# Interest-based STEM Education for Children

Yuxuan Hu

School of Communication, University of Miami, Miami, FL, US

yxh783@miami.edu

**Abstract.** The demand of STEM (science, technology, engineering, and mathematics) education popularization is growing. Nowadays, the STEM education should be focus, especially on children. Children should be known about STEM as early as possible, even to learn some basic knowledge. Using Participatory observation method to keep kids' interest in STEM education, during education this study met some problem and demand. Through research, observe, and test, this study showed the interest will be the most important in STEM education. The various performances and behaviors displayed by the students helped the study to analyze, investigate and summarize. The purpose of this research will get some information and experience from children, to observe the interest and understanding of children with STEM. Using this result can make a plan for kids' education on STEM in the future. In the meantime, this study can help educator to get more understanding for the children's mental processes in study.

**Keywords:** STEM Education; Children; Participatory Observation.

## 1. Introduction

Do you know about STEM? Improving science, technology, engineering, and mathematics (STEM) education, especially for traditionally disadvantaged groups, is widely recognized as pivotal to the U.S.'s long-term economic growth and security in an interdisciplinary and applied approach. Rather than teach the four disciplines as separate and discrete subjects, STEM integrates these subjects into a cohesive learning paradigm based on real-world applications [1]. Though the United States has been the top in this area, students who have been focusing on these topics recently is too less. According to the U.S. Department of Education, only 15% of high school students are interested in a STEM career and have proven proficiency in STEM subject [2]. Nowadays, lower than 27% of middle school student showed an interest in a STEM field, a statistic network site showed, but 57% of them will lower their interest in STEM after they graduate from middle school [3].

STEM interest is a good trend in education, human, and societal development. This work will focus on STEM subjects during college study, so in addition to my major, and I have also chosen to volunteer in The Home Team STEM program. It is called "STEM Robotics" and this program in Ponce de Leon Middle School will offer this chance for students to familiar with Robotics STEM Programs [4]. This new type activities will encourage to those kids with lower technique and experience with these concepts while providing new members with an opportunity to serve as a mentor and teammate. This program introduces the students to Lego, a software platform produced by Lego for the development of programmable robots based on Lego Building Blocks. Each version of the system includes an intelligent 'brick' computer that controls the system, a set of modular sensors and motors, and Lego parts from the Technic line to create the mechanical systems [5]. These students learned the following concepts, which enabled them to build and program their own robots with the ability to receive commands directed by the students' using tablets, computers, and smartphones. Students will also learn some simple coding skills. "STEM Robotics" program is constructed in Ponce De Leon middle school, and offers this opportunity for students who study there.

In this study, the interest of STEM in children will be the most important degree. Using Participatory Observation method, it will let me know what are the STEM looks like from kids' viewpoint. Following up with middle school students and finishing STEM program project together, is an important point to do research on kid's STEM education, because the purpose is what these children think about STEM. As you know, STEM is a new education area and definition in the world, so there is probably not have too much experience in education. Nowadays, STEM area education

has occurred in more and more college, but it shouldn't just start at college education. It needs to make students aware this filed when they were young. From high school even middle school, let them have a more study option in the future, so that make a plan earlier. Kid's behavior and what they think about STEM will impact the STEM education style and plan for children.

Concepts at the heart of STEM—curiosity, creativity, collaboration, and critical thinking-are in demand, and they also happen to be innate in young children [6]. This is a comprehensive, creative and unconstrained study area, there are countless kids who have their critical thinking but limited by single study area. STEM education may will rescue them.

The purpose of this research is to observe the children's behavior and interest in STEM area, the help educator to set a plan which focus on STEM education for children. In the rest of part will focus on the method, the process and result observation.

## 2. Related Works

### 2.1 Literature Review

#### 2.1.1 An Effective Approach/Method to Motivate Students in STEM Program

The STEM curriculum is not always delivered with a similar approach. That became evident in research where two ways to teach children STEM are introduced. The results of each study showed a different impact on the kids. In Ceren Orek's study, he highlights LEGO robotics to create game software, but children think they cannot learn this as easily as learning to use a pen or a pencil. In addition, when they are being taught to use this robotics, the perceived difficulty contributes to them gradually losing interest in STEM robotics [7]. Alan Buss from the second research study connects STEM to daily life activity with the students. The student creation of handmade projects in relation to themes close to daily life such as the use of the vacuum cleaner or wind turbines, encourage student interest and motivation [8]. This type of real-world application shows us a stronger impact on student interest and motivation to use STEM applications. In addition, this enhances the confidence of students because they think they can maybe do some good things for the world toward positive change, and make some distribution for the world and may change the world. The approaches to learning STEM can clearly impact student motivation, and the need for organizations to consider their approach carefully cannot be underestimated.

Just like normal education, STEM education is also need begin as early as possible for kids. There is another study which indicated why STEM education should begin in children. In AytüI Üret's study, the effect of STEM education on the creativity of 5 years old children was examined. AytüI Üret delegated the relationship between STEM education and creativity in early years of kids. The semi-experimental method with ppc group is used to observe the difference of creativity level between study and control group. 'Torrance Tests of Creative Thinking Figural A and B Form' were used as data collection tools in the research. As a result of the research, a statistically significant difference was found between the experimental group and control group TTCT pretest total scores ($p<5$). The results revealed that the effect of STEM education on the creativity of 5 years old children attending kindergarten is positive and this effect is permanent [9]. Through author's study, it is not hard to see the important of STEM education for the formation of kid's mind-set. STEM education will cultivate children's individual thinking for all thing in their future.

#### 2.1.2 Purpose of Study

There is an opportunity to educate these kids using researcher's viewpoint and degree. Usually, in middle school and high school, the teaching style is not match with STEM. Join with The Hometeam robotics program will have an opportunity to choose a strong approach around the STEM focus to make kids interested in education, and try to use the feeling and perspective that was the same as a normal middle school students' classmate to treat this young guy. Communicate with them from their point of view to understand what they want, then teach them. The brain development and experience are totally different between kids and college students. My mom is a psychologist, and she always

noted my mental activity from kids to now and told me. I have almost understood my brain and thought development, so I know the thought degree of mine when I was kid. This is a good opportunity to observe how to make sure all kids feel like they have the same opportunity to express their viewpoints to best help them learn the material and feel confident with the STEM concepts that they are being introduced to. Just because it is STEM does not mean they will sustain interest. What will sustain them, is part of what my study is about their involvement and motivation to learn the material presented to their degree, and try to use my way to teach them.

### 2.2 Transition

In the article "The impact of an out-of-school STEM education program on students' attitudes toward STEM and STEM careers", the author pointed out some issues during educating students. student participants' self-efficacy on the computer use declined significantly in this study. Perhaps the learning curve associated with Lego programming during robotics and coding issues while using Scala Game Design affected this result. The survey question included such items as: "It is hard for me to look for answers to questions on the Internet" and "Even if I try very hard, I cannot use the computer just like use paper and pen." They will find these results further by conducting student focus groups in Years 3 and 4 of the study [10]. When they tested the constructs of video gaming, computer gaming, and computer use by type of treatment (gaming only or robotics/gaming), students in the robotics/gaming clubs had significantly higher scores on video gaming. Fortunately, in my home team program, we will use the same equipment to teach students. The only way that is different is the teacher is me, this study will use a different way to teach and lead them rather than the article used.

### 2.3 Method

#### 2.3.1 STEM Education Methods Used for Children and College Students

Teaching for Children and teaching for college students are totally different, and it is important for us as college volunteers to understand these differences to contribute to a program's success. For the kids, ask them the reason why they come to the STEM robotics program, and try to find their interest then talk about that. After that, let them do some basic work in robotics, but this study won't lead them. They should follow their own thinking and creativity to finish this work. The work in this program is to tell them the result of their design, and give my advice. The rest of the work belongs to them, it won't limit what they can do.

For college students, the education methods of professors in UM are to tell us the basic purpose of this work and purpose, then teach us the technique by hands-on-hands. After we get the theory of the class, we will get some additional material to read, work, and get feedback and advice from professors.

Interest Oriented and Participatory Observation will be the education method for children in this study. During the education process, maintain kids' interest will be the first, and observe their behavior.

#### 2.3.2 What I Observed

For this study, volunteers were all college students, so all of volunteers knew the way to educate college students, so this work should to tried to understand and find some ways to approach the education of these kids. These kids looked so excited and looked like they were playing with the toys after the equipment assigned. That is a good beginning, then volunteer told them the purpose of this equipment, and what we should do to finish with that. The program provided hundreds of LEGO bricks and some electronic components like wire lines and batteries. Each time we built-up the members, these kids always shocked me. They didn't just play like the author stated, they are so intelligent and orderly. After they know the purpose and understand the way to execute it, each group guys finish their assignments immediately, who spelled the LEGO, who combined the wirelines, and who woke up the batteries. Even though they had a clear assignment and purpose, they still couldn't find out the right part of bricks, wire lines, and battery, and they always did wrong work during the project. Actually, that's the only part I should do: help them to finish their own purpose. When

volunteer realize they went the wrong way or couldn't find the correct material, they will help them and tell them the right way.

### 2.3.3 The Result of My Observations has Made Me Reflect on My Own Learning

During 5 weeks observation, the deep reason and method to educate children for STEM was found out. In the beginning, volunteer want to talk about what they observed. There were always 4 table teams to finish work each week, and these guys were always in the same group each week. This work has tried to help 4 teams each week, then volunteer realized that the technological level and interest of robotics of each team were different, so that the result and effectiveness of each group were totally different. The second table's guys were intelligent, and they looked like they had too much experience and interest in robotics. Without any help from me or my teacher, they always overfill their work each week. As a result, they accomplished the whole goal of this semester using three weeks. The first and third teams were the hardest trying group, because they obviously didn't have any experience and acknowledgement in STEM and robotics, but they were always keeping a positive attitude to work with, so volunteer would help them as well. They also finished the whole project before the last program time, Congratulations. But the fourth team, volunteer didn't know why they came to the home team program. They looked like they didn't have any interest in robotics and STEM, only focused on their smartphones and talked about what they wanted to do after the program. The result of them was that they didn't finish any job during this semester.

According to my observation, volunteer think the best way to educate children is not about how to teach them, but about themselves. Even though the teacher is the most important in education, this also depends on if the kids like the subject from the deepest of their heart. Maybe the question if children have interest in STEM robotics or another subject has already been decided when they were born. Either the kid has high intelligence or they have a strong interest and are trying to work hard, both of them can be successful. It doesn't matter how volunteer teach them or how they let children learn or get interested. Maybe that is why there are hundreds of majors in college, because each person has their own interest from their genes. Whatever the way to teach them when students were young.

## 3. Discussion

During the research, this work has summarized the two ways which writers did to educate STEM robotics for children. Understanding the impacts of such approaches become important for a Home Team robotic program success. This is because keeping kids motivated and engaged with STEM robotic material. The first approach was using LEGO robotics to create games software, but the result is children think they cannot get an ability like using pen or pencil when they use these types of robotics so that they gradually lose their interest in STEM robotics. Second way is to connect STEM with daily life. Both of two ways above have their strength and limitation. The strength is they let children join with the real STEM study process, but the limitation is these children don not have enough ability to figure out the program which two study provide, so that kids will lose their confident and interest. volunteer think the most important thing to make children interested in is to let them be valuable. During our first program day, volunteer just help the kids to find out what tools he needs, and when he is confused to build volunteer will help him to follow the instructions. During the process, volunteer asked him some questions about STEM and why he wanted to join this program, and his answer was incredible. "I know the future of the world cannot exist without technology, so this study wants to be an engineer, even though my whole family are doctors. This program is the only way for me to get close to technology without my mother's control." This study couldn't believe this was spoken by a middle school student. This kid indicated the importance of interest for children. As I thought, the importance of education for children is finding the correct way to make them motivated to be interested. Also, the difficulty needs to be within their control.

## 4. Conclusion

In conclusion, after done the research and observation of the Home Team STEM Robotics program. The whole process uses participatory observation method for each team's working. When they did the wrong work or didn't know how to do the next step, volunteer could help them. Each week they could finish a part of the whole work, until last week we finished the robot which could be controlled by our laptops. That was successful and useful research.

About the STEM education, this work wishes this education area can be a study option in middle school or high school. First of all, during this study observed, these kids who joined the STEM-Robotic program were all have curiosity, creativity, and collaboration when they finish our job. These guys thinking idea, behavior looks different with almost students in normal class. Secondly, these kids have their own individual/critical thinking already. They have their own reason about why they like STEM, even someone had found some problem in our world, and already have a basic solution plan in the future. These two behaviors and thinking idea is rarely happen in normal education area class in middle/high school. Both of my research and my observation indicated these two points.

# References

[1] Yu Xie, Micheal Fang, Kimberlee Shauman. STEM Education, 2015, 13(5), 5-7.

[2] Ceren Ocak. Integrated STEM education: The impact of an out-of-school STEM education program on students' attitudes toward STEM and STEM careers, 2019, 16(4), 32-33.

[3] Rodger W. Byee, what is STEM education? 2010.

[4] Alan Buss. Journal of science education technology: Using Robotics and Game Design to Enhance Children's Self-Efficacy, STEM Attitudes, and Computational Thinking Skills. Accessed 4 Jun. 2016 Fangfang. Research on power load forecasting based on Improved BP neural network. Harbin Institute of Technology, 2011, 20(3), 15-17.

[5] Kebritchi, Mansureh. International Journal of Cognitive Research in Science, Engineering and Education, 2013.

[6] Janice S. Morrison. Ties STEM education monograph series attributes of STEM education. 2006, 15(7), 97-99.

[7] Ceren Ocak. Integrated STEM education: The impact of an out-of-school STEM education program on students' attitudes toward STEM and STEM careers, 2019, 35(7), 122-125.

[8] Micah Stohmann, Tamara J. Moore, Gillian H. Roehrig. Considers for Teaching Integrated STEM Education. 2012, 79-81.

[9] Aytül Üret. Exploring the effectiveness of STEM education on the creativity of 5-year-old kindergarten children, 2021, 842-855.

[10] Ponce De Leon STEM program Official website, 2022.10.2.