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Master Thesis

Thesis title:

"Increasing students' learning motivation on computer programming by robotics-based instruction / teaching model in a high school of Macedonia"

Translation of the working title in Albanian:

"Rritja e motivimit për mësim në programimkompjuterik nëpërmjet të modelit për mësimdhënie të bazuar në robotikë në shkollat e mesme në Maqedoni"

Translation of the working title in Macedonian:

"Zgolemuvanje na motivacijata pri ucenje kompjutersko programiranje koristejqi model na instrukcij/predavanje bazirano na robotika vo srednite ucilishta vo Makedonija"

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ABSTRACT

In this research work, the impacts of instruction method using hardware control such as robotics in learning programming languages will be examined. We particularly aim to discover the differences between the Practical teaching / learning pedagogy with Robotics and classic learning methods. The technological improvements have changed many aspects of our life-style. Almost everything turned upside-down by the software, which also controls robots. This amazing changes on technological improvements also make us believe some science fiction movies in which we have seen the technology at the top of its level, such as scenes with robots which act like a human being. We see that today technology is not far away from these scenes. A lot of companies are on the search of making a better robot which will serve for the human being. There is a question remaining in our heads. Why don't we integrate this robotics curricula into our school lessons? We found it very powerful to teach students programming languages.

This research work aims to find out how students gain knowledge involving in robotics instruction method and learning programing languages with robotics tools. Teaching programming language via hardware control such as robotics is very popular at this time and will be in the future. We expect this will help students learn programming language with great eagerness by dint of very popular technology ‘robotics’. This study also aims to make a small contribution to the education in Macedonia.

The second aim of this study is to inform computer science teachers about how much their instruction methods based on robotics affect the outcome of their class. We expect that this study will have positive effects to the field of computer science education. The computer science class is different from other classes. Computer science teachers have to use new educational methods because of continuously improving technology. All the world is getting instant information on what’s new in technology via social media. Computer science teachers should take the first step to introduce the news to their students in a practical way. It is the way to help students see the changes on technology in your class.

CHAPTER 1

1. INTRODUCTION

1.1. BRIEF OVERVIEW

Robotics based instruction & teaching model is a new pedagogical model. All the students will have Robomind Academy software installed on their computers. They will practice programming problems using this program. Students will have different materials on the robots for each exercise to make the projects. After programming the robot, they will observe their robots' behavior and then they will make some changes on programming if needed.

As a new model of instruction, robotics can be considered very powerful model to have positive influence on students' results such as their achievements and engagements.

Modern technology takes on an important role in our education system. Everything is surrendered by technology [1] says: "[this]Children encounter digital technologies daily in their lives and they ''know'' what is going on, such as automatic paper towel dispensers that ''know'' when hands wave". Technology is something to be understood not only to use it. We need to raise public awareness of existing and potential of technology. Questions remain in our heads, why don't we use technology while it is everywhere? For example, robotics-oriented problems are really helpful to make the understanding concept of programming languages easier [2]. We need this technology in classrooms. There are many teachers that use robotics as educational tool [3]. Teachers are the leaders to handle this situation. They take important role to change the traditional classes into technological classes.

Besides, usage of robotics in educational processes has significantly increased recently. According to [1] what makes robotics studies popular for educationists is that it's interdisciplinary and project-based learning approach which offers "major new benefits in education at all levels" [10]. Robotics deals with 21st century technologies and can foster problem finding skills, problem solving skills, communication skills, collaboration skills, imagination and creativity [17].

Robotics instruction-based lessons helps students a lot with engaging them in the practices. It brings students in learning curiosity, collaboration between fellow students and so on [11]. According to these gains, usage of robotics in education as a tool increases students' learning and motivation [10]. Moreover, providing robots for students and schools is easier than before. Many schools in the world have started to apply brick-based robotics classes to develop constructionist learning and student thinking [11] which leads students to add computation to traditional construction method [13]. "Robotics is an excellent tool for teaching science and engineering, and it is a compelling topic for students of all ages. However, the art, science, and pedagogy of teaching hands-on robotics is still in its infancy" [12].

PBL (Project based learning) in the concept of Robotics is learning strategy that uses Robotics Project and foster team collaborative working. According to [14] "This learning environment includes all of the robotics development materials. Usage of visual programming and control technologies supports students' discrete learning abilities at school level." In this learning method students ask and refine questions, debate ideas, make predictions, collect and analyze data, draw conclusions, and communicate their findings to others. Thus, students learn with all of their capacity and curiosity.

1.2 Objectives of Research Study

The main objectives of this study are:

- To promote the awareness of technology.
- To promote the usage of technology within Robotics based model.
- To engage students in computer programming and problem-solving activities
- To encourage creativity and initiative.
- To increase accessibility to learning
- To encourage participation in STEM activities in Yahya Kemal Colleges

The main purpose of the research study is to investigate and assess the impacts of the Robotics instruction model on 10th grade Yahya Kemal College students' learning programming in Tetovo, Macedonia. The main aim to compare and assess the differences between the robotics model programming learning pedagogy and traditional learning methods.

The technological improvements have changed many aspects of our life-style. Everything has turned upside down by the impacts of technology development especially in robotics field. Every aspect of our life has been affected by robotics technology; from Computer Numerical Control (CNC) machine to Artificial Intelligence (AI) robot Sophia. These astonishing improvements indicate us to use today's technology(robotics) in education. There are many researches to discover the learning results of the courses that use new technologies in the school curricula. But such studies haven't been conducted in Macedonia till today. This study aims to make a small contribution to education in Macedonia.

Another aim of this study is to inform Informatics teachers about how much their programming lessons using the robotics instruction methods affect the results of their class. The Robotics instructed classes has more positive impacts on learning programming and other disciplines compared to other classes. Robotics instructors have compelling reasons to use new educational methods. These reasons are;

• To lecture the theory & practice in short class time, generally one class hour (45 min). In this regard curriculums are weak.

• Some students may not have the chance to use a robot at home. They may have smartphone or tablet simulators but using a real robot is a totally different experience.

• Students are more motivated when learning through robots.

• Robotics classes are based on learning by doing methodology. (Task-based learning, project-based learning) This makes learning deeply rooted. In this methodology students see the results of their work immediately after finalizing the task and learn better.

• Robotics classes can easily be integrated with other school subjects such as mathematics, physics, arts and design etc.

• Robotics studies are by its nature competitive. While students are trying to complete a task in robotics they compete with their peers and when they complete the task, they run their robot and show their work to others. This itself gives students the mood of competition which can be very motivating at that age.

• Robotics classes teach students the academic value of computational thinking. While programming a robot, students are obliged to think like an AI considering all possible internal and environmental factors which makes them realize the way sophisticated intelligent machines including the human brain work.

CHAPTER 2

2. LITERATURE REVIEW

Robotics instruction model is viewed as using class time for active learning which is applied practically, it also gives great opportunities to help students meet environment in which they will have greater teacher-student and peer-to-peer collaboration and interdisciplinary engagements.

Robotics teaching model also gives opportunities to its learners to meet these different pedagogies:

Project Based Learning (PBL), is way to give the lecture through the projects. While students do them, they also capture the lecture through these projects and practices. PBL is very important method to make learners much more motivated to do the activity and make them focus to complete the project by comprehending the lectures strongly. Students will also learn how to work in a team. This system will recall collaborating workings. ….

Computational Thinking: It is obvious that working with Robotics instructions tasks in the classroom requires computational thinking. Because the robot system works in such a computer system. This is the only way to find the solution of the problems. In a sense we need to contact with robot using the same method (computer thinking). Using such robotics materials and building them in a perfect mechanism which will set a behavior to the Robot to do a task such as hitting a target or changing the direction of it. These kind of practices on the Robot will need computational thinking and it will improve problem-solving skills while students work on it.

Stem based learning: Education within the fields of science, technology, engineering, and mathematics (STEM) has been identified as a key priority in recent times and one that can be well served through robotics-based learning as a gateway R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18). Robotics leads students to deal with Stem areas of education by giving them with active, multi-disciplinary learning experiences that are both practical and require effective engagement to improve problem-solving thinking.

In a sense, the study of robotics actively engages students across all four STEM disciplines. These disciplines we observe through Robotics based instruction teaching model will make students use all disciplines in the same time. It will also develop students' skills from different areas (Science, Technology, Engineering, Mathematics)

Here is the analysis how Robotics engages students across Stem;

- Science – students experiment with and modify the robot, designing plans for the robot to follow which they update based on their observations;
- Technology – students operate the robots and use tools and materials to build prototype solutions, such as building longer fingers to enable the robot to pick up items from a long distance;
- Engineering – students acquire engineering skills as they engage in designing and creating solution scenarios in response to specific problems or challenges, and;
- Mathematics – students utilize a variety of formal mathematical ideas, concepts, and procedures, including measurement, algebra, geometry, and statistics.

Problem Based Learning (Problem-Solving): a wonderful way that directs students to "learn to learn"; Students in groups are looking for solutions to real world problems, which are based on a technology- based framework used to engage students' curiosity and initiate motivation, leading so to critical and analytical thinking *Alimisis, D., Moro, M., Arlegui, J., Pina, A., Frangou, S., & Papanikolaou, K. (2007, August)*

2.1 ANALYSES OF ROBOTICS

This thesis targets to find out if there is any benefit of the robotics-oriented lessons on the students' learning in the information and computer technology (ICT) lessons and if it has any advantages over the traditional teaching methods in the computer science lessons. The integration of robotics into classroom instruction can improve the students' learning motivation.

Another important role of the research is building a communication opportunity between teacher and student. Project based learning pedagogy will be very helpful to do this job. Students will always be contacted while they do projects or other tasks in class.

This research also deals with computational thinking. Robotics-oriented classes will be observed within project-based learning pedagogy. There are plenty of competition in robotics category. Students will get prepared for the competitions. It will be a wonderful tool to make students always motivated in training their robots. They will get more than robotics when they go to competition areas such as friendships, interest in technology and a wish to learn more related to engineering and computing PETRE, M., & PRICE, B. (2004, June).

As an instructor, especially a computer science teacher, we have to show our students correct ways to learn the discipline with interest and eagerness. We have to guide them to deal with these useful disciplines such as robotics. Students always have tendency to lose a lot of time on computer. We play significant role in preventing it. Teacher-Student interactions will fix this problem and turn it into making their time useful.

In recent years using Robotics Technology in education has become very popular and it can be a standard of teaching-learning practice to increase students' active learning in higher education. Rapidly developing technologies in general, and specifically robotics make different kind of learning opportunities possible, considering the new ways to encourage peer social interactions, and also leads to increase the creativity, social, and cognitive development (R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18)). Considering the falling the number of the science and technology students, as an educator we have to drag students' attentions to these disciplines as early as possible (PETRE, M., & PRICE, B. (2004, June). Numerous arguments meet on generating and sustaining students' motivation. Many writers support the robotics as an educational vehicle (e.g.,Kumar and Meedan 1998). Robotics plays very important role to make students deal with technology directly instead learning the things theoretically. Learning the things not only theoretically but also practically makes the knowledge stay longer time and hence the abstract ideas becomes more concrete.

Teaching through robotics will be powerful tool for education system to combine with other disciplines that robotics utilizes (R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18). This is what our education system and our generation looking for. We will let students learn many disciplines at the same time while they touch the knowledge. Possible benefits of robotics-oriented classes will positively influence students' learning and motivation Fagin, B., & Merkle, L. (2003). Students need to be motivated for learning through this methodology. Just reading words on the document is not sufficient to be successful in our time; Learners should be perfect in reading, comprehending and dealing with different multimedia (American Library Association (ALA) 2000; Thoman and Jolls 2003).

We have seen that Robotics-oriented lessons change the environment of the class positively. It increases the active learning. Students don't need to have background to learn

programming in robotics (YANCO,, H., MEEDEN,, L., & College, S. (2003, December). All of the students become active learner in robotics classes because of its attractiveness and its perfect concept. One of the most affected and attractive part of applying robotics-based teaching to curriculum is project-based learning (PBL). PBL is very powerful strategy that would increase student' motivation and lead to self-directed learning (Blumenfeld et al., 1991).

We will utilize PBL (Project based learning) in the concept of Robotics-oriented lessons. Students will find solutions using problem-solving strategies and they will learn from mistakes (PETRE, M., & PRICE, B. (2004, June). It will show them how to think and how to solve the problems within steps. PBL is one of the most productive way to make the subject much more understandable compared to other ways. Instructor forms groups comprise between 2 and 4 students. Group members try to solve the problem given by instructor. Learners makes a great collective work while they struggle to figure out the solution. It helps them to discover a lot about mechanism, programming and dealing with different ideas.

According to some educators' opinions through hands-on experimentation, robotics helps students to understand the abstract science, engineering and technology (SET) in concrete concept level (Barker, B. S., & Ansorge, J. (2007) which helps students to make a connection between SET and real-world. They gain amazing understanding through these robots such as learning mechanism while they connect some robot pieces each other. The Projects are done in class gives to the students a lot experience about figuring out new mechanism which also drags them to learn much more about constructions and engineering. Learners connects this engineering mechanism with technology (programmable platforms) to get the robots. They start learning our technology age at their early ages which gives them a lot of advantages and motivations to invest for their future.

With the Robotics model, the new learners show better performance compared to traditional model in different level of learning categories as it shown in Table 8. Students in robotics classes spend much more time in practice while other class do in theory. In Robotics classrooms, students go from the lowest level(remembering) to achieve the highest level (creating). PETRE, M., & PRICE, B. (2004, June) mentioned that the important role of applying this model to lessons is to drag student's attentions to discover concepts and ways that are mostly considered difficult. They start asking questions about the concept or principles they are trying to deal with and also look for the answers, because robotics makes

students to succeed what they want to accomplish. The desire ‘make it work’ plays also significance role on students working performance and motivations.

2.2 Area of Studies in the Robotics

Besides the different methodologies used in robotics classroom research, there were many areas of study where the robotics classroom had been implemented. The analysis of this explored the research question "What areas of robotics classroom studies have been researched?" and “What subjects are involved in robotics studies?” This study reported that the robotics classroom had been implemented in various areas of study. (R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18) mentioned that robotics can be used as a gateway to the STEM which makes robotics linked with other study areas.

According to Hill, A. O. (2015) various studies in robotics classroom in recent years showed different fields of studies, including science, mechanical engineering, electrical engineering, computer science and even psychology.
Some core lessons directly connected robotics studies are:

- **Mathematics**: For good understanding of algebra and geometry
- **Physics**: Electrical circuits, mechanics, material science and other key topics for robotics.
- Other Useful subjects are connected to robotics studies;
    - **Computing and Programming**: Programming is the very important for Robotics. This is the way programmers can instruct the robots to make him do a movement
    - **Design and Technology**: Design has important role to give good looking to the robot and affects its performance.
    - **Specific Engineering Disciplines**: Automotive, Bioengineering, Electronics, Mechatronics and Mechanical engineering. All of these can be beneficial for aspiring roboticists.
    - **"The Body" - Mechanical Engineering:** This branch of engineering looks at the physical systems which make up a robot.
    - **"The Nervous System" - Electrical and Electronic Engineering:** This branch of engineering gives a basis in electronics, embedded systems, low-level programming and control theory.

Various technology tools or online/offline platforms have also been used in robotics classroom research. Therefore, this section will find the answer to the research question "What technology tools or online platforms have been used for implementing the robotics classroom?". In implementing the Robotics classroom model to the class, there are some technology tools which are listed in Table 1.

There are many researchers that they used different robotics tools for their studies. Most of them preferred to apply it by Lego robotics products. Lego Mindstorm is one of them, there are four reasons (Cost, Flexibility, Student Interest, Professional Curiosity) why it was selected for lessons (*Klassner, F., & Anderson, S. D. (2001)).*

1. **Cost:** Lego Mindstorm education kit with about 540 construction pieces, sensors, motors, programmable hardware is around 400€
2. **Flexibility** : The Mindstorm education kits support reusable constructions with bricks pieces, sensors(touch, rotation, color and ultrasonic) and motors(Large servo and gyro). Platforms of similar price to Lego Mindstorm mostly needs soldering or one-shot construction methods that makes their reuse in courses not useful and impractical (*Klassner, F. (2002, February 27)*).
3. **Student Interest:** Most of the students can be considered that they are familiar with Lego products already, because of their practices at their early ages with Lego bricks(*Klassner, F., & Anderson, S. D. (2001)).* Considering their background at Lego bricks, students enjoy working with Lego pieces at high interest.
4. **Professional Curiosity:** Robotics practices also ignited student's curiosity to the top level. It gave them courage and motivation to build whatever they want by focusing on 'making the robot do what I want (*PETRE, M., & PRICE, B. (2004, June)).* This way leaded students make different inventions. They got a self-confidence at building robots.

Table 1. Technological Tools or Online/Offline Platforms in Robotics Classroom Research

Source: (author, year)	Technology tools or Online/Offline Platforms
YANCO, H., MEEDEN, L., & College, S (2003, December)	Handy board and Lego Mindstorms
Klassner, F. (2002, February 27)	Lego Mindstorms
R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18)	Lego Wedo
Alimisis, D., Moro, M., Arlegui, J., Pina, A., Frangou, S., & Papanikolaou, K. (2007, August)	Lego NXT
Barker, B. S., & Ansorge, J. (2007)	Lego Mindstorms
PETRE, M., & PRICE, B. (2004, June)	Lego Mindstorms

Using robots as a tool to assist in teaching of programming languages started becoming popular by some educators (*Barnes, 2002;Fagin & Merkle,2003).* For example, (Fagin and Merkle (2003)) and (Barnes (2002)) utilized robots to guide their students to learn programming languages of Java and ADA. It helped them to understand the basics of programming structures. It also helped them out to understand the engineering concept and mechanical aspects of the robot (Beer et al.,Nourbakhsh et al.,2005).

Programming robot behaviors is carried out using the programming languages. We can see the list of programming languages that are used during the different researchers' practices at their work (Table 2). Almost every robot has its own application programming interface (API). They are based on different programing languages such as Python, C, C++ ... *YANCO,, H., MEEDEN,, L., & College, S. (2003, December).*

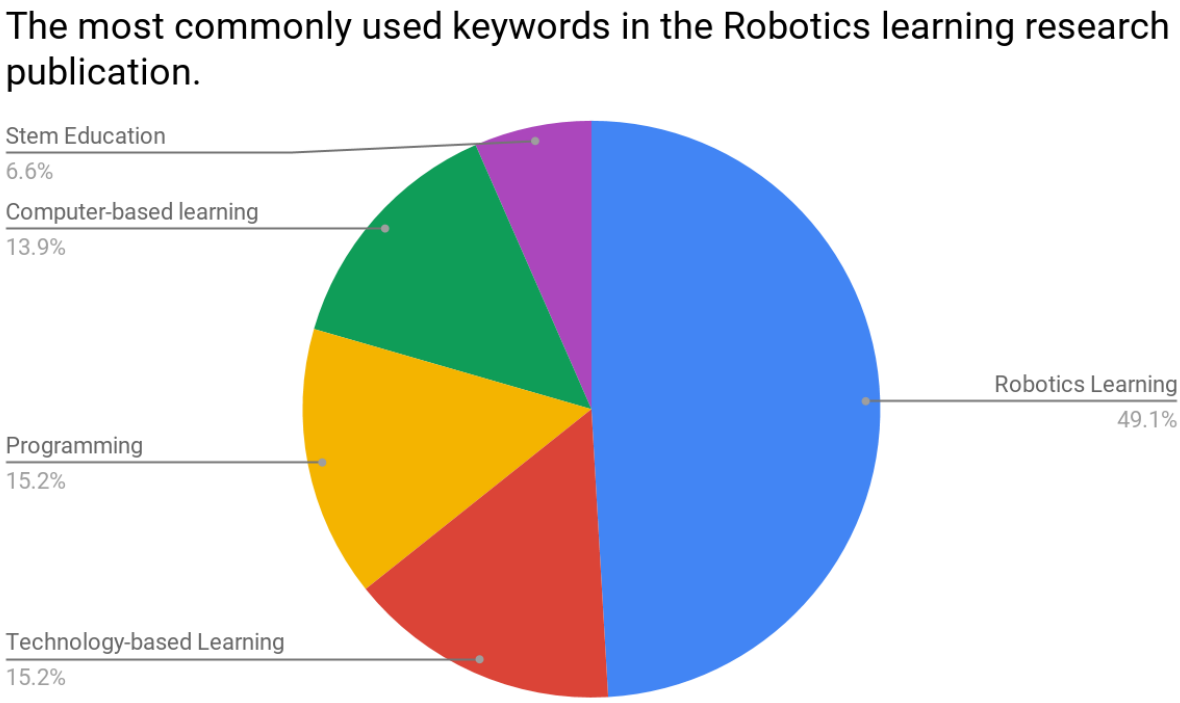
Table 2. The Programming Languages are used in Robotics Classroom Research

Source: (author, year)	Programming languages that are used during the courses
Fagin,Merkle(2003) and Barnes*(2002)*	Programming Languages of Ada and Java
Klassner, F. (2002, February 27)	C, Java and Lisp
YANCO,, H., MEEDEN,, L., & College, S. (2003, December)	Python
R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18)	CHERP
PETRE, M., & PRICE, B. (2004, June)	C

Regarding a lot of articles that are written, keywords have a significant role in journal publication and they define the outlines of the researcher's ideas. The researcher has to choose correct keywords for their journal articles publications, well-chosen keywords help their articles to be rapidly identified and cited by others (M. G., & B. F. (2017)). Otherwise, readers would not be able to find articles without those relevant keywords.

Through the keywords we can reach the main concepts of the research and make an analyze for its benefits, findings and earnings to our study area. Using more than 10 journals related to Robotics instructed courses, I found more than 10 keywords which were defining the content of the research. I selected most used keywords in the chart below (Figure 03). Robotics learning was used as the main keyword, followed by Programming, Stem Education, Computer-based learning, Technology-based learning.

Figure 3.



Mataric, M. J. (2004, March) said that: "Robotics is a growing field that has the potential to significantly impact the nature of engineering and science education at all levels, from K-12 to graduate schools". It's an excellent tool that are compelling students to study.

According to some researchers' reports, learning robotics is pretty fascinating and helps students to get prepared for the SET subjects. (*Fagin, B., & Merkle, L. (2003)).* Also some researchers noted that female students had more tendency to use robotics as a tool than traditional SET teaching techniques *(Nourbakhsh et al., 2005;Roger & Protsmore, 2004)*

2.3 Impacts on Students' Learning

It is expected that students will be more motivated and learn many aspects of how to program quicker and better using lego robotic tools such as EV3 Mindstorms, Nxt or one of the Lego Wedo robot series. In case those tools aren't supplied to the classrooms, there is still

a solution to make class deal with robotics environment using simulated platforms like the ROBOTC Robot Virtual World (RVW) and Robomind Academy. The simulation environment prevents potential problems which are related with a robot's electronics, mechanics, power, and placement allowing the students to focus on troubleshooting their code rather than their robot (Major, Kyriacou , & Brereton 2011). But still working with real robot tools more rewarding than simulated platforms.

(American Library Association (ALA) 2000; Thoman and Jolls 2003) said this:" Just reading letters on a page is no longer enough to be successful in the twenty-first century; children also need to be fluent in reading, understanding and communicating with different forms of multimedia". Being familiar with current technology is an amazing advantage for young generations to get acquainted with them at their early age.

Robotics-oriented classes will include project-based learning (PBL) methodology in which students will complete some tasks for each lesson. This teaching model will lead every single student will try to complete the tasks or projects in the influence of competitiveness of other groups. PBL in robotics lessons will be much more powerful with its visual attractiveness. Visual world attracts students' attention which also motivates them doing the tasks with great eagerness.

Controlling the things with your commands always become charming. We expect students in robotics classes to be much more motivated learning programming languages under the statement of "making the robot do what I want" PETRE, M., & PRICE, B. (2004, June). The following table (Table 4) summarizes students' effective learning achievements in robotics classroom research

Table 4. Students' Achievement

Author(s) and year	**Impacts**
PETRE, M., & PRICE, B. (2004, June)	Many of the children found some topics difficult, but later they become easier to them by robotics
(Nourbakhsh,Crowley, Bhave, Hamner, Hsium, Perez-Bergquist, Richards, & Wilkinson, 2005).	Working with scientific and mechanical principles of robotics, Students can understand abstract concepts and get more functional level of understanding

Fagin, B., & Merkle, L. (2003)	Robotics Teaching is more interesting and helps students to increase their study performance to Science, Education and Technology (SET) subjects
Karahoca, D., Karahoca, A., & Uzunboylu, H. (2011).	Robotics activities help students to develop their skills cognitively.
Karahoca, D., Karahoca, A., & Uzunboylu, H. (2011).	Robot making works had a great role to increase students' capabilities and self-confidence
Klassner, F. (2002, February 27)	Robotics projects have more positive than negative influence on students' appreciation of the issues behind design of "hardware-software" agents.
Klassner, F. (2002, February 27)	Robotics gave students strong understanding of the concepts in project goals

Student's Motivation Besides students' achievement or effective learning, students' motivation also has important place in implementing the robotics classroom. Motivation is something relevant with action. In a sense it is the sparkle of the initial of the fire. Gulcan, A., & Fetaji, B. (2017) said this: "In education, motivation is acknowledged as one of the most crucial elements which support students' performance and achievement ".

Some researchers showed that robotics has great influence at learning and motivation Fagin, B., & Merkle, L. (2003). Motivation is most crucial part of learning process which takes significant role to lead to the success. As it is listed in table (Table 5) where impacts of the Authors' have mentioned.

Table 5. Students' Motivation

Author(s) and year	Impacts
PETRE, M., & PRICE, B. (2004, June)	There are many arguments they centre on generating and sustaining students' motivation
Fagin, B., & Merkle, L. (2003)	Different age groups show that the potential effectiveness of robotics has influence on both learning and motivation
PETRE, M., & PRICE, B. (2004, June)	The desire to "make it work" gave sufficient motivation

Students' Engagement The following positive impact is extending students' engagement. Most researchers agree that the purpose of robotics instructed courses is to establish students' engagement with active learning.

Wonderful opportunity of Robotics is applying different disciplines together with robotics instructed teaching. It engages students with other subjects. For instance, teaching children about programming and robotics using appropriate methods could be powerful tool for educating them across multiple domains (R. *Kazakoff, E., Sullivan, A., & U. Bers, M. 2012, October 18).* Robotics generates high interest and engagement at students and promotes this interest in math and science career (Barnes, D. J. 1999).

Table 6. Students' Engagements

Author(s) and year	Impacts
Barnes, D. J. (1999)	Robotics generates high interest and engagement at students and promotes this interest in math and science career
Rogers, C., & Portsmore, M. (2004).	Robotics is a helpful tool to teach mathematical and scientific principles
R. Kazakoff, E., Sullivan, A., &	Teaching children about programming and robotics using

U. Bers, M. (2012, October 18)	appropriate methods could be powerful tool for educating them across multiple domains
R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18)	Through Robotics, they can learn technology, engineering, math's and also sequencing skills
PETRE, M., & PRICE, B. (2004, June)	In Robotics students also learn problem-solving techniques and processes

Students' Interaction Students' interaction is the other positive impact of Robotics Instructed courses in the classroom environment. Robotics as a new technological device has great influences at building better peer social interactions (*R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18).* By the contribution of robotics students will gain attitude to give value to the teamwork(collaborations). Collaboration means sharing, helping, supporting, encouraging and giving self-confidence each other. It is another career skill that robots appear to foster (Nourbakhsh et al. (2005) and Beer et al. (1999).

Table 7. Students' Interaction

Author(s) and year	**Impacts**
R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18)	Robotics as new technological device has a great influence at building better peer social interactions
Alimisis, D., & Kynigos, C. (2009)	Programmable robotics constructions have a great role to enhance students' learning science and technology concepts
Nourbakhsh et al.(2005) and Beer et al. (1999)	Teamwork is another career skill that robots appear to foster
Karahoca, D., Karahoca, A., & Uzunboylu, H. (2011).	Robotics is applied in PBL (Project Based Learning) which lead students to make collaboration

CHAPTER 3

3. Research Methodology

Our study is built on numerous studies involving teaching novice programming using robots. This study is an action research. Participants of this research are divided into two groups of the second-grade students of Yahya Kemal College in Tetovo. One of the classes is assigned as a control group, and other were assigned as the experimental group. A preliminary survey from all groups are conducted. This survey questions aim to find out the student's background knowledge of their logics such as how to solve an algorithm issue.

Two different powerful programs (Codeblocks and Robomind academy) will be used. One group will use CodeBlocks which is a compiler of C/C++ Programming languages. They will have some exercises in programming languages. They will use that platform to compile and run their programs. Another group will use Robomind academy where students will also code, run and see the robot's behaviors from virtual view. Robotics group will use any desired browser to reach the Robomind academy' website. The main programming mode will be the computer. Ev3 Mindstorm Lego Education set also can be used in robotics classes if there is enough financial support.

It is expected that students will be more motivated and learn many aspects of how to program quicker and better using a robotic simulation environment like the Robomind academy. (Major, L., et al. 2011) said that: "The simulation environment destroys potential problems connected with a robot's electronics, mechanics, power, and placement allowing the students to focus on troubleshooting their code rather than their robot." Although it seems easier to work with Simulation environment, still working with real robots is great experience. You will not only build and code a program. It will give you more disciplines to reach by robotics (R. *Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18).* Other group will also learn programming in a traditional way without additional interface like in robotics classes (virtual world). They will learn basics of programming language with C++ using Codeblocks compiler. Both groups will follow the similar curriculum.

Robotics-oriented classes will have project based learning in which students will complete some tasks for each lesson (Karahoca, D., Karahoca, A., & Uzunboylu, H. (2011). Because virtual world attracts students' attention, it also motivates them doing the tasks with great eagerness. Controlling the things with your commands always become charming. We

expect students in robotics classes to be much more motivated to learning programming languages under the statement of "making the robot do what I want" PETRE, M., & PRICE, B. (2004, June).

Most important part of this pedagogical model is to give a very powerful interactive learning. Especially collaborative working is great study model that contributes a lot to team members. In teamwork, members can come up with an idea faster than their individual performance. It helps to implement peer-peer communications (*R. Kazakoff, E., Sullivan, A., & U. Bers, M. (2012, October 18).* In collaboration, members will work together respectfully, they will think together which will make them to talk about the similar problems and solutions. Collaborating will empower their union. Sharing their knowledge in team will be their policy. Everyone in team will learn how to solve the problem after their collective work.

In this study, the same objectives for both groups were used. The tests, quizzes and observations were collected and recorded. Furthermore, questionnaires were recorded and transcribed for analysis.

The research target group are the 10th grade students of Tetovo Yahya Kemal College. There are 2 different classes with around 20 students each: II-A, II-B . According to 6-7 weeks lessons experience, each class has approximately the same educational background of computer science lessons.

3.1 Research Questions and Hypothesis

Robotics as a newly appeared school subject provides new learning atmospheres for students and new pedagogical approaches for teachers. A classroom with robotics materials on desks is a reason to make children excited for a new learning experience. Additionally, the study of robotics helps the teacher to introduce or strengthen many science subjects such as geometry, math's and physics. We find students have more eager and top curiosity while they practice with robots. It brings new challenges to overcome

One of the problems is that, robotics as a school subject is nonexistent in the high school curricula in Macedonia except for a few private high schools. When we include robotics lessons in the curricula, we encounter with the difficulty of having some extra classes weekly to teach learners about the concepts of robotics in terms of mechanism and programming. After a while it turn out to fun by students' deep interest to this subject. Of

course, they needed to devote some extra time to comprehend its fundamentals and get the skill of programming.

Second problem is that, considering the cost of a Lego EV3 set for teaching robotics which is around 400 euros, for the average Macedonian parents it is too much to afford. Hence, the best solution seems to use the robots at school. This makes home practice impossible for students.

Third problem is that, robotics practice needs a tutor because it requires the programming skill which is hard to achieve without the guidance at the amateur level. By tutor guidance students acquire the programming skill

Considering the situation of the high school students' programming learning, contribution of robotics classes in Macedonia and the problems mentioned and arguments are shown previously. Problems devised the hypothesis as below.

"Does the robotics instruct model has a positive impact on the student learning in the Programming learning?"

The research questions are:

- "Will The robotics-based teaching / instructional model in Computer Programming lessons be more efficient in the aspect of motivation of students to learn and in general?"
- "Will this methodology improve the results of learning?"
- "Will this methodology increase the motivation to study and learn programming?"
- "Will this methodology increase the comprehension of the programming concepts?"

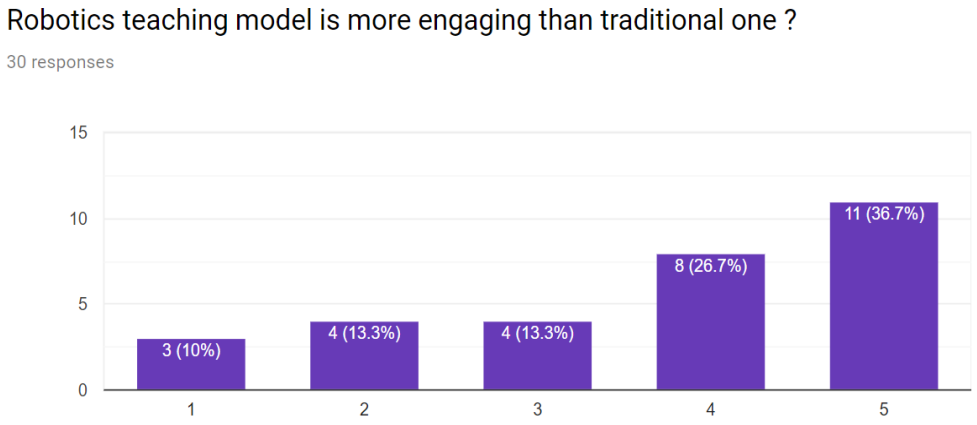
CHAPTER 4

4. RESULTS AND DISCUSSIONS

In order to get the learners' feedback and get the impact of the research study we have asked 21 questions to 30 participants in questionnaire. Considering learning methods used in courses, the general level of learning and hypothesis, we have prepared the questions. The results are given below.

In this chapter, the results are analyzed of the survey, considering all the responses of 1's and 2's as disagree and rest of the answers as agree

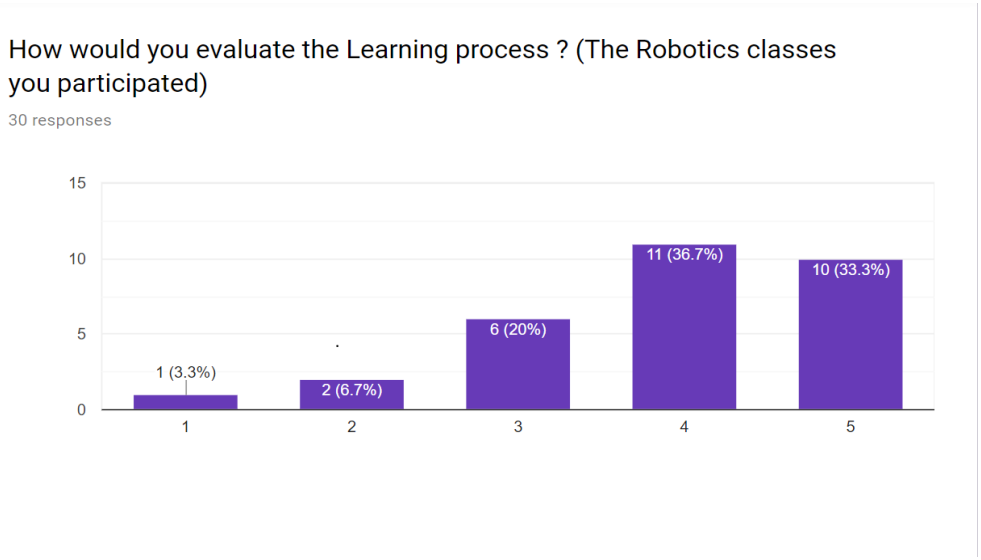
Figure-8. Results from comparison between robotics and traditional methods at engaging



Q1. Robotics teaching model is more engaging than traditional one?

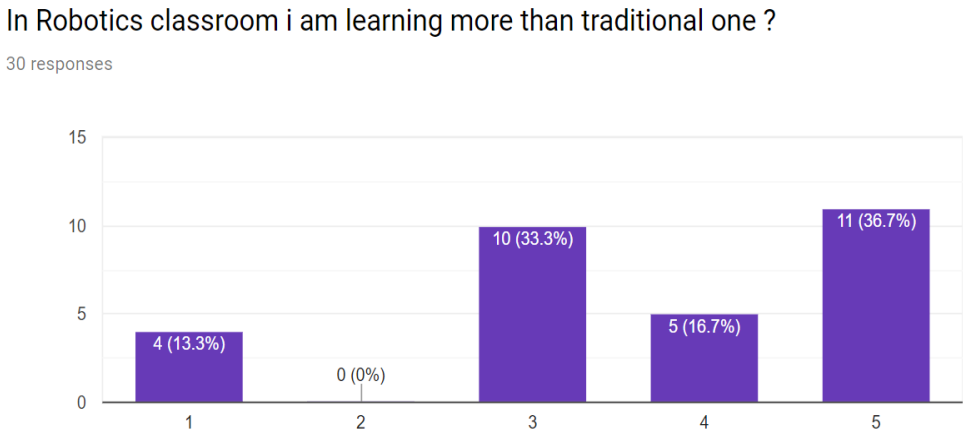
According to the diagram below shown in the figure 8; we can say there were 27 positive answers and 3 negative answers which makes %90 agrees and %10 disagrees. So, attractiveness of robotics lessons made students to love the learning which directly led students to engage.

Figure-9 (Evaluation of Robotics)



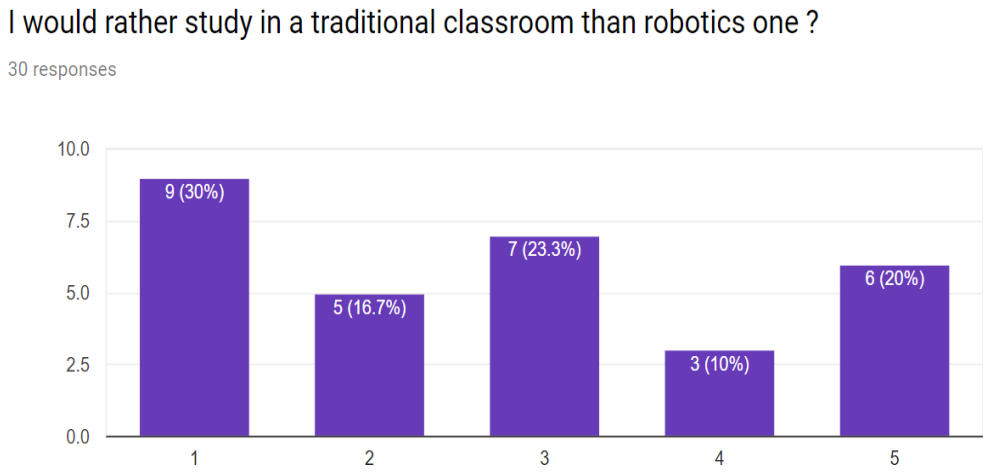
There were 23 positive answer and 7 negative answer. Considering those answers, we can say %76 agrees and %24 disagrees at this question. According to results, Robotics classes gave high points as a feedback to the applied program. We can say that, learning with robotics is wonderful.

Figure-10 (Results from comparison between robotics and traditional methods at learning level)



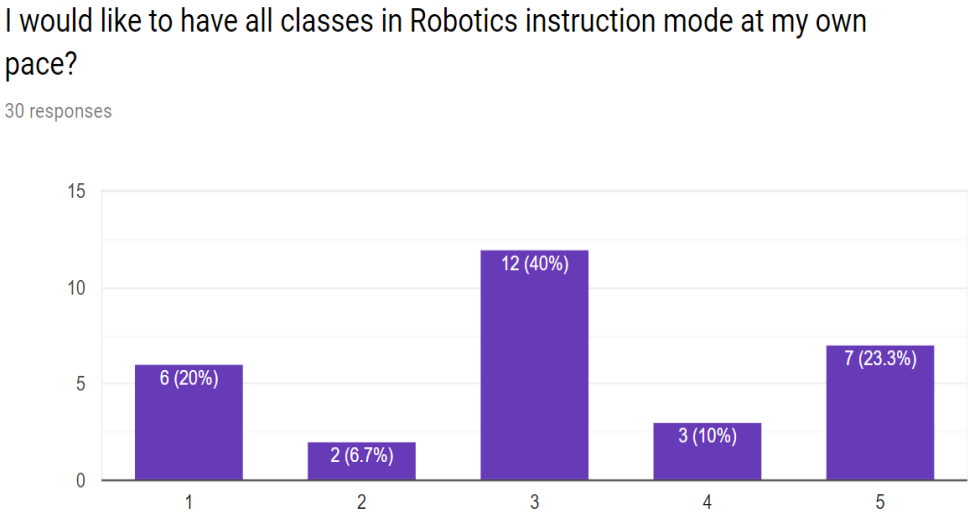
There were 26 positive answer and 4 negative answer. Considering those answers, we can say %87 agrees and %13 disagrees at this question. Students learn better using robotics methods. Almost all class enjoy learning with robotics. It also shows the power of usage of technology in class.

Figure 11. Results from assessing the methodology and approach undertaken



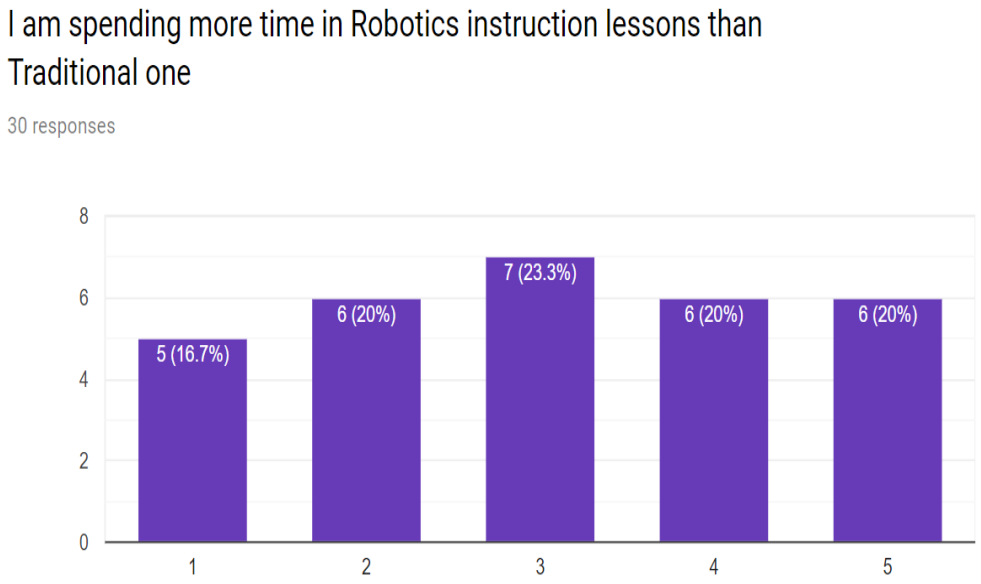
There were 16 positive answer and 14 negative answer. Considering those answers, we can say %53 agrees and %47 disagrees at this question. A little bit more than %50 of class likes to study at traditional method. We can't underestimate the efficiency of the traditional classes while the results show very good values in the graph.

Figure 12. Results from assessment of participants on their attitudes



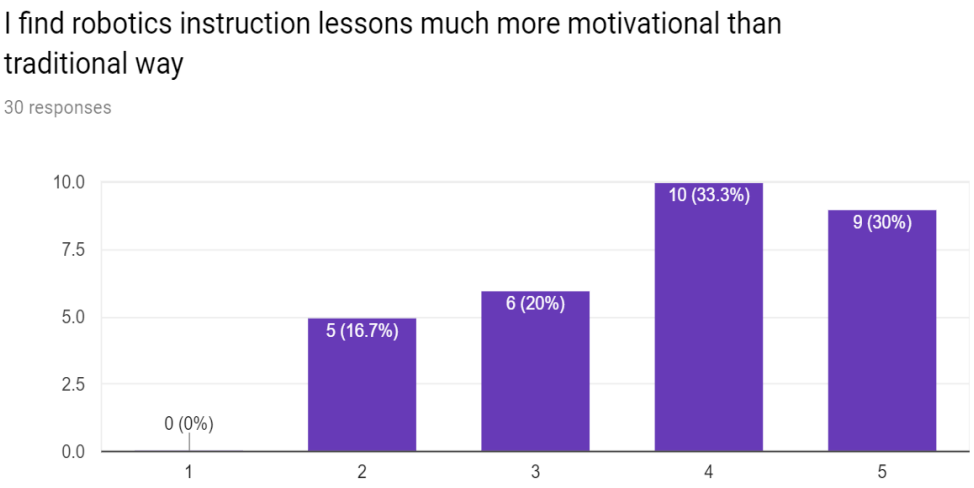
There were 22 positive answer and 8 negative answer. Considering those answers, we can say %73 agrees and %27 disagrees at this question. It a sense students are able to manage learning the instructions at their own paces using robotics instructions.

Figure-13 Results from assessment of participants on their attitudes



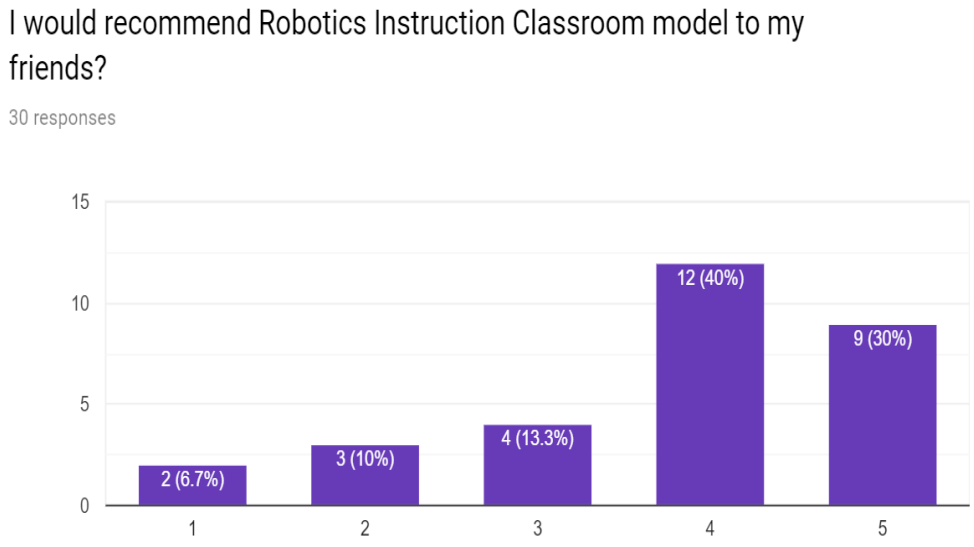
There were 19 positive answer and 11 negative answer. Considering those answers, we can say %63 agrees and %37 disagrees at this question. It means most of the class spends their time at robotics instructions. It also makes them to enjoy it. We mostly spend more time on the things that we love.

Figure-14 Results from assessment of participants on their motivation



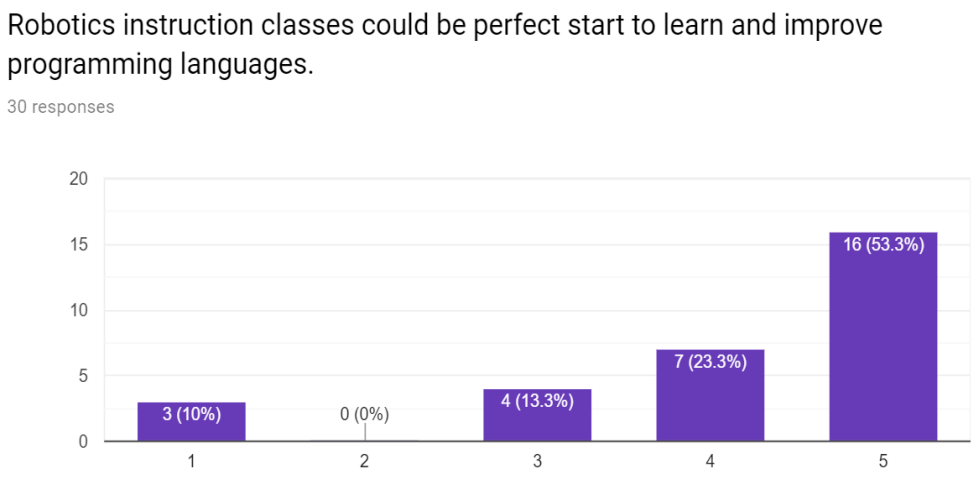
There were 25 positive answer and 5 negative answer. Considering those answers, we can say %83 agrees and %17 disagrees at this question. It makes robotics instructed lessons much more motivational. Robotics based model encouraged them to do the task. In a sense, we can say that, it helped them a lot to ignite the curiosity which took a role for maintaining the tasks till the end.

Figure-15. Results from assessment of participants on their motivation



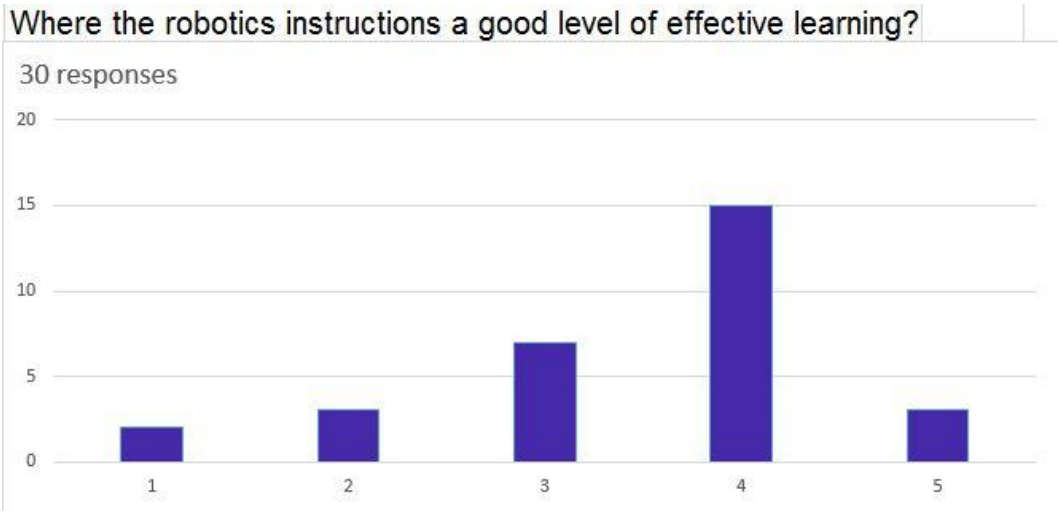
There were 25 positive answer and 5 negative answer. Considering those answers, we can say %83 agrees and %17 disagrees at this question. %83 of the class like to recommend robotics lessons to their friends. Even if we assume, no one recommends for Robotics lessons. I have seen some students who asked me to participate robotics classes. They were under influences of robotics students' performances which already built robotics love in themselves.

Figure-16 (As a perfect start tool to programming learning)



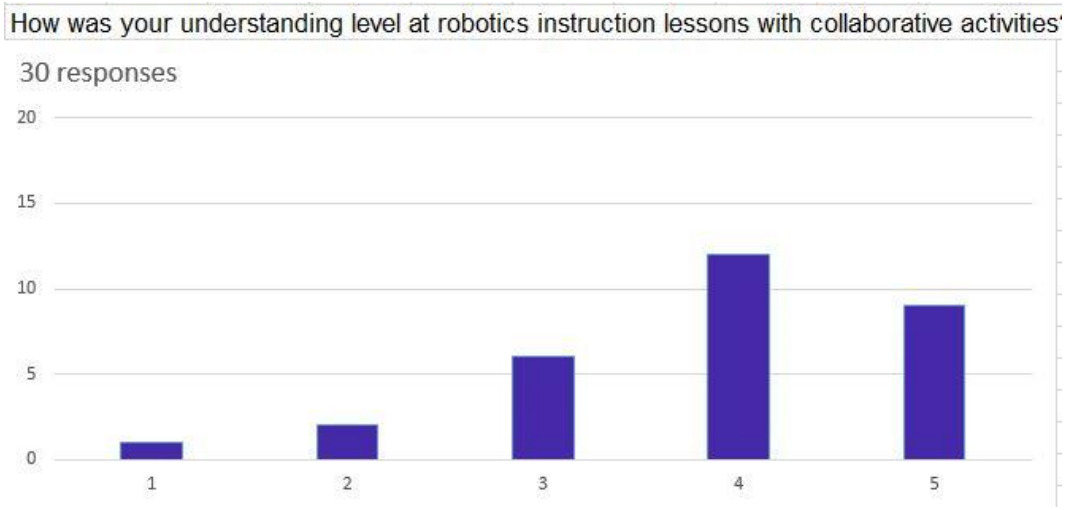
There were 27 positive answer and 3 negative answer. Considering those answers, we can say %90 agrees and %10 disagrees at this question. Programming is really challenging and hard to start. As we see from the results, robotics is a wonderful start tool at learning programming languages.

Figure-17. Results from the impact of internal factors



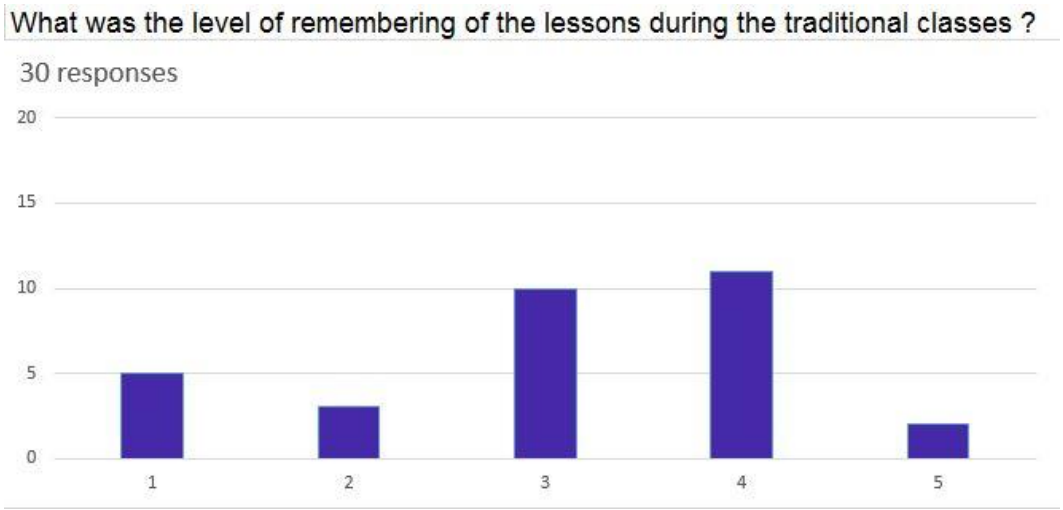
There were 25 positive answer and 5 negative answer. Considering those answers, we can say %83 agrees and %17 disagrees at this question. It makes us to accept of effectiveness's robotics instructed lessons based on 2 different classes' responses to the survey. The result shows that it is an applicable program as effective learning tool in programming lessons.

Figure-18 (The effect of collaborative activities to students' understanding at robotics)



There were 27 positive answer and 3 negative answer. Considering those answers, we can say %90 agrees and %10 disagrees at this question. Robotics encourages students work together and they understand better while help and learn from each other. Results also proves that collaborations increase the comprehension level at learning process.

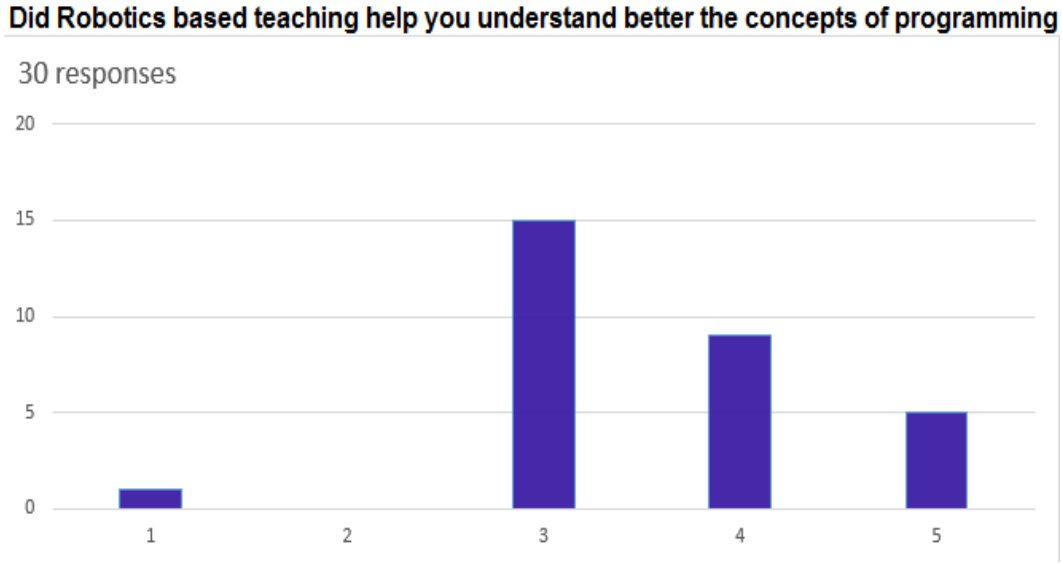
Figure 19 (Remembering level of the Traditional Classes)



There were 25 positive answer and 5 negative answer. Considering those answers, we can say %74 agrees and %26 disagrees at this question. Although very few students vote excellent

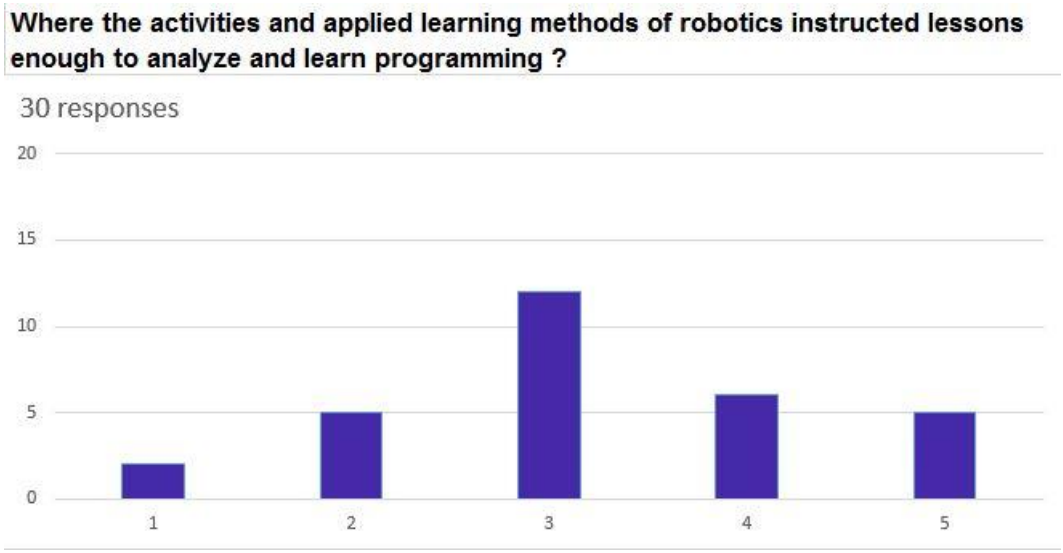
point, most of the students kept the remembering level of traditional classes very good by voting 3's and 4's. We can say that remembering level was pretty well at traditional classes.

Figure-20 (Understanding level of the Programming at Robotics)



There were 29 positive answers and 1 negative answer. Considering those answers, we can say %96 agrees and %4 disagrees at this question. This huge percentage shows that Robotics has excellent impact on programming learning.

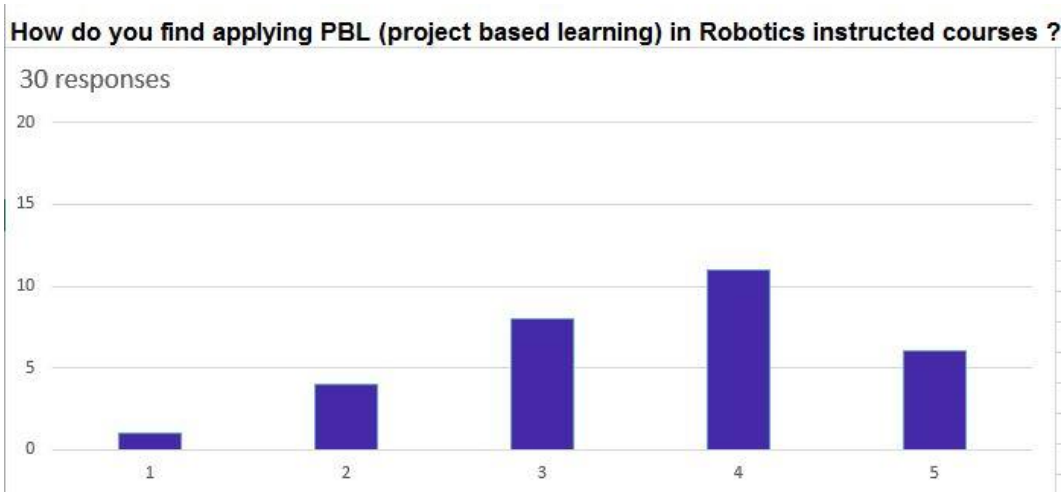
Figure-21 (Activities level of the Robotics)



There were 24 positive answer and 6 negative answer. Considering those answers, we can say %76 agrees and %24 disagrees at this question. The rich content of the applied robotics

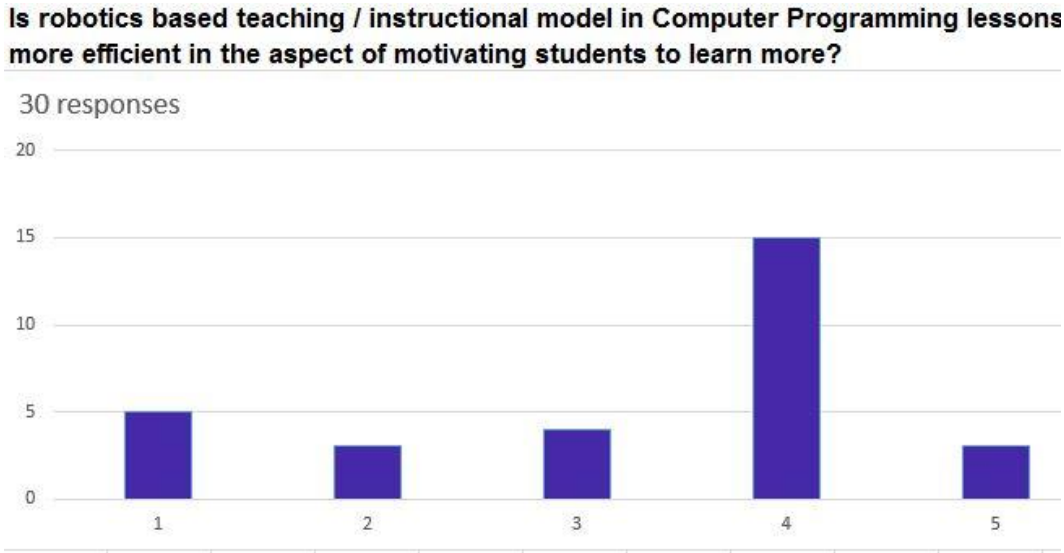
program was sufficient to teach the concept of the programming. Results also support that robotics instructed lessons with its plenty of practices was pretty attractive.

Figure-22 (PBL (Project Based Learning) at the Robotics)



There were 25 positive answer and 5 negative answer. Considering those answers, we can say %83 agrees and %17 disagrees at this question. Robotics lessons become much more helpful to students through PBL. We can also see it from the results that PBL makes students much more confident at maintaining and finishing their project successfully.

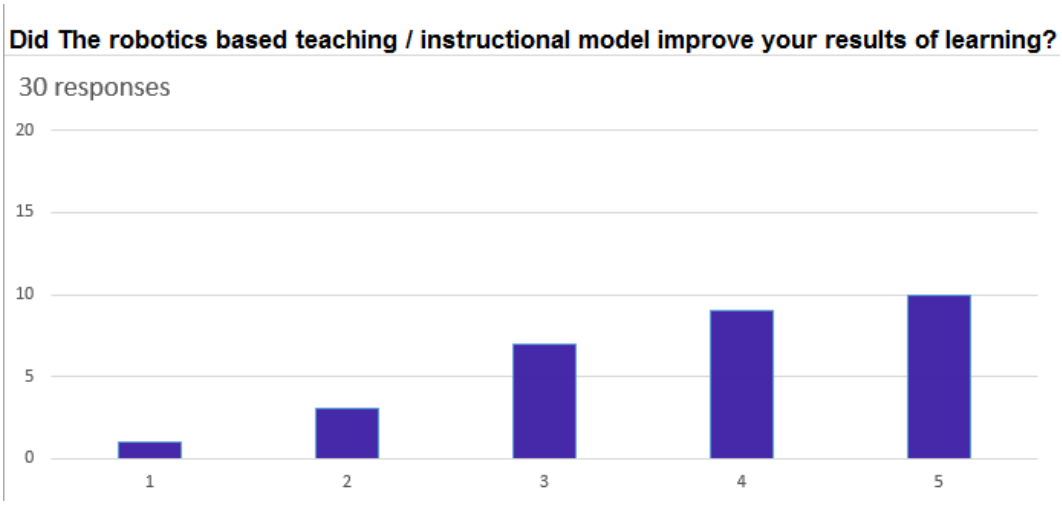
Figure-23 (Efficiency of Robotics classes on programming lessons)



There were 22 positive answer and 8 negative answer. Considering those answers, we can say %73 agrees and %27 disagrees at this question. Although it is not acceptable by some students, most of the students agree that it is pretty motivating. Those students were already

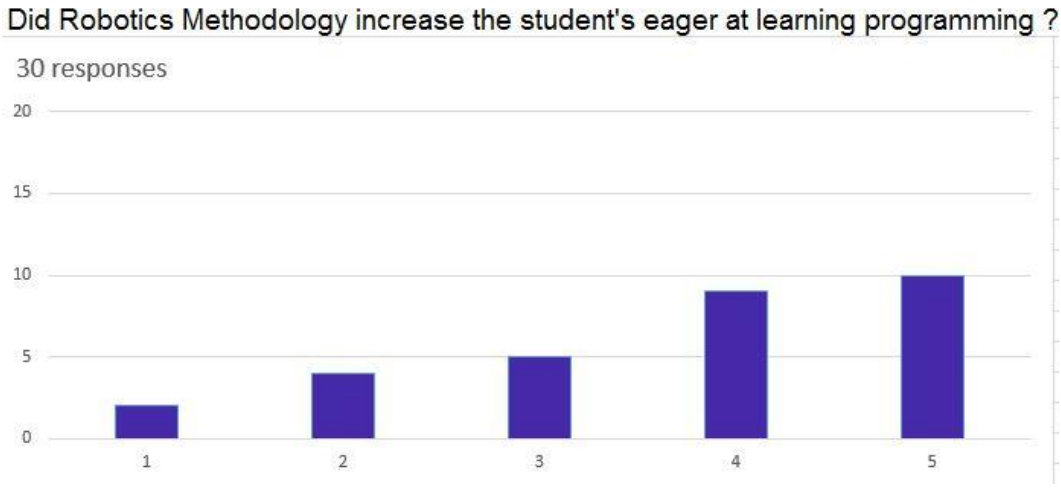
attracted by the physical parts of the Lego and robots. It made them also to control using the programming of the system. We can say that programming become joyful while they control the parts of the robots with it.

Figure 24 (Improvement progress in Robotics)



There were 25 positive answer and 5 negative answer. Considering those answers, we can say %83 agrees and %17 disagrees at this question. Most of the students agree on the point of "Robotics improves results of learning". As we also analyzed students results after applied 2 different programs, we have seen more progress at robotics instructed lessons compared to traditional one.

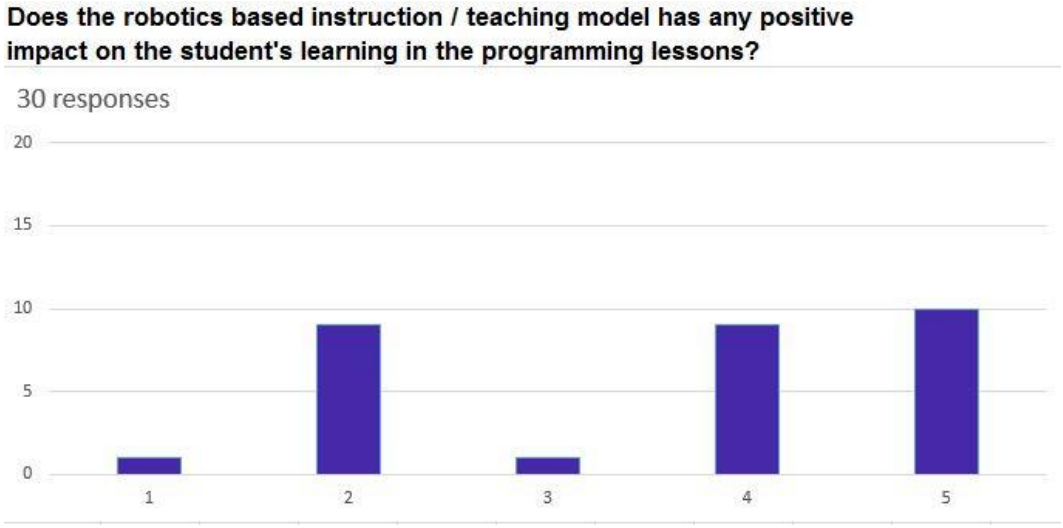
Figure-25 (Interest level to learn programming at robotics)



There were 24 positive answer and 6 negative answer. Considering those answers, we can say %80 agrees and %20 disagrees at this question. As we see in the graph heights of the bars is being increased while it goes from bad value to perfect value, which make most of the

participants love this robotics-instructed programs. Beside the results, we can also see their eager from students' patience to make the robot function better and also decorate them well to look better.

Figure-26 (Impacts of the Robotics lessons in programming class)



There were 20 positive answer and 10 negative answer. Considering those answers, we can say %66 agrees and %34 disagrees at this question. Although traditional learning has impact on programming learning but we can say robotics instructed learning couple of steps ahead than traditional one as it shown in the table. We can say that, most of the programming learners love to work with robotics.

4.1 HISTOGRAMS, DATA ANALYSIS and FINDINGS

In this chapter we will also see the histograms of the students' entries in the survey. Histograms will show the numerical data. It will let us to discover, and show, the underlying frequency distribution (shape) of a set of continuous data. This will allow the inspection of the data for its underlying distribution (e.g., normal distribution), outliers, skewness, etc.

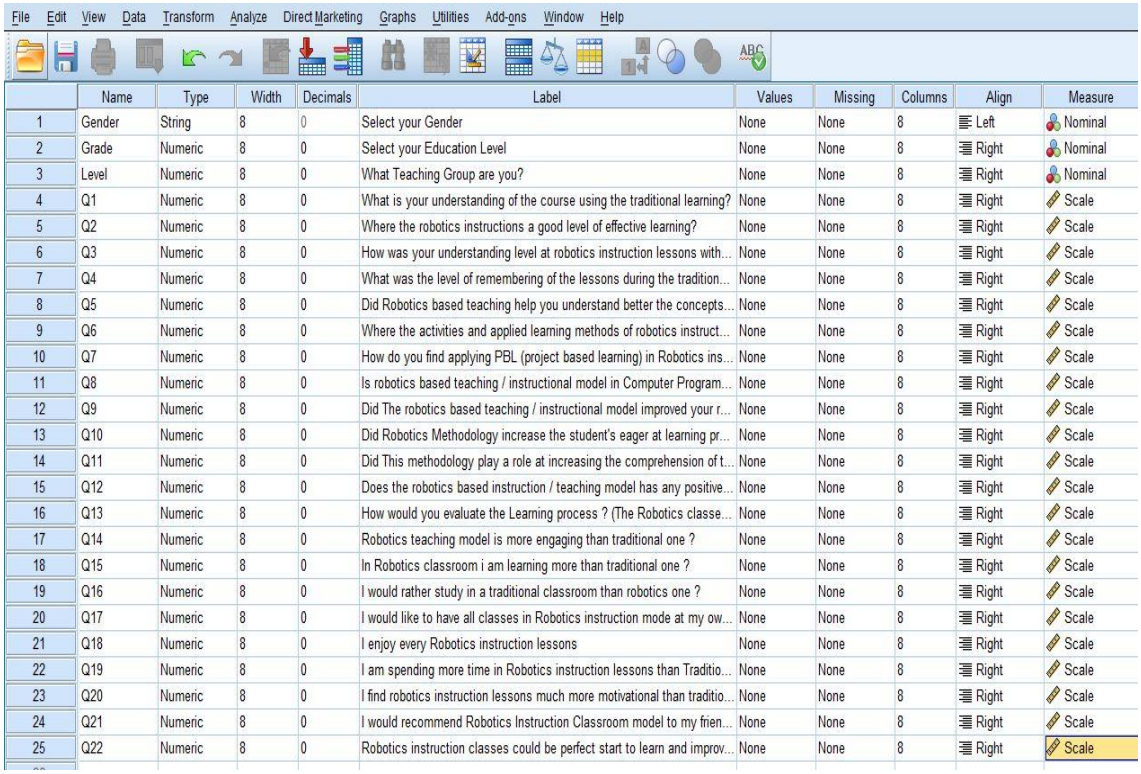
4.2Robotics Instructed Learning Survey Analyzing

SPSS VARIABLE VIEW

SPSS stands for Statistical Package for the Social Sciences which is widely used as a Statistical Analytic Tool in the Field of Social Science, Such as Market research, Surveys, Competitor Analysis, and others.

It is a comprehensive and flexible statistical analysis and data management tool. It is one of the most popular statistical packages which can perform highly complex data manipulation and analysis with ease.

Here I have defined the variables of the input values assigning their variable types such as numeric, string, gender and etch. All the survey questions are written in the label part and value lengths also defined.



	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure
1	Gender	String	8	0	Select your Gender	None	None	8	Left	Nominal
2	Grade	Numeric	8	0	Select your Education Level	None	None	8	Right	Nominal
3	Level	Numeric	8	0	What Teaching Group are you?	None	None	8	Right	Nominal
4	Q1	Numeric	8	0	What is your understanding of the course using the traditional learning?	None	None	8	Right	Scale
5	Q2	Numeric	8	0	Where the robotics instructions a good level of effective learning?	None	None	8	Right	Scale
6	Q3	Numeric	8	0	How was your understanding level at robotics instruction lessons with...	None	None	8	Right	Scale
7	Q4	Numeric	8	0	What was the level of remembering of the lessons during the tradition...	None	None	8	Right	Scale
8	Q5	Numeric	8	0	Did Robotics based teaching help you understand better the concepts...	None	None	8	Right	Scale
9	Q6	Numeric	8	0	Where the activities and applied learning methods of robotics instruct...	None	None	8	Right	Scale
10	Q7	Numeric	8	0	How do you find applying PBL (project based learning) in Robotics ins...	None	None	8	Right	Scale
11	Q8	Numeric	8	0	Is robotics based teaching / instructional model in Computer Program...	None	None	8	Right	Scale
12	Q9	Numeric	8	0	Did The robotics based teaching / instructional model improved your r...	None	None	8	Right	Scale
13	Q10	Numeric	8	0	Did Robotics Methodology increase the student's eager at learning pr...	None	None	8	Right	Scale
14	Q11	Numeric	8	0	Did This methodology play a role at increasing the comprehension of t...	None	None	8	Right	Scale
15	Q12	Numeric	8	0	Does the robotics based instruction / teaching model has any positive...	None	None	8	Right	Scale
16	Q13	Numeric	8	0	How would you evaluate the Learning process ? (The Robotics classe...	None	None	8	Right	Scale
17	Q14	Numeric	8	0	Robotics teaching model is more engaging than traditional one ?	None	None	8	Right	Scale
18	Q15	Numeric	8	0	In Robotics classroom i am learning more than traditional one ?	None	None	8	Right	Scale
19	Q16	Numeric	8	0	I would rather study in a traditional classroom than robotics one ?	None	None	8	Right	Scale
20	Q17	Numeric	8	0	I would like to have all classes in Robotics instruction mode at my ow...	None	None	8	Right	Scale
21	Q18	Numeric	8	0	I enjoy every Robotics instruction lessons	None	None	8	Right	Scale
22	Q19	Numeric	8	0	I am spending more time in Robotics instruction lessons than Traditio...	None	None	8	Right	Scale
23	Q20	Numeric	8	0	I find robotics instruction lessons much more motivational than traditio...	None	None	8	Right	Scale
24	Q21	Numeric	8	0	I would recommend Robotics Instruction Classroom model to my frien...	None	None	8	Right	Scale
25	Q22	Numeric	8	0	Robotics instruction classes could be perfect start to learn and improv...	None	None	8	Right	Scale

SPSS DATA VIEW

Throughout the SPSS data view, we can see all the data that entered by the learners of the courses. First row of the data table shows us the parameters from the SPSS variable list. We can analyze their answers using their input from the table.

The numbers that we see in the SPPS data view table shows the students' input to the survey, I also use them as a bin (a class interval) which is coming from the probably answers (1,2,3,4,5). The numbers present:

1= Poor

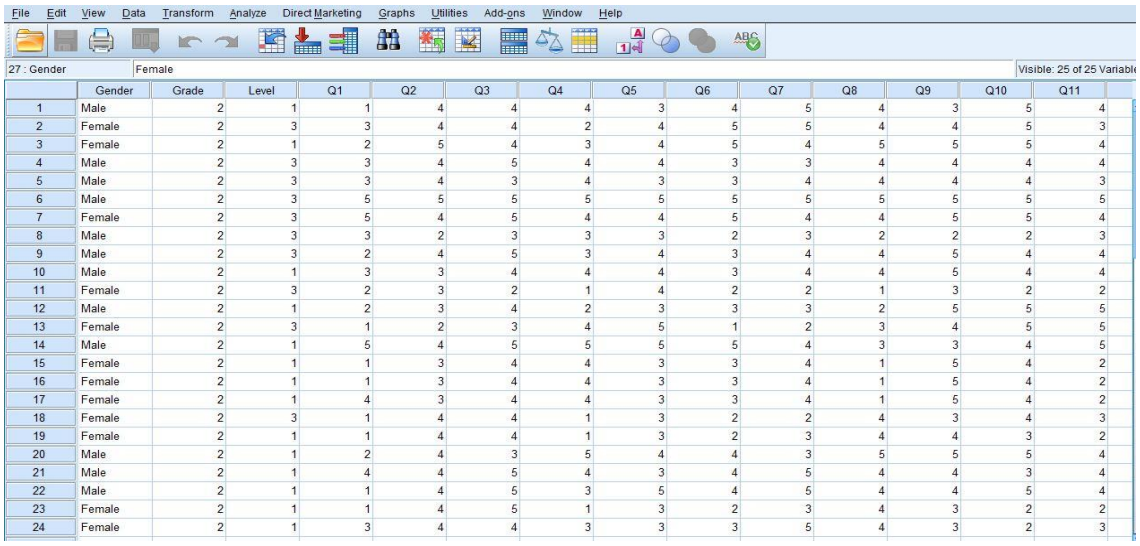
2= Satisfactory

3= Fair

4= Very Good

5= Excellent

Figure-1 (SSPS data view)



	Gender	Grade	Level	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
1	Male	2	1	1	4	4	4	3	4	5	4	3	5	4
2	Female	2	3	3	4	4	2	4	5	5	4	4	5	3
3	Female	2	1	2	5	4	3	4	5	4	5	5	5	4
4	Male	2	3	3	4	5	4	4	3	3	4	4	4	4
5	Male	2	3	3	4	3	4	3	3	4	4	4	4	3
6	Male	2	3	5	5	5	5	5	5	5	5	5	5	5
7	Female	2	3	5	4	5	4	4	5	4	4	5	5	4
8	Male	2	3	3	2	3	3	3	2	3	2	2	2	3
9	Male	2	3	2	4	5	3	4	3	4	4	5	4	4
10	Male	2	1	3	3	4	4	4	3	4	4	5	4	4
11	Female	2	3	2	3	2	1	4	2	2	1	3	2	2
12	Male	2	1	2	3	4	2	3	3	3	2	5	5	5
13	Female	2	3	1	2	3	4	5	1	2	3	4	5	5
14	Male	2	1	5	4	5	5	5	5	4	3	3	4	5
15	Female	2	1	1	3	4	4	3	3	4	1	5	4	2
16	Female	2	1	1	3	4	4	3	3	4	1	5	4	2
17	Female	2	1	4	3	4	4	3	3	4	1	5	4	2
18	Female	2	3	1	4	4	1	3	2	2	4	3	4	3
19	Female	2	1	1	4	4	1	3	2	3	4	4	3	2
20	Male	2	1	2	4	3	5	4	4	3	5	5	5	4
21	Male	2	1	4	4	5	4	3	4	5	4	4	3	4
22	Male	2	1	1	4	5	3	5	4	5	4	4	5	4
23	Female	2	1	1	4	5	1	3	2	3	4	3	2	2
24	Female	2	1	3	4	4	3	3	3	5	4	3	2	3

In this questionnaire there are 22 questions cross-checking students' perception of robotics instructed classroom. Question are asked considering the both sides (traditional and robotics instructed classrooms). We used same questions from the reverse direction.

Second step to analyze the data was to find descriptive statistics. I first found the frequencies of the answers to each question. The analysis show that for instance for the 1st question;

Table-1 (Students Groups)

What Teaching Group are you?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I	19	63.3	63.3	63.3
	II	10	33.3	33.3	96.6
	III	1	3.3	3.3	99.9
	Total	30	100	100	

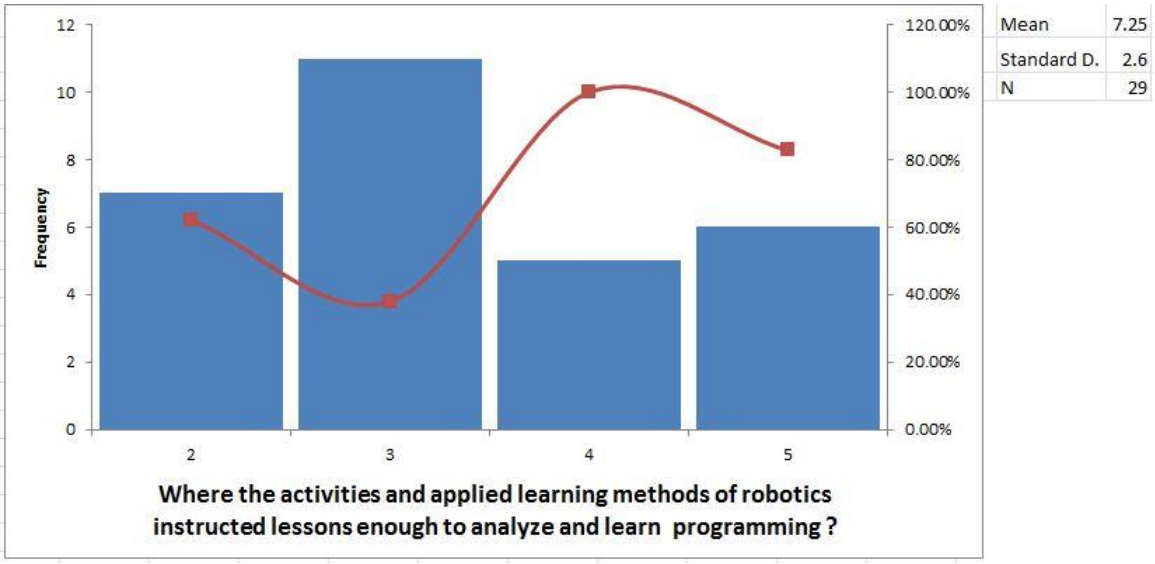
In total, there are 30 students who took the questionnaire and 19 of them (63.3%) are from the 1. Group which means student got first 30th place from the college entrance examination, 10 students (33.3%) are from the 2. Group who has taken place between 30th-60th places and 1 student was from 3. Group who has taken below 60th places. All of the answers are valid. (100%)

For the second question the frequencies are shown in the table 11 below.

Table-2 (Activities level of the Robotics)

Where the activities and applied learning methods of robotics instructed lessons enough to analyze and learn programming ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	6.7	6.7	6.7
	2	5	16.7	16.7	23.3
	3	12	40.0	40.0	63.3
	4	6	20.0	20.0	83.3
	5	5	16.7	16.7	100.0
	Total	30	100	100.0	

This table shows at most %40 agree at the level of number 3(Fair). %20 of the values belongs to number 4(Very Good) and %16.7 of the values belongs to number 5(Excellent).



Here is the graph which shows a histogram of answers of the question (below the graph). The shape is skewed left. You see that mostly answered 2's and 3's in the survey. It could be symmetric histogram if 2's and 3' could be voted in the same number of votes.

Cumulative values of the table show that about %77 of the responses positive while we consider 3's, 4's and 5's as positive.

Table-3 (Statistics of some results)

Frequencies

Statistics

		What Teaching Group are you?	Robotics teaching model is more engaging than traditional one ?	Where the robotics instructions a good level of effective learning?	Did Robotics based teaching help you understand better the concepts of programming ?
N	Valid	30	30	30	30
	Missing	0	0	0	0
Mean		10.0	6.0	6.0	6.0
Std. Error of Mean		1.957890021	1.5	2.408318916	2.5
Median		10	4.0	3	5.0
Mode		#N/A	4.0	3	#N/A
Std. Deviation		3.391164992	3.4	5.385164807	5.6
Variance		81	11.5	29	31.5

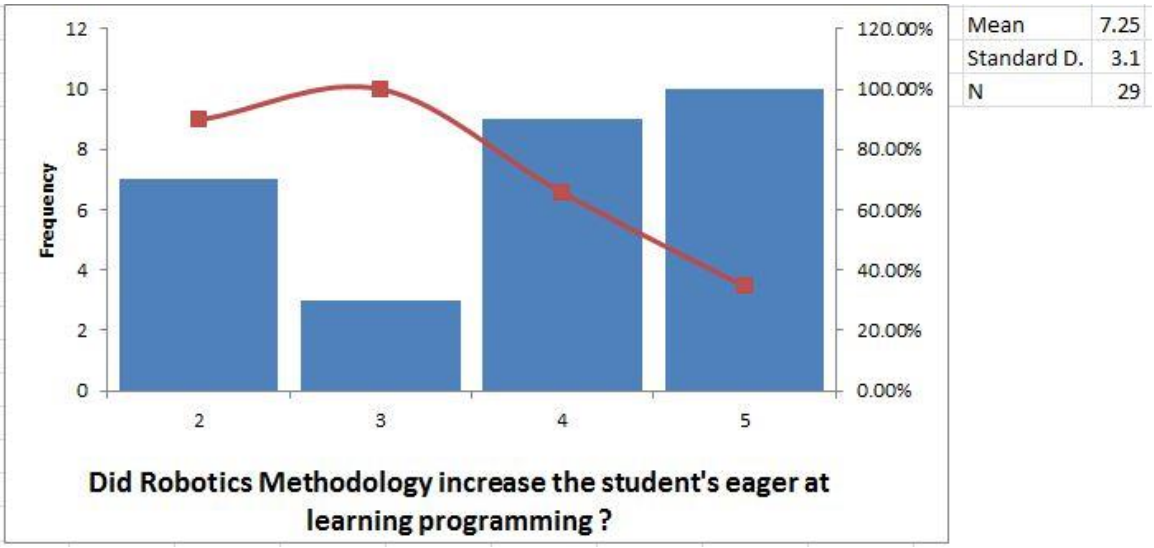
As we can see in the table above the type of answers for each question have consistency. The mean and median values for the questions 1, 2 and 3 are very close to each other. (means = 6, 6, 6, medians = 4.00, .3.00, 5.00) This shows that students produced similar answers and treated these questions in the same way.

The mean and median values are relatively close to each other for each question. This shows that data set is close to the normal distribution with a little skewness to the right. This results from high frequency of 4's and 5's in students' answers. This can also be seen in the below.

Table-4 (Interest level to learn programming at robotics)

Did Robotics Methodology increase the student's eager at learning programming ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	6.7	6.7	6.7
	2	5	16.7	16.7	23.3
	3	4	13.3	13.3	36.7
	4	9	30.0	30.0	66.7
	5	10	33.3	33.3	100.0
	Total	30	100	100.0	

This table shows at most %66.6 agree at the level of number 4(Very Good). %33.3 of the values belongs to number 5(Excellent)

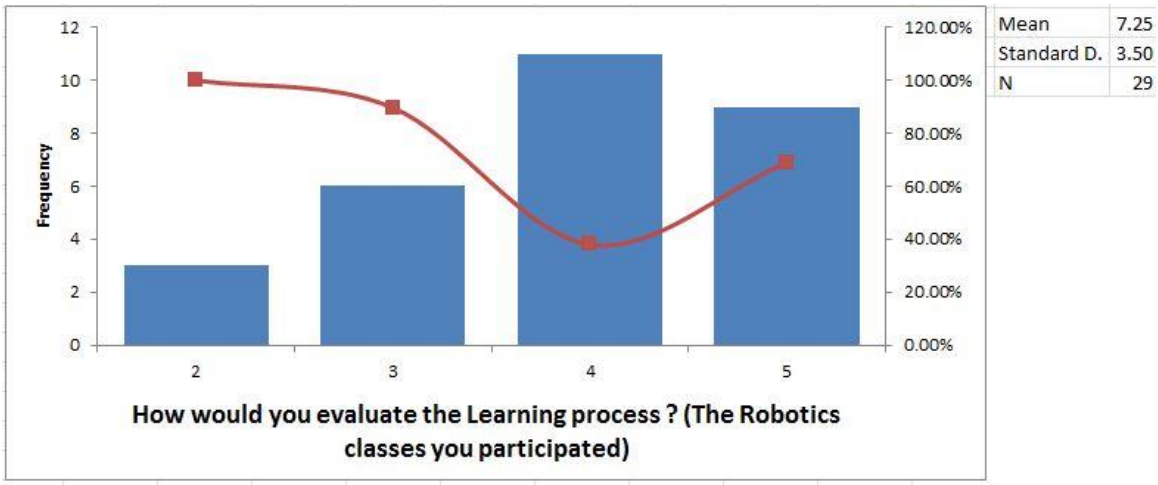


Here is the graph which shows a histogram of answers of the question (below the graph). The shape is skewed right. More answers are given from 4's and 5's. It took a role to make the amount of 2's and 3's less than others, it seemed values got increased incrementally from 3 to 5. It made it skewed right histogram.

Table-6 (Evaluation of the Robotics)

How would you evaluate the Learning process ? (The Robotics classes you participated)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.3	3.3	3.3
	2	2	6.7	6.7	10.0
	3	6	20.0	20.0	30.0
	4	11	36.7	36.7	66.7
	5	10	33.3	33.3	100.0
	Total	30	100	100.0	

According to this table out of 30 valid answers 33.3% of them is 5, 36.7% of them is 4, 20% of them is 3,6.7% of them is 2 and 3.3% of them is 1. This shows that majority of the students (3s, 4s and 5s=90%) approve of the Robotics instructed lessons.

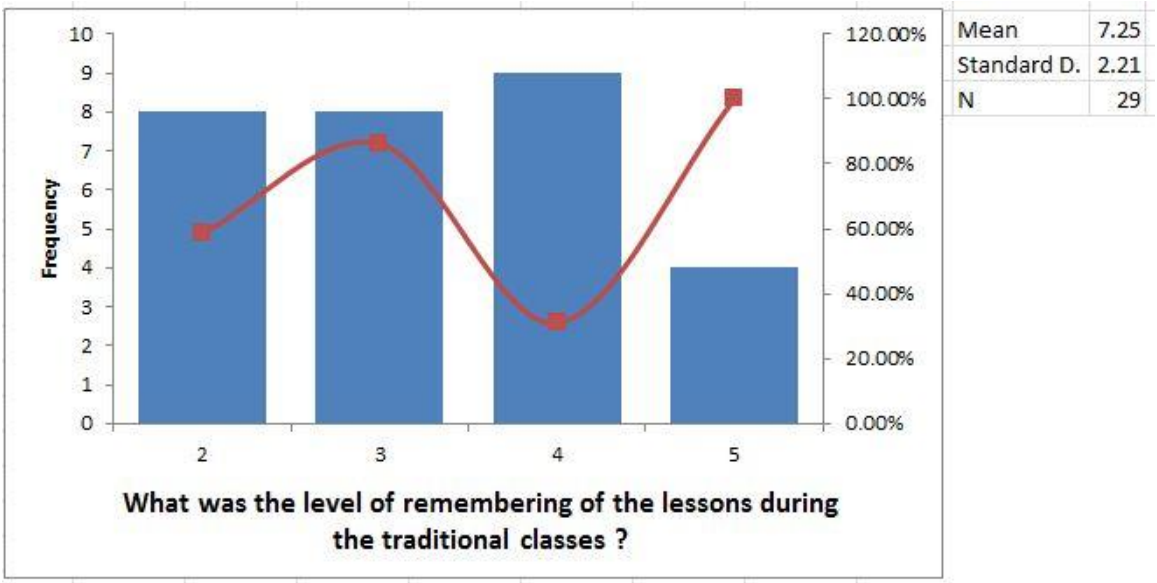


Here is the graph which shows a histogram of answers of the question (below the graph). The shape is skewed left. Most of the answers were from 4's and 5's. 2's and 3's below the average.

Table-7 (Remembering level of the Traditional Classes)

What was the level of remembering of the lessons during the traditional classes ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	5	16.7	16.7	16.7
	2	3	10.0	10.0	26.7
	3	9	30.0	30.0	56.7
	4	11	36.7	36.7	93.3
	5	2	6.7	6.7	100.0
	Total	30	100	100.0	

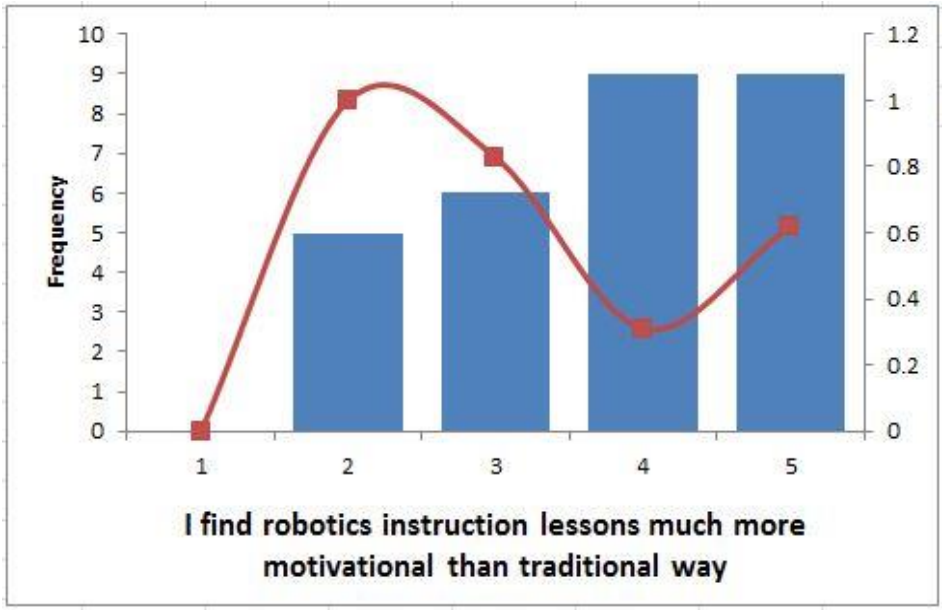
According to this table out of 30 valid answers 6.7% of them is 5, 36.7% of them is 4, 30% of them is 3,10% of them is 2 and 16.7% of them is 1. This shows that majority of the students (3s, 4s and 5s=74.3%) approve of the Robotics instructed lessons. At most 93.3% accepted it as 'very good'.



Here is the graph which shows a histogram of answers of the question (below the graph). The shape is skewed left. Amount of 2's and 3's more than average, it makes the level of remembering less in traditional classes.

Table-8 (Motivation levels at applied methods)

I find robotics instruction lessons much more motivational than traditional way					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	0	0.0	0.0	0.0
	2	5	16.7	16.7	16.7
	3	6	20.0	20.0	36.7
	4	10	33.3	33.3	70.0
	5	9	30.0	30.0	100.0
	Total	30	100	100.0	



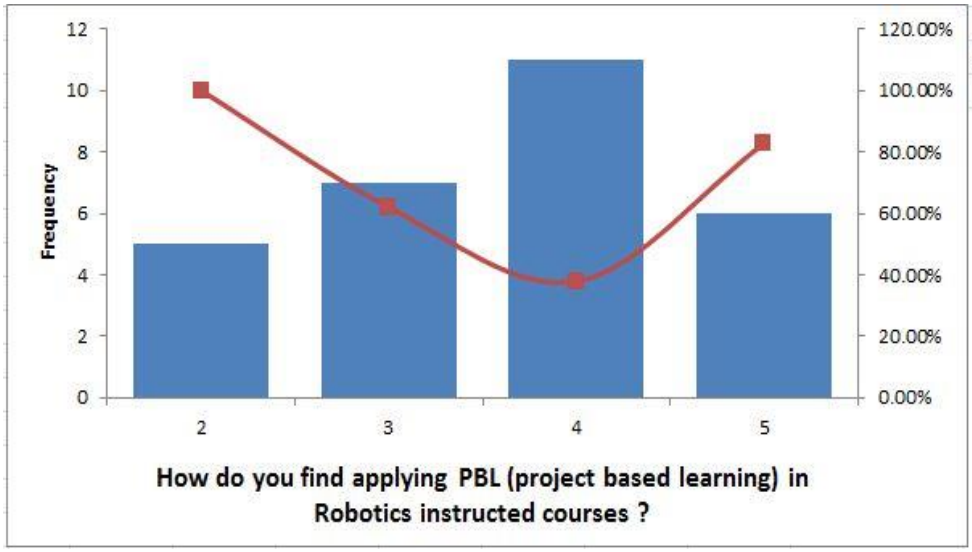
Mean	7.25
Standard D.	2.06
N	29

Here is the graph which shows a histogram of answers of the question (below the graph). The shape is skewed left. Amount of 2's and 3's less than average, it makes the robotics-instructed classes much more motivational.

Table-9 (PBL (Project Based Learning) at the Robotics)

How do you find applying PBL (project based learning) in Robotics instructed courses ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.3	3.3	3.3
	2	4	13.3	13.3	16.7
	3	8	26.7	26.7	43.3
	4	11	36.7	36.7	80.0
	5	6	20.0	20.0	100.0
	Total	30	100	100.0	

According to this table out of 30 valid answers 20% of them is 5, 36.7% of them is 4, 26.7% of them is 3,13.3% of them is 2 and 3.3% of them is 1. This shows that majority of the students (3s, 4s and 5s=83.3%) approve of the Robotics instructed lessons.



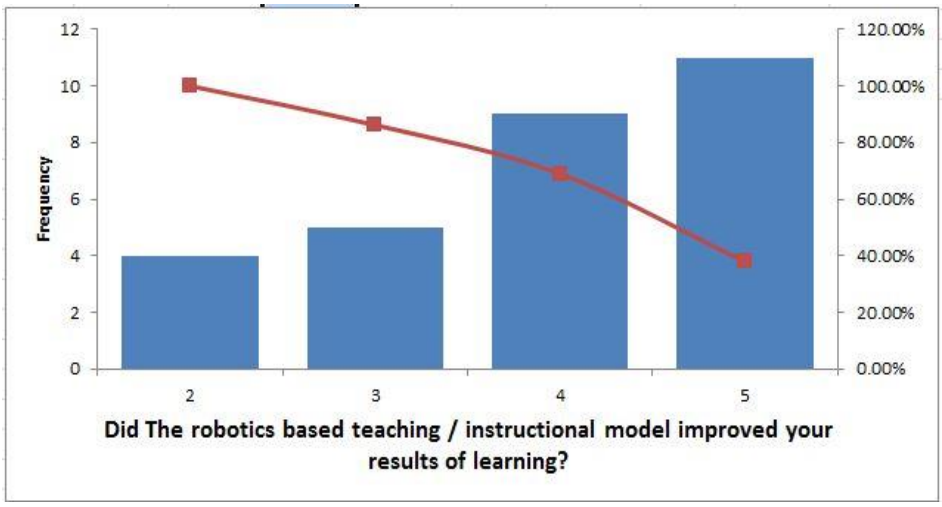
Mean	7.25
Standard D.	2.63
N	29

Here is the graph which shows a histogram of answers of the question (below the graph). The shape is skewed left. 4's has been chosen highly compared to others. 2's and 3's was less than the average. Considering this fact, result was positive by the amount of 4's and 5's.

Table-10 (Improvement progress in Robotics)

Did The robotics based teaching / instructional model improved your results of learning?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.3	3.3	3.3
	2	3	10.0	10.0	13.3
	3	7	23.3	23.3	36.7
	4	9	30.0	30.0	66.7
	5	10	33.3	33.3	100.0
	Total	30	100	100.0	

This table shows at most %66.7 agree at the level of number 4(Very Good). %33.3 of the values belongs to number 5(Excellent)



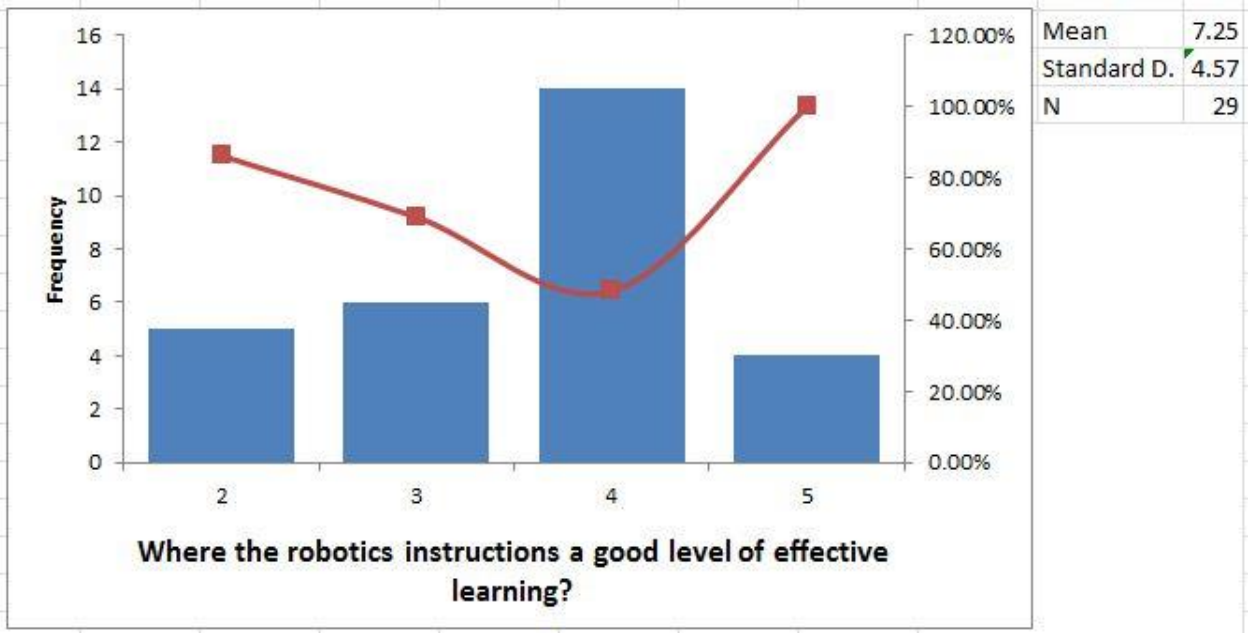
Mean	7.25
Standard D.	3.30
N	29

Here is the graph shows a histogram of answers of the question (below the graph). The shape is skewed left. As we see the amount of 4's and 5's was highly chosen by the participants. So, robotics-instructed lessons improve student's learning.

Table-11 (Level of Learning in the Robotics)

Where the robotics instructions a good level of effective learning?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	6.7	6.7	6.7
	2	3	10.0	10.0	16.7
	3	7	23.3	23.3	40.0
	4	15	50.0	50.0	90.0
	5	3	10.0	10.0	100.0
	Total	30	100	100.0	

This question analyze shows at most %90 of values is very good. It shows how effective this teaching method is.

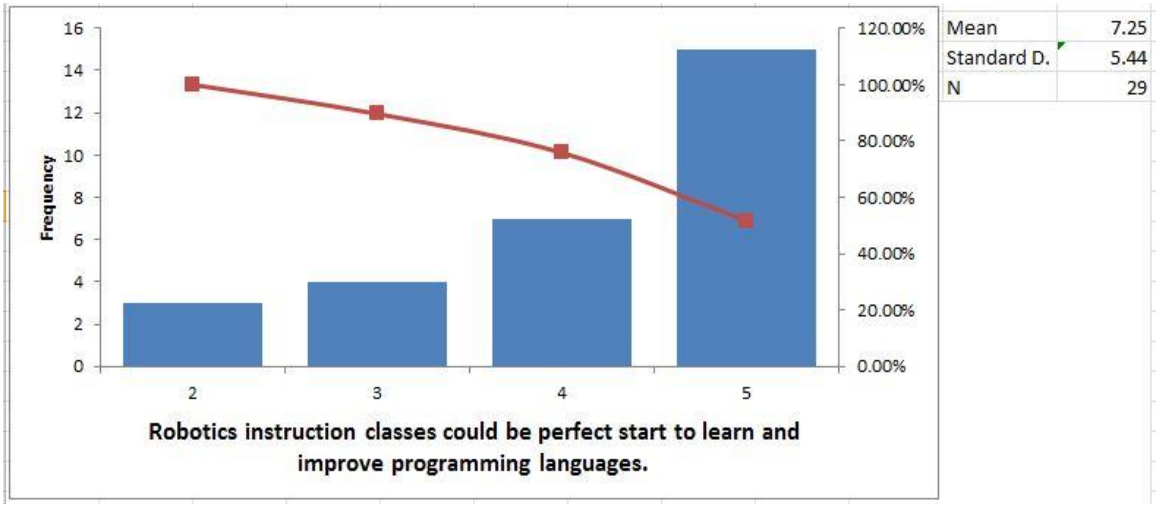


Here is the graph shows a histogram of answers of the question (below the graph). The shape is skewed left. Number 4 was chosen highly. The amount of the 2's and 3's didn't suffice to make it a bad level of effective learning. It is pretty effective at learning process.

Table-13 (Robotics as a programming learning tool for the beginners)

Robotics instructed classes could be perfect to learn and improve programming languages at the beginning.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	10.0	10.0	10.0
	2	0	0.0	0.0	10.0
	3	4	13.3	13.3	23.3
	4	7	23.3	23.3	46.7
	5	16	53.3	53.3	100.0
	Total	30	100	100.0	

This table shows at most %53.3 agree at the level of number 5(Excellent). %46.7 of the values belongs to number 4(Very Good). It can approve the applied program as an excellent model for teaching the programming to beginner level learners.

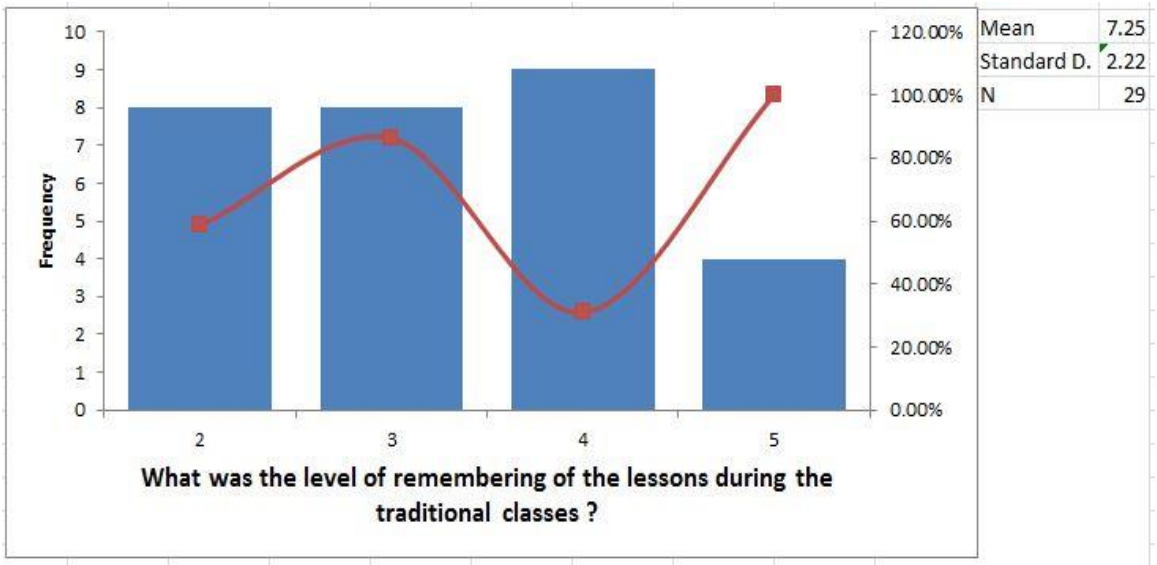


Here is the graph shows a histogram of answers of the question (below the graph). The shape is skewed left. Obviously amount of 5's has highest numbers in the graph. It also makes only itself bigger than average. We can say robotics as perfect tool can be used to start to learn programming languages

Table-14 (Remembering level of the Traditional Classes)

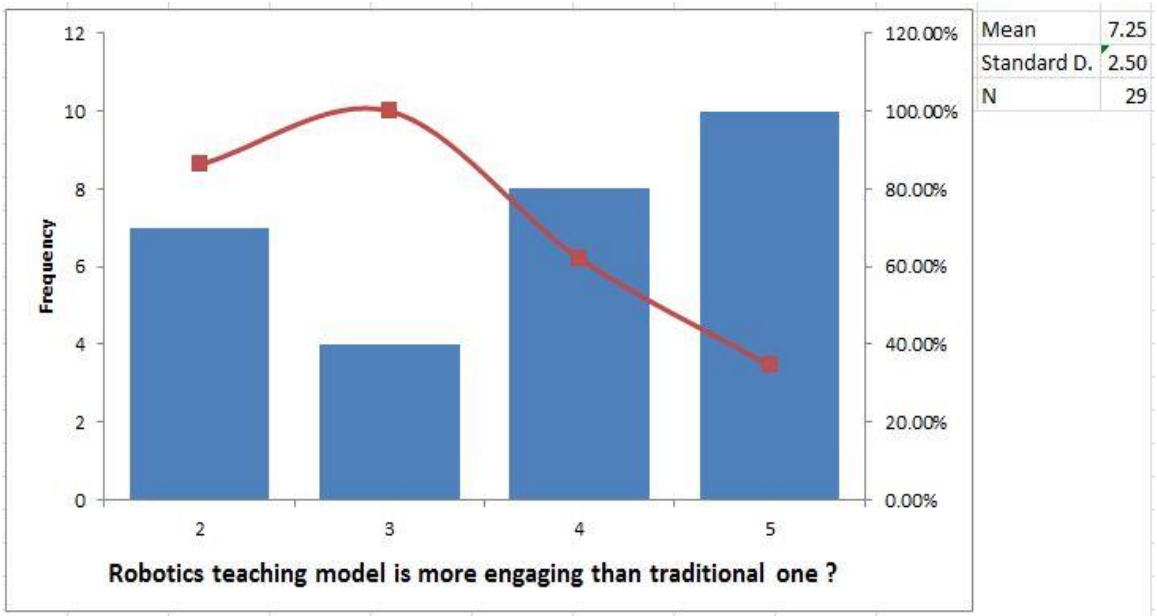
What was the level of remembering of the lessons during the traditional classes ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	6	20.0	20.0	20.0
	2	3	10.0	10.0	30.0
	3	9	30.0	30.0	60.0
	4	11	36.7	36.7	96.7
	5	2	6.7	6.7	103.3
	Total	31	100	103.3	

This table shows at most %96.7 agree at the level of number 4(Very Good). %6.7 of the values belongs to number 5(Excellent)



Here is the graph shows a histogram of answers of the question (below the graph). The shape is skewed right. Although amount of 4's has the highest value, 2's and 3's values are more than average, it makes the level of remembering at traditional classes not really good**Table-15** (Comparison between applied programs at their engaging to the programming)

This table shows at most %63.3 agree at the level of number 4(Very Good). %36.7 of the values belongs to number 5(Excellent) which makes %63.3 students accept the Robotics more engaging than traditional one.



Here is the graph shows a histogram of answers of the question (below the graph). The shape is skewed left. Amount of 5's and 4's are more than mean, it takes role to assign the answer positive at this graph. So robotics teaching model is more engaging than traditional one.

4.3 STUDENTS' ASSESSMENT RESULTS OF PERFORMANCE

In this part students are listed in a table where their group numbers and test results are shown. Group numbers are defined based on students' entrance examination to high school. After the 4 weeks period of study program for each course (Robotics instructed and without Robotics lessons), students took exam. The results of the exams are shown below the table. **- (Exam Results of the 2 Applied Programs during the Research)**

Experimental Group				**Control Group**		
Student	**Group**	**Result**		**Student**	**Group**	**Result**
Student 1	**1**	**103**		**Student 1**	**3**	**26**
Student 2	**3**	**23**		**Student 2**	**1**	**94**
Student 3	**3**	**21**		**Student 3**	**3**	**17**
Student 4	**2**	**59**		**Student 4**	**3**	**17**
Student 5	**2**	**49**		**Student 5**	**2**	**73**
Student 6	**2**	**23**		**Student 6**	**2**	**73**
Student 7	**2**	**49**		**Student 7**	**2**	**53**

Student 8	**1**	**96**		**Student 8**	**1**	**79**
Student 9	**2**	**62**		**Student 9**	**1**	**46**
Student 10	**1**	**30**		**Student 10**	**2**	**58**
Student 11	**1**	**89**		**Student 11**	**1**	**71**
Student 12	**2**	**64**		**Student 12**	**1**	**78**
Student 13	**1**	**68**		**Student 13**	**2**	**80**
Student 14	**1**	**99**		**Student 14**	**1**	**100**
Student 15	**2**	**68**		**Student 15**	**2**	**70**
Student 16	**1**	**66**		**Student 16**	**1**	**86**
Student 17	**2**	**79**		**Student 17**	**2**	**70**
Student 18	**2**	**41**		**Student 18**	**2**	**55**
Student 19	**2**	**58**		**Student 19**	**2**	**62**
Student 20	**1**	**77**		**Student 20**	**1**	**86**
Student 21	**1**	**100**		**Student 21**	**1**	**100**
Student 22	**1**	**66**		**Student 22**	**1**	**64**

A one-way between groups analysis of variance was conducted to explore the impact of the Robotics instructed learning on students' learning in robotics class. Students were divided into two groups. First group (group 1) has robotics instructed lessons in classroom and second group has lessons without robotics materials. So, comparing these two data set above, SPSS is used to get ANOVA statistics. The results are shown in the tables below.

Descriptives

Grade Average

	N	Mean	Std. Deviation	Std. Error	Interval Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Experimental	22	66.3	23.6	5.03	55.7853	76.7057	17	100
Control	22	60.1	28.7	6.12	47.3725	72.8093	0	103

According to the exam result table above, the total number of the students who attended my

class is 44. There were 2 main groups from 10th grade students. First group Experimental one is presenting the results of robotics instructed class while second group is presenting traditional classes. Also, students' levels are measured using their entrance exam results to the college.

The means values for the Robotics instructed group is higher than Traditional group (Group 1 mean = 66.3, Group 2 mean = 60.1) This result shows that group 1 students were affected positively by robotics instructed learning

ANOVA						
Source of Variation	*Sum of Squares*	*df*	*Mean Square*	*F*	*P-value*	*F crit*
Between Groups	416.663	1	416.663	0.6041	0.44137	4.07265
Within Groups	28968.258	42	689.720			
Total	29384.921	43				

This table shows the output of the ANOVA analysis and whether there is a statistically significant difference between the group means. We can see that its significant difference between the group means because, F values (0.6041) is less than F critical (4.07265) which approves the hypothesis.

We can also see P value (0.441) is bigger than the standard α level (.05) so we hold the null hypothesis for the assumption of homogeneity of variance and conclude that there is no Significant difference between the two groups' variances.

CHAPTER 5

5. CONCLUSIONS

This research study investigates to find out if there is any benefit of the robotics-oriented lessons on students' learning in the information and computer technology (ICT) lessons and if it has any advantages over the traditional teaching methods in the computer science lessons. The integration of robotics into classroom instruction can improve the student's learning motivation.

Another important aim of ours is to build communication opportunities between teacher and student. Project based learning pedagogy was very helpful to do this job. Students will always be contacted while they do projects or other tasks in class. As shown in Table 8, implementing Robotics model allows the students to use more time supporting higher-level learning tasks such as participating international competitions, a group discussion, collaborations etc.

Table 8. Comparison between Traditional Classroom and Robotics Classroom in Achieving Higher Order Thinking of Bloom's Taxonomy

Level of Learning	**Traditional Classroom**	**Robotics Classroom**
Remembering	Short time lasting (Theoretically)	Long time lasting (Practically)
Understanding	Ordinary Interest (Question & Answers)	Extra Ordinary Interest (Reflection, Peer-Peer discussion and collaboration)
Assimilating and Implementing	Hard to get adapted	Easily Get adapted and deal with it in practice
Analyzing	Homework	Classroom Activities with robots Group discussions
Applying, **Evaluating,** **Creating**	Homework	Student Projects Performance in Competitions Contribution to the Group

The study of robotics instructed classrooms was based on the theory of Bloom's revised taxonomy of cognitive domain. This taxonomy provides six levels of learning. The explanation is arranged from the lowest level to the highest level:

1. **Remembering:** in this stage, the students try to recognize and recall the information they receive; they also try to understand the basic concepts and principles of the content they have learned.

2. **Understanding:** the students try to demonstrate their understanding, interpret the information and summarize what they have learned.

3. **Applying:** the students practice what they have learned or apply knowledge to the actual situation.

4. **Analyzing:** the students use their critical thinking in solving the problem, debate with friends, compare the answer with peers, and produce a summary. The students obtain new knowledge and ideas after implementing critical thinking or a debate in group activities. In this level of learning, the students also produce creative thinking.

5. **Evaluating:** assessment or established peer-review knowledge, judge in relational terms; in this stage, students are evaluating the whole learning concepts and they could evaluate or make judgment on how far they successfully learned.

6. **Creating:** the students are able to design, construct and produce something new from what they have learned (Bloom, 1969).

This research also deals with computational thinking. Robotics-oriented classes were observed within project-based learning pedagogy. There is some competing in robotics category. Students will get prepared for the competitions. It was wonderful tool to make students always motivated in training their robots. They will get more than robotics when they go competition area such as friendships, interest in technology and a wish to learn more related to engineering and computing [9]. As an Instructor, especially a computer science teacher, we have to show our students correct ways to learn the discipline with interest and eagerness. We have to guide them to deal with these useful disciplines such as robotics. Students always have tendency to lose a lot of time in the computer. We take a significant role preventing it. Teacher-Student interactions will fix this problem and turn it into making

their time use properly. We expect students to have warm and positive approach to the robotics-oriented classes. Robotics-oriented groups' test and class work scores are expected to be higher in compared with traditional groups scores. Learning motivation of the students and teacher-student interaction are expected to be in a higher-level during classes.

Additionally, this study may contribute to the computer science education by invoking the computer science teachers to realize the benefits of the Robotics-Oriented classes in their education life.

5.2 Limitations

On the other hand, this approach has a few limitations that require further research. One of the most important things is financial part of getting the Ev3 Lego Mindstorm sets for interactive lessons. We overcome this problem by implementing simulation of the robot to the curriculum.
We have used program of RoboMind Academy. It somehow helped out to perform the robotics lessons. After then we contacted some parents to encourage them participating their children to international robotics competition. They liked the idea. They bought their own lego ev3 sets.

Another difficulty is students' lack of knowledge at math's and physics. we realized it during the lessons that students were challenging about some calculations. We as high school teachers assume that students are familiar with required math knowledge in robotics. After then we see students can overcome some problems. It can be fixed by implementing some more exercises about the robotics problems so the week students can comprehend the issue better.

New technologies have made it possible for educators to understand the many possibilities of their educational life. Especially here in Macedonia, researchers may study different aspects of the robotics instructed learning.

Declaration of My Own Work

I, **Bayram Koyuncu** , confirm that the work for the following term paper with the title: " **Increasing the student's learning motivation on computer programming by robotics-based instruction / teaching model in a high school of Macedonia** " was solely undertaken by myself and that no help was provided from other sources as those allowed. All sections of the paper that use quotes or describe an argument or concept developed by another author have been referenced, including all secondary literature used, to show that this material has been adopted to support my thesis.

Proofreading report

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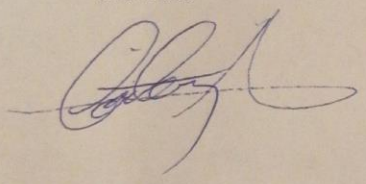

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