known as Geoplay.

The rapid growth of 21st century technology around the world has introduced robotic gamification in education to support the PdPc process in schools. However, it is only used to teach Science and Mathematics subjects in schools (Ponce, Molina,

Caudana, Reyes, & Parra, N. M, 2019) and is not integrated in any social science subject like Geography.

*Attitudes and interests in geography*

Previous research has shown that attitudes play an important role in determining one's personality as it can influence the way people act or act, the objects, and events they experience (Aishah, Ruzaini & Siti Asiyah, 2011). Nihra Haruzuan and Chandrathevy (2010) state that if a student has a positive attitude towards classroom learning, then academic achievement is positive (Hanifah et al. 2017). This is because if a person has a positive attitude towards the lesson, then the person will indirectly like the subject (Hanifah et al. 2017). There are several studies conducted by researchers that show that a student's attitude can influence academic achievement in geography.

In a study conducted by Hibszer (2011) in a secondary school located in the City of Silesia Voivodeship Poland showed that students have a negative attitude towards learning geography subjects. This can be explained by the form of a distributed questionnaire, which survey found that 94.6% of respondents answered that studying geography subjects was difficult. In addition, the Ottati study (2015); Hibzer (2011); Aydın (2011); Tomal (2010), on the other hand, found that the reason students dislike geography is due to too many facts and concepts to remember and memorize (Hanifah et al. 2017). In addition, students do not like geography subjects because of the boring and teacher-centered way of teaching teachers. In short, students' attitudes toward these negative subjects can lead to their performance decline (Rich, 2011).

This situation is counterintuitive if a student has a positive attitude toward the subject of geography. Rich Research (2011) concludes that students with a positive attitude towards geographic learning can improve their achievement. For example, in Ozdemir's (2012) study on the attitude of upper secondary students to geography subjects in Karabuk, Turkey. The results showed that 83.5% of the students from 200 respondents liked geography subjects because of their positive attitude towards geography. This study is also in line with the findings of Tomal's (2010) study which shows that students have a positive attitude towards geography because students

believe that by studying geography, they can learn the environment and the environment and solve problems they face in everyday life.

From the above, it is clear that students' attitudes towards geography subjects are very important as they can influence a student's achievement. Students who do not have a positive attitude toward a subject have trouble achieving success in the subject. Therefore, to achieve success in geography learning, the development of a positive student attitude towards the subject should not be neglected. An individual's interest is important because it can influence whether the student wants to learn. If one does not have a high interest in a particular field, it can be a hindrance for the person to achieve great achievement (Johari & Norsuriani, 2011).

Study by Uly (2012) emphasized that students' interest in learning is a force that motivates students to persevere. This means that a student's interest in geography is very important as it can motivate one to work harder and harder to achieve great results. High interest in geography subjects can improve student achievement and, in turn, less interest in achievement (Normah, 2012; Roslee & Mohamad Saifullah, 2013). There are several studies that show why students are less interested in geography learning. Among them is the study of Nuratu (2014), which revealed that students are less interested in geographic learning due to the rich geographical content of the content as well as the lack of learning materials and infrastructure such as geography laboratories, libraries, weather stations and other infrastructure needed to become more meaningful learning (Hanifah Mahat et al. 2017).

In addition, students also noted that the lack of qualified teachers to teach these subjects was seen because of their declining interest (Nuratu, 2014). Meanwhile, the study of Abdul Said, Baharom, Mohd Yusof, Mohamad Johdi and Francis (2011) also emphasized that students are less interested in the attitude of teachers who do not mix methods in teaching geography and lack good interaction between teachers and students (Rohani, Hazri & Nordin, 2010). In conclusion, a student's interest in a geographic subject plays a very important role in the learning process for better achievement. This

is because when a person is interested and liked, the person will respond positively in a variety of areas.

### *Geography curriculum in Malaysia*

Geography is one of the subjects offered in the education system in Malaysia and was first introduced at the primary level in 1927 and at the university level in 1959. Previously, geography was a core subject for the lower middle and upper classes. . However, following the introduction of the New Secondary Curriculum (KBSM) in 1989, geography subjects have been changed from core to elective (Ministry of Education Malaysia, 2015).

This has led to a decline in the number of students studying geography. At the same time, there are also students who feel that this subject is not important (Mohmadisa et al., 2013; Abdul Hamid et al., 2006). In fact, one of the reasons schools do not offer geography subjects at SPM level is also because students' excellent achievement in geography subjects is low in SPM examinations (Shamsiah & Azman, 2015). Thus, there is a concern that the geography of the subject will continue to be considered as the subject of choice if the student does not show good performance in the examination.

However, changes in the curriculum have shown that the Secondary Curriculum Integrated Curriculum (KBSM) has been transformed into a new curriculum that is more focused on ensuring the quality of education in Malaysia. Changes in Secondary Integrated Curriculum (KBSM) to High School Standard Curriculum (KSSM) Geography for example contain aspects of content, pedagogy and assessment that need to be integrated and planned in teaching and learning (PdP) as described in the Curriculum and Assessment Standard Document (DSKP). Geographical secondary school and curriculum standard is built to equip students with the knowledge and skills of geography and values to produce citizens who are confident, competitive, visionary, and capable of managing the environment responsibly. Geography DSKP is a document that teachers must refer to when implementing PdPc to achieve that goal (Curriculum Development Division, 2018).





Source: Curriculum Development Division, 2018  
Figure 1. Focus of the Upper Secondary Geography Curriculum

Teaching and Learning Strategies in KSSM Geography emphasizes student-centered deep learning through inquiry-based learning such as project-based learning, problem-based learning, classroom learning and cooperative and collaborative learning. In addition, fieldwork should be carried out for the purpose of strengthening students' understanding of Geography. Teachers need to carefully design PdPc strategies to produce students with 21st Century Skills as desired (CPC, 2018).

The assessment in the Geographical Survey is part of the PdPc. Assessment should be done in a variety of ways. Through assessment, students' levels of achievement and achievement can be identified and recorded for reference and needs of various parties. Assessment of students' level of understanding and mastery in Geography learning should be carried out on a regular basis to ensure that the objectives of the Geography KSSM will do and achieved (BPK, 2018).

#### *Performance in geography: secondary school review*

Various studies have been conducted on discussion of achievement of examination results either at the lower middle or upper level for geography subjects have shown that the better performance is only achieved in the Lower Secondary Examination (PMR) which is then replaced by Form 3 Assessment (PT3) (Hanifah Mahat et al. 2017). However, at the upper secondary level, student achievement in geography subjects is low as most students taking geography subjects are students with low

academic achievement (Mohd Faris et al. 2013). In fact, the SPM examination report from 2000 to 2009 issued by the Malaysian Examination Board (LPM) shows that SPM candidates have low scores for the geographical skills component. Meanwhile, based on the SPM exam answer quality for Paper Geography 2013 subject 2013, the LPM showed that most candidates failed to answer the questions well and well (Shamsiah & Azman, 2015).

Other weaknesses include the lack of understanding of geographic concepts and terms and the inability to use effective language adjustments. Candidates will not be able to apply the skills of calculating and interpreting the map and determining the location on the map (LPM 2013). The answers provided by the candidates for this group indicate a modest amount of knowledge in the Geographical Skills section. The quality of the candidate's response is satisfactory. The answer is simple and without description. There are also candidates in this group who try to write descriptions but do not meet the facts. The language barriers used are not exactly in line with the requirements of the scoring rules. There are also negative responses. Candidates are confused about changing the scale to get answers to distance-related questions. Candidates will not be able to apply counting and mapping skills as well as determining location on the map.

### **The Effectiveness Of Game Approaches**

There have been numerous previous studies that have tried to establish the relationship between game approach and student motivation and achievement.

#### ***Games and motivation***

Students' cognitive levels can be observed through their mastery of the game itself (Nurhuda & Fariza, 2017). Huang et al. (2010) also emphasized that digital games for educational purposes should have a positive impact on students' cognitive, motivational processes and can provide extrinsic rewards to students. As a simple example, a game requires a skilled player to master the techniques of the game and to take action to achieve the goal in the game. (Nurhuda & Fariza, 2017). This can be learned through the experience of the player himself as each challenge presented is different. In

general, each player has the opportunity to successfully overcome a difficult game after mastering the process itself (Koster, 2004).

The game design is designed to look at a player's level of expertise as well as to improve his skill level to solve more difficult challenges. Many emotions can be learned through games in which most games provide different levels of emotion, such as curiosity, frustration, and excitement (Lazarro, 2004). Emotion formation through games can help students transform students' negative emotions into more positive emotions through the experience of a game. For example, a player will experience many setbacks and frustrations in trying to achieve the goals in the game. Usually, a game allows players to try again and again until players master it.

On the other hand, looking at students' social angles, games often allow players to experiment with their identities and roles according to the needs and desires of the players (Lee & Hammer 2011). Through the game, players have the opportunity to try out their unique identities that build student social confidence. Huang et al. (2010) also emphasized that Digital Games for educational purposes should have a positive impact on students' cognitive, motivational processes and can provide extrinsic rewards to students. The design of the built-in robotics game should be effective in raising the motivation for teaching materials for all students with different academic abilities (Shakir, 2018).

In geography education, motivation and games can be seen through studies conducted to improve student memory in teaching and learning and to increase student interest in the subject being taught and create a fun environment between teachers and students during PdPc. A total of 24 students from Form One Anggerik, SMK Telok Datok, Banting, Selangor were involved in the study conducted by the researcher. Preliminary reviews indicate that students are not proficient and cannot remember the geography lessons being taught. Students are also less confident and less interested in geography learning. Additionally, students play more than they concentrate on when PdPc is in the classroom. In addition, Students are also quick to get bored of geography lessons. In order to address this problem, the researcher is through the activity of

conducting game activities using interesting fuel. The conclusion of the study is that. Game activities allow students to think and reduce student fatigue in the classroom during PdPc. With this in mind, students are more mindful of the addition and enjoyment of the teacher and the student indirectly motivating the student.

### *Games and achievements*

According to Sung and Hwang (2013) study, the performance of students who study science in a collaborative environment using educational computer games is statistically significant compared to students who learn using conventional methods. In addition, learning with card games can improve student achievement in learning. (Gogal, Heuett, & Jaber, 2017; Zhang, 2017; Martí-Centelles & Rubio-Magnieto, 2014; Bayir, 2014; Liu & Chen, 2013). In addition, a study by Norhaida (2017), through a gamification approach to teaching and learning Algebraic Expression topics for two students such as trying to measure student achievement and thinking skills using traditional approach methods and experimental groups using gamification approach methods. The findings show that the gamification approach improves student achievement in Algebraic Expressions rather than using traditional methods because it can help students be more active, confident and improve their thinking skills.

## **Method**

### **Design of gamification process**

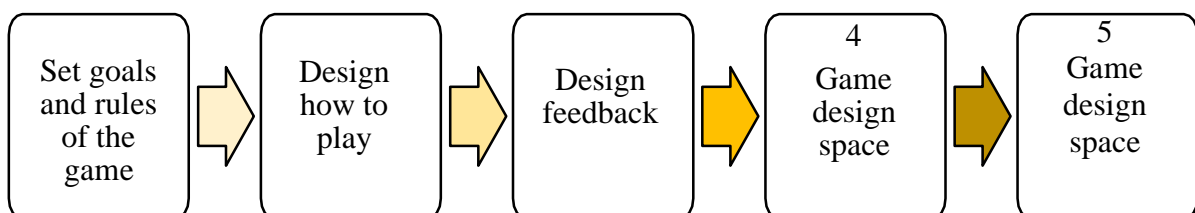
Basically, the goal of a game is just for fun and fun, but the tradition of play is trying to apply it as an intermediate medium in the learning process. In designing a game, a designer should take into account the gameplay mechanism created so that the game looks interesting and not boring (Rohani et al, 2018). The table below shows the game design and the motive of a game designed.

Table 1. The Game Design and The Motive of a Game Designed

Game Design Element		Motives
Game Element: Mechanics	Game Element: Dynamics	
Documentation of behavior	Exploraion	Intellectual curiosity
Scoring systems, badges, trophies	Collection	Achievement
Rankings	Competition	Social recognition
Ranks, levels, reputation points	Acquisition of status	Social recognition
Group tasks	Collaboration	Social exchange
Time pressure, tasks, quests	Challenge	Cognitive stimulation
Avatars, virtual worlds, virtual trade	Development/organization	Self-determination

Source: Khaleel et al. 2016

Based on the table above, the design of elements in game design has certain motives. Game mechanics are rules and rewards in the game aimed at evoking the emotions of the players, while the mechanisms inherent in the dynamic game are set to stimulate players' motivation and desire (Siti Rohani et al. 2018)). For example, the scoring system is set in a group of game mechanics, while points are recorded in the dynamic game section. The motive of scoring is to determine the performance of players individually or in groups. Therefore, game design can influence the mood and behavior of players. In addition, Tan (2018) has suggested five steps that can be taken to implement the gamification process. This process of gamification can be initiated from any of these five steps. However, for those who are new to the gamification field, it is advisable to follow the steps in the gamification process. The five steps of this gamification process can be seen in Figure 2.



Source: Tan (2015)

Figure 2. Five steps of the gamification process

### **Gamification and learning theory**

In generally, there are three main learning theories namely behaviorism, cognitivism and constructivism which are usually associated with Games Based Learning (GBL) practice (Tan, 2018). Nonetheless, the relationship between learning and games is more focused on student-centered support for the theory of traditional constructivism. All kinds of learning will encourage students to actively build their meaning and understanding and focus on each game. In the book entitled *Flow: The Psychology Of Optimal Experience* by Csiksmihalyi (1991), he also supported GBL's practice by emphasizing the need to balance challenges in the game through the increasing skills of each student. This theory emphasizes that balance should be maintained throughout the game so that students do not become bored by challenges too easily, and do not feel overwhelmed when challenges become too difficult (Tan, 2018).

### **Result and Discussion**

There is a great deal of literature review that shows that using games that are later integrated into robotics in teaching will enhance students' motivation and achievement for more enjoyable geographical learning (Keiper, 1996; Kerski, 2000; West, 2003; Milson & Earle, 2008). In addition, studies by Tuzun, Yilmaz Soylu, Karakus, Inal, and Kizilkaya (2009), Yazici and Dermirkaya (2010), Vos, Meijden, and Denessen (2011), and Santos, Sanagstin, Leo, and Blat (2011) revealed that motivational values enhance student achievement in geography. However, there are no studies that focus on the geography students who are weak and moderate in achievement in experimental design research. Therefore, this study will be conducted to fill the gap in the study of the use of robot games on student motivation and achievement based on the conceptual framework depicted in the figure below.

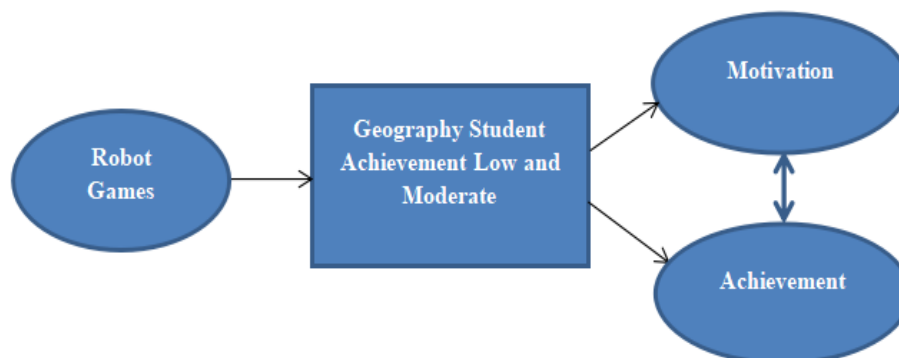


Figure 3. Conceptual Framework

Figure 3 shows that this study focuses on the impact of Robotics-based teaching on motivation and achievement among poor and moderate geography students. The findings of this study show that there is a relationship between dependent variables namely motivation and achievement. In addition, Figure 3 also shows that this study focuses on the design of a quasi-experimental study to examine the impact of using robot games on student motivation (learning goals), motivational impact of student achievement and the impact of GIS on student achievement. Based on this design, quantitative and qualitative data collection together occur in one phase of research. Quantitative data will be collected through the quasi-experimental design of the experiment and 20 pre-post choice questions and multiple-choice tests, qualitative data will be collected through observation and interview. The data collected will be analyzed separately and the findings compared and measured in the interpretation section. In this regard, it can be concluded based on the diagram above explaining the robot gamification mechanism in Geography learning that is needed to develop and present in today's academic world. This research is actually significant to develop as an effort to create a corpus of knowledge that can serve as a pioneer to stimulate further development of new studies in the future.

### Conclusion

Most educational theorists such as Papert (1993) believe that robotic activity has great potential for improving teaching and learning in the classroom. However,

Williams, Ma, Prejean, Lai, and Ford (2007) assert that there is limited empirical evidence to prove the robotic effect of the curriculum completely. In this regard, educators have begun to develop ideas and develop activities to incorporate robotics into teaching a wide range of subjects that not only focus on math, science and engineering, but also other social sciences such as geography, economics and history. However, these robotics activities do not replace teachers' abilities in teaching and learning, but act as stimulating, connecting, and controlling teaching aids to maximize their quality.

### **References**

Reference should use minimum 80% of primary referral sources (international journal) of the last 10 years of publications and written in APA IV style. Unpublished reference is not suggested to be cited. Written in a single space (or at least 12pt), the reference list is spaced 1 space. Some examples of reference / reference writing methods in the referral List are given below.

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