TRƯỜNG ĐẠI HỌC SƯ PHẠM TP HỒ CHÍ MINH
TẠP CHÍ KHOA HỌC
KHOA HỌC GIÁO DỤC
ISSN: 1859-3100 Tập 15, Số 7 (2018): 5-21

HO CHI MINH CITY UNIVERSITY OF EDUCATION
JOURNAL OF SCIENCE
EDUCATION SCIENCE
Vol. 15, No. 7 (2018): 5-21

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BUILDING AND ORGANIZING TEACHING STEM TOPIC "THE POTENTIAL ENERGY VEHICLE"

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Received: 12/7/2018; Revised: 23/7/2018; Accepted: 25/7/2018

ABSTRACT

The contest on the potential energy vehicles has been held by Ho Chi Minh City Department of Education and Training annually is participated by many high schools. Aim of the competition is to help students use scientific knowledge of kinetic energy, potential energy, dynamic variation, etc., combining the use of technology, engineering and mathematics to design vehicles running long distances maximum with fixed time and initial height, size and volume of vehicles in accordance with regulations of organizers. However, dynamometer design is only made by a small number of students. The article guides the construction and teaching of the STEM theme vehicle to help teachers to teach all students, promotes positive thinking and help students apply knowledge into practice.

Keywords: potential energy, potential energy vehicle, apply knowledge into practice.

TÓM TẮT

***Xây dựng và tổ chức dạy học chủ đề STEM* "xe thế năng"**

Cuộc thi xe thế năng do Sở Giáo dục và Đào tạo TP Hồ Chí Minh tổ chức hằng năm được đông đảo các trường phổ thông hưởng ứng tham gia. Cuộc thi nhằm giúp học sinh vân dụng kiến thức khoa học về động năng, thế năng, biến thiên cơ năng… kết hợp sử dụng kĩ thuật, công nghệ và toán học để thiết kế chiếc xe chạy với quãng đường dài nhất trong khoảng thời gian và độ cao ban đầu cho trước, với kích thước và khối lượng xe phù hợp với quy định của ban tổ chức. Tuy nhiên, việc thế kế xe thế năng chỉ được thực hiện bởi một số ít học sinh. Bài báo hướng dẫn xây dựng và tổ chức dạy học chủ đề STEM xe thế năng nhằm giúp giáo viên có thể dạy cho tất cả học sinh, phát huy tính tích cực và giúp học sinh vận dụng kiến thức vào thực tiễn.

Từ khóa: thế năng, xe thế năng, vận dụng kiến thức vào thực tiễn.

1. Introduction

Facing the change of the times, Vietnam's education has been transformed with special attention to STEM education. Education authorities and educational organizations have organized many STEM activities such as: STEM festivals, water rocket contests, robot contests, Olympic 30/4 STEM education courses, *etc*. These activities have created a

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strong effect both inside and outside schools. Especially, application of STEM - potential energy vehicle, in the context of the Olympic competition 30/4 expansion Ho Chi Minh City, is an opportunity to show skills, exchange, learn, and develop STEM capacity. Actually, it is a push for schools to adopt STEM education into their curriculum. However, this activity is not approaching each class, each student. Researches on the application of potential energy vehicle to teaching have not been published. Therefore, this study aims to develop and organize teaching of STEM topic - the potential energy vehicle, in order to develop capacity of students, especially STEM capacity.

2. Content

2.1. The potential energy vehicle

The potential energy vehicle is a toy, the original energy powered provided by a tilted plane that does not use any other source of energy. The potential energy vehicle is designed so that vehicles can go the longest distance and in a straight line. Generally, the potential energy vehicle is placed on top of a tilt plane, rolled down the slope and continued to move on the horizontal plane (Figure 1). The result is calculated as the distance from the base of the plane to the location of the stopping the potential energy vehicle. If the potential energy vehicle is off the boundary of the runway (Figure 2), the result as the distance from the base of the plane tilt to the position of the vehicle out off the boundary.

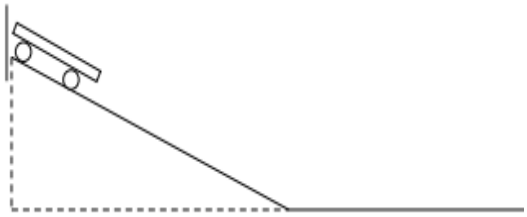


Figure 1. *Set the vehicle on the tilt plane*

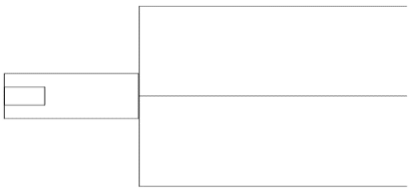


Figure 2. *Running track of the potential energy vehicle*

2.2. Building the STEM topic "the potential energy vehicle"

2.2.1. Problem reality

STEM application contest- the potential energy vehicle is a part in the April 30th Olympic Games Open Ho Chi Minh. In this contest, "Students are based on the application of knowledge, skills in mathematics, science, technology and technology, students explore and experiment to design, manufacture in accordance a car what has ability to move furthest away"(Ho Chi Minh City Department of Education and Training, 2018). It sets requirements for high school selection and fostering team competition. However, most students do not know STEM, the potential energy vehicle. Students are not equipped with the basic knowledge of science, mathematics, technology and basic machining skills. Therefore, research on potential energy vehicles is essential and meaningful.

2.2.2. Ideas topic

The potential energy vehicles have many designs ranging from simple to complex, depending on the material. This abundance is the basis organizing STEM activities about the potential energy vehicles such as: pattern or design, make oriented or self-design, self-make.

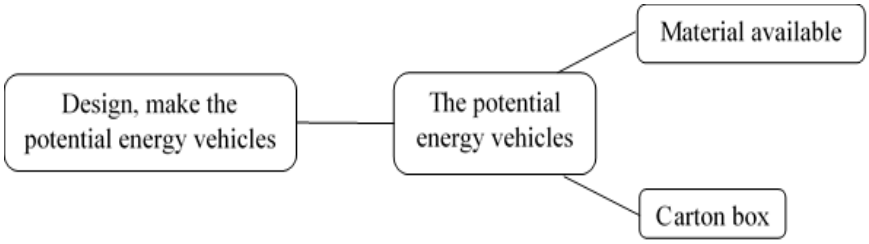


Figure 3. *Diagram ideas the potential energy vehicles STEM topic*

2.2.3. The objective to develop STEM capacity

Science (S): application of knowledge of energy, gravitational potential energy, kinetic energy, potential energy, energy variable theorem, law of conservation of power, friction force for analysis motion of the potential energy vehicles.

Mathematics (M): Analyze the dependence of gravitational potential on the mass and position of the potential energy vehicle, calculates the maximum speed and potential energy stored in the vehicle.

Technology (T) – engineering (E): work with the engine configuration drawing; read the configuration of the vehicle, create the potential energy from many material, work with basic material optimal.

For the direction of the development Technology (T) - engineering (E) capacity, it is depended on activity of the way of per the potential energy vehicle. Corporeality:

Activity: build a potential energy vehicle from material available

Technology (T): the use of available details such as mica disk wheels, bearings as bearings, etc and machining equipment such as wrench to tighten the nut, screw machine to catch screws on the chassis, use a 10-wrench, screwdriver (or screwdriver) to assemble the vehicle.

Engineering (E): read the assembly instructions for the car; assembly of the car from the available details; draw the structure of the car; Measures the parameters of the available details.

Activity: build a potential energy vehicle from cardboard

Technology (T): analyzes the nature of cardboard, show how to work cardboard and how to use cardboard with scissors and paper knife, use of equipment such as technical compass, angle meter, tape measure, use glue gun to match the details made from cardboard.

Engineering (E): draw a schematic design of the potential energy vehicle from cardboard, to build the potential energy vehicle from the cardboard.

Activity: design, make a potential energy vehicle

Technology (T): select and search for materials and equipment for the development of the potential energy vehicle, use or find the solution to work the details of the potential energy vehicle.

Engineering (E): outline the design of the vehicle; make the potential energy vehicle, write a guide to fabricate and use the vehicle.

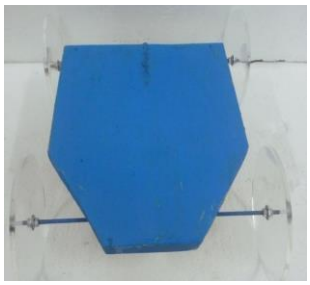
2.2.4. Design process of teaching organization

Table 1. *Main process of teaching organization about the potential energy vehicle*

Unit	Organization form	Duration	Task
The potential energy vehicle - assembled products	Work in group - assembly practice	45 min	Determine the parameters of the details; assembly vehicles according to the document, operate and determine the speed of the potential energy vehicle at the foot of the slope.
The potential energy vehicle from cardboard	Work in group - manufacture practices	150 min	Design drawing of the car; Manufacture of potential energy vehicle from cardboard; operate and determine the farthest distance of the potential energy vehicle.
The potential energy vehicle	Project based learning	3 weeks	Design of technical drawing of the potential energy vehicle, search material, search equipment, make the potential energy vehicle, make a PowerPoint presentation about the potential energy vehicle, write document about use guide.

The process of teaching " the potential energy vehicle - Assembled Products"

Table 2. *Advantages and disadvantages of the potential energy vehicle assembled*

Illustration	S_{max}	Advantages	Disadvantages
 ***Figure 4.*** *The potential energy vehicle 1*	35,5 m	Optimized high technical design; easy to assemble; short assembly time; pretty; move far; less deflected; simple car tuning; disassembled and assembled multiple times; highly secure in assembly.	High cost; many details are processed so students are not allowed to do the fabrication.
 ***Figure 5.*** *The potential energy vehicle 2*	33,5 m	Highly technical design; easy to assemble, relatively short assembly time; move far; affordability; disassembled and assembled multiple times; highly secure in assembly.	Vehicles are still deflected, car calibration process is relatively difficult, the operation of inserting silver bullets into mica disk is relatively time-consuming and difficult to correct, the vehicles mass is relatively large.

We make the potential energy vehicle in Figure 4, follows:

Preparing

Figure 6. *Tools and equipments to manufacturing the potentail energy vehicle*

Detailed sets are available: four ball bearing (Φin = 6 mm, Φout = 14 mm), 4 mica disk (Φin = 6 mm, Φout = 160 mm), two inox axis steel toothed teeth (Φ = 6 mm), four nut (Φin = 6 mm), four pin ball bearing (Φin = 14 mm), four clamb wheel ($\Phi_{\text{toothed shaft}}$ = 6 mm, Φout = 16 mm), wood (25 cm x 35 cm), eight screws (l = 20 mm), one round iron.

Machine tools: one screwdriver (or screwdriver), one pliers, two wrenches 10, one pair ruler, one tape measure.

Learning tasks

STEM activity:……..……Team:……Class……..….Time……..…….

Activity 1. *Determine the parameters*

To measure the inner diameter and outer diameter, we use .... Mica disk has inner diameter Φ_{in} =…… outer diameter Φ_{out}=……in order to…, ball bearing has inner diameter Φ_{in} =……, outer diameter Φ_{out}=…… in order to……, clamp wheel with tooth diameter Φ =…, outer diameter Φ_{out}=……in order to……

Activity 2. *Assembling and operating a potential energy vehicle*

1. Let's draw the configuration map a potential energy vehicle.
2. Let's analyze the energy change when the potential energy vehicle was rolled down.
3. What is the distance of the longest moving vehicle?
4. Which factor is most affect the results of the potential energy vehicle?

Activity 1. *Determine the parameters details*

Teacher activities	Student activities
Give tasks to students: Use a pair ruler, tape measure to measure the specifications of the details. Please describe their uses. → complete activity 1 in the Learning tasks	Get tasks
Provide equipment, details and instructional document to students.	Get equipment. Measure the specifications of the details → write them in A0 paper → complete activity 1 in the Learning tasks
Organize what students report result, teacher coordinators and conclusions.	group presentation

Activity 2. *Assembling and operating a potential energy vehicle*

Teacher activities	Student activities
Assistant of the teacher conducts the assembly of the model potential energy vehicle, explains how to work and pair the details.	Observation
Organize team work: draw the configuration map and assembly a potential energy vehicle. Observation and help students	Read instructional document → assembly a potential energy vehicle, draw the configuration map in A0 paper.

Activity 3. *Operate the potential energy vehicle and determine the speed of vehicle at the foot of the slope*

Teacher activities	Student activities
Require each team in turn drop the potential energy vehicle from the top of the trough.	Each team in turn drop the potential energy vehicle, Observe the motion of the vehicle.
Organize to team calibration of the couplings of the potential energy car, complete activity 2 in the Learning tasks	Analyze the factors affecting the outcome of the car, proceed to correct the position of pairing → improve the achievement.
Organize to team to collect data on slant trough, distance traveled.	Record data, complete the practice report at home.
Organize to team disassemble the potential energy vehicle, pay equipment, details of the vehicle	Disassemble the details of the potential energy vehicle. Inspection of equipment, details → Hand over to teacher.

The process of teaching " The potential energy vehicle from the cardboard "

Table 3. *Advantages and disadvantages of the potential energy vehicle from the carboard*

Illustration	S_{max}	Advantages	Disadvantages
 ***Figure 7.*** *The potential energy vehicle from the cardboard*	9,5 m	Low cost; easy to find materials, easy to work with the manipulation of paper knife and scissors; simple design; easy to make.	Easily deformed; Small volume should be easily affected by wind; great friction; short travel distance; easily deflected; difficult to adjust the car; structure uncertain; high durability; non-reusable; Possible risk of injury when students use paper knife, glue gun.

Based on the process of organizing STEM educational experiences in high school by Nguyen Thanh Nga and Hoang Phuoc Muoi (2018), we have built the process of teaching "The potential energy vehicle from cardboard" is as follows:

Preparing

Figure 8. *Materials and equipment for the make the potential energy vehicle from cardboard*

Materials: cardboard, 2 straws, 2 skewers.

Processing equipment: 1 scissors, 1 technical paper, paper knives, roll ruler, glue gun and glue. Technical drawing drawing tools: pencil, A_0 paper. Learning tasks

LEARNING TASKS

STEM activity:.....

Team:……Class……..Date…….

Activity 1. Analyzes the nature of cardboard

Advantages:.....

Disadvantages: .....

Processing plan: .....

Activity 2. Drawing design of the potential energy vehicle from cardboard

Drawing design .....

Alysis disadvantages .....

Activity 3. Operation and analysis of motion process

Achievement of the potential energy vehicle.....

Advantages of the potential energy vehicle .....

Disadvantages of the potential energy vehicle.....

Analysis of motion process.....

Activity 1. *Analyzes the nature of cardboard and processing cardboard*

Teacher activities	Student activities
Ask team work: Give the student cardboard. Ask the students to analyze the characteristics of the cardboard cover, highlighting its advantages and disadvantages. Analysis of cardboard processing.	Team work: get cardboard, observation → analysis → show how cardboard work with paper knife and scissors.
Ask student report the results of analysis. Teachers conclude.	Student representatives report the results.

Activity 2. *Drawing design of the potential energy vehicle from cardboard*

Teacher activities	Student activities
Ask team work: Give student pencils and A0 paper →ask student complete the technical drawing of the potential energy vehicle from cardboard	Team work: Get the pencil and A0 paper → Discuss design ideas → sketches into technical drawings.
Organization report technical drawings and ask students to show the method of processing the corresponding details from the cardboard. Teachers and students ask and answer questions, comments after each presentation.	Representatives of groups → Discussion groups, pointing out the advantages and disadvantages of the design drawings → Clarify how to process details such as chassis, wheels from cardboard → Exchanging, clarifying and improving draw design drawings.

Activity 3. *Make the potential energy vehicle*

Teacher activities	Student activities
Request students to repeat the regulations on safety in manufacturing → give equipment and materials for the make the potential energy vehicle of energy to students.	Repeat the regulations on safety in manufacturing → give equipment and materials for the make the potential energy vehicle of energy to students.
Ask team work: make make the potential energy vehicle from cardboard, measuring the parameters of the size of the car. Observe, make sure the groups comply with the safety regulations, support needed when students have difficulty.	Team work: assembly of components from cardboard → assembly of components into the potential energy vehicle → measurement of size parameters → commissioning operation → repair and improvement
Ask students to check equipment, materials and hand over to teachers.	Check equipment, materials and hand over to teachers.

Activity 4. Organization competition " the potential energy vehicle " and parsing results

Teacher activities	Student activities
Ask the students to help prepare the track and the tilt plane.	The student representative prepare the track and the tilt plane with teacher.
Show of the rules of the competition (similar to the rules apply to STEM application test - Olympic 30/4).	Listen and discuss, clarify the rules of the competition.
Organization competition "The potential energy vehicle"	Represent the groups to drop their the potential energy vehicle 1 times → drop

Show results	vehicle 2 times → drop vehicle 3 times → recorded the highest results.
organization reports the results of making and operating the potential energy vehicle from cardboard → discussion → conclusions about the potential energy vehicle from cardboard. Conclusion on: principles of operation, technical measures to pay attention.	Representatives of students report the results of manufacturing and operation → show the adventages and disadventages of the potential energy vehicle from cardboard → indicate the notes when processing, manufacturing → analysis of the movement of the potential energy vehicle from the top of the tilt plane until it stops.

Plan project teaching "The potential energy vehicle"

Based on the process organizing project based learning (Nguyen Thanh Nga *et al*., 2018), we develop the process organizing project based learning "The potential energy vehicle"as follows:

Stage		Duration	Tasks
Prepare project		Day 1 (2 lessons)	*1. Introduce the project:* the project of the potential energy vehicle to select products and groups of students who are capable, passionate to participate in the 30/4 Olympic competition in Ho Chi Minh City, applying STEM -The potential energy vehicle. *2. Identify the products of the project:* The potential energy vehicle PowerPoint, presentation about the potential energy vehicle, the guide document fabricate and use the the potential energy vehicle. *3. Determine the form of assessment:* Assessment based on the results of the potential energy vehicle, the powerpoint report and the final test. *4. Determine the support plan*: meet the teacher, use social network such as Facebook or Zalo channel. Students can borrow and use equipment from STEM classrooms.
Perform project	Project planning and design direction of the potential energy vehicle	Day 2 (2 lessons)	1. Teachers work in groups, project planning, assign tasks to students in groups → Students work in groups to complete the plan and approve the project plan. 2. Lecturers design ideas for A0 paper. → Organize discussions and suggestions to improve the idea of designing potential vehicles. → Suggest the purchase of materials and equipment necessary.
	Deploy	2 next	Students will follow the plan: find information from books,

	the project the potential energy vehicle	weeks	newspapers, the Internet, show the principles of operation, relevant scientific knowledge → Find appropriate materials, processing equipment and support resources → Carry out, fabricate the potential vehicle → Test operation → Repair, improvement → Establish a fanpage to promote the project and write documentation.
Project finished		day 3 (2 lessons)	Teachers organize teams in turn to drop the vehicle to record results. Students presented their project results through powerpoint, ask and answer questions after each presentation. Teacher concludes about knowledge central. Teachers organize groups of students to self-evaluate each other, in combination with teachers' assessment. Organization of the final exam.
Develop project		Day 4 (2 lessons)	The teacher selects outstanding students during project implementation and instructs students to research improvements to optimize the potential energy vehicle, prepare for participation STEM application competition - the potential energy vehicle.

2.3. Teaching experimentation and results

These teaching processes were experimented by us at Hoa Sen High School (Lotus High School – LHS) in the second semester of 2017 – 2018 school year.

Table 4. *Experimental planning for pedagogy the STEM topic "the potential energy vehicle"*

Lessons	Experimental class	Features
Potential energy vehicle – assembled product version	Hoa Sen STEM Club 1	18 students which were divided into 6 groups. Most students are good in assembling skills.
Potential energy vehicle carton paper version	Hoa Sen STEM Club 2, Hoa Sen High School	40 students in grade 10 which were divided into 6 groups. Most students are used to manufacturing processes which make engineering products. These students are also good in classical processing skills.
Potential energy vehicle	10A10 class, Hoa Sen High School	33 students which were divided to 4 groups. Most students had not joined any studying processes before.

The experimental results in each teaching process are as follows:

Lesson "Potential energy vehicle – assembled product version"

Figure 9. *2 Assist students in assembling samples*

Figure 10. *Students group proceed to assemble the potential energy vehicle*

Figure 11. *Test potential energy vehicle after assembly*

In general, these groups were so focused and assembled the potential energy vehicles successfully. There were three groups have right operations in assembling potential energy vehicle, the moving of vehicle doesn't move out of the boundary. The fastest of time was 4 minutes 3 seconds, and the slowest was 9 minutes 13 seconds. These groups spent most of time experimenting and editing vehicle to not moving theirs going out of the boundary. Most students determined the correct parameters and use of details, how to assemble the details together. Specifically, students show the effects of bearings to reduce friction, mica clamping and mica wheels, so that the wheel does not shake, thus limiting orbits. With 3 students/group, most students treated as using a 10-wrench to tighten the nuts, screwdrivers to screw the screws, pliers to open or twist the mica disc, clamps, etc. Students are also excited to test, operate potential energy vehicle. The course provides students with access to meticulously machined, high-tech content through which students achieve a level of technical understanding.

Lesson "Potential energy vehicle carton paper version"

Figure 12. *Student process the parts of potential energy vehicle from carton paper*

Figure 13. *Students test potential energy vehicle from carton paper*

Figure 14. *Potential energy vehicle of student groups*

Classroom atmosphere was really exciting, the students were not only comfortable in exchanging and exchanging materials, but also made questions with enthusiasm and commented on design drawings and measures to improve the results of the potential energy vehicles. In addition, students could create their own cardboard processing method for the frame, wheels, navigation parts, decorative parts. Although the groups agreed on a design drawing, the dynamics of the groups remained different in size, shape and layout (Figure 14) students demonstrated a sense of self-reliance and creativity. In addition, students thought actively, founded technical solutions to improve the results. For example, group 6 added water bottles to the end of the chassis (this proposal increases the vehicle mass to avoid being affected by the wind, enhancing the vehicle's focus for the purpose of storing more potential energy). Students founded that carton paper is easy to find, easy to process, save money but easily deformed, the vehicles were too light so they were easy affected by the wind, the friction was strong, the carton wheels were not really rounded so that affected the motion of the potential energy vehicles. This indicates that the first-time student is able to read the technical structure and evaluate the technical solution. For more important, students could take part in the making space: using paper knives, scissors, and technical compasses well to cut the carton paper into pieces, using glue guns to pair the details together. Use a measuring tape and a pencil to draw, mark the carton paper to be cut. Finally, students interact continuously between students in groups, between groups, between students and students, showing their brains, promoting their strengths in communication, presenting reports. However, the creativity of the students is framed within the limits of the material, in the materials selected by the teacher and provided, in a short time. Therefore, students are not really able to express their abilities, especially their technical creativity.

Project "Potential energy vehicle"

In general, the project was welcomed by many students in a positive way. The project has mobilized the participation of the majority of students, active participation in the school and at home. All groups completed the project and moreover, Group 2 also implemented the project in advance, exceeding the requirements of the main product. Student faced two major obstacles when implementing the project, namely: lack of funds, looking to buy materials and processing equipment. Specifically, in order to implement high-tech, high-tech ideas (such as group 3), team leaders have to mobilize the contributions of each student in the group, seeking the support in the mechanical shop. Or did not find the material (like group 1) thanks to group 4 support. However, some students are unfamiliar with project-based learning, not aware of the benefits of project-based learning. Therefore, some project implementation is not timely. In addition, some groups are ineffective, have not mobilized all resources, lack of coordination among students. Although the student designs were presented using power point, which meets requirements

of content but still not reached the form. Exists in the group that student report almost read slideshows without understanding how to manufacture, operating principles. These are weaknesses that need to be overcome and supplemented for students in other similar activities.

For power generation: after the second session, the team has completed the design drawing, shaping the structure of the potential energy vehicle. In order to build a power vehicle according to the drawings, groups of students themselves seek more information on the Internet, search for and materials themselves, mobilize and borrow processing equipment to complete the potential car. of project). At the end of the project, four teams completed 5 potential vehicles (group 2 made 2 16b and 16e). Under long-term conditions, students are self-motivated to learn, perform tasks and create different products not only in terms of design ideas but also in materials that make up the potential energy vehicle. However, the potential vehicle, project products of the group, not yet optimal, satisfies the maximum 20 m point requirement.

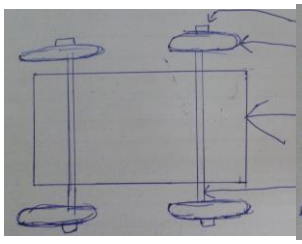


Figure 15a. *Design drawing of group 1*

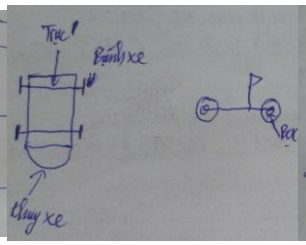


Figure 15b. *Design drawing of group 2*

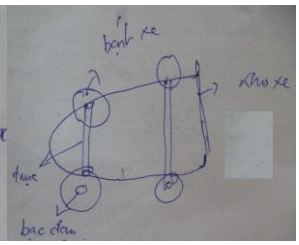


Figure 15c. *Design drawing of group 3*

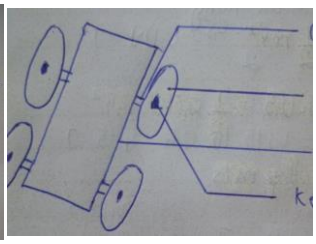


Figure 15d. *Design drawing of group 4*

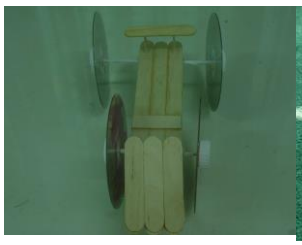


Figure 16a. *Potential energy vehicle of group 1*

Figure 16b. *Potential energy vehicle of group 2*

Figure 16c. *Potential energy vehicle of group 3*

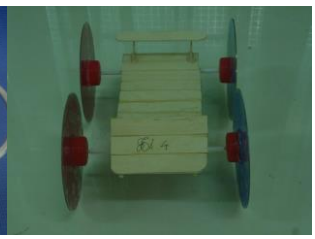


Figure 16d. *Potential energy vehicle of group 4*

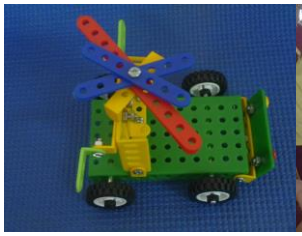


Figure 16e. *Product potential energy vehicle version 2 of group 2*

Figure 17. *Group 4 proceed to drop potential energy vehicle*

Figure 18. *Group 2 edited portential energy vehicle after the first drop*

Figure 19. *Delegater stating to report*

Table 5. *Analysis of advantages ang disadvantages of potential energy vehicle in each group*

Team	Main materials	S_{max}	Advantages	Disadvantages
1 Figure 16a	Pressing tongue sticks, oblique, straw, CD, lid.	11,5 m	Simple designs, easy making, low prices.	Being out of direction, non-strong chassis, strong friction.
2 Figure 16b	Wool panels, ball – bearing, CD.	15,5 m	Good designs, easy making, having beauties, reasonable prices, against friction by ball bearing.	Spinning of CD disks were not synchronizing → the vehicles were out of way at the end, no noticing to the sharp of vehicle
3 Figure 16c	Ball – bearing, iron – frame, iron disk	13,5 m	Good designs, high engineering, against friction by ball bearing, strong structure, sustainable structure.	Too heavy, high prices, many difficult details, the vehicles were still out of way
4 Figure 16d	Pressing tongue sticks, oblique, lid, CD.	14,5 m	Simple designs, having beauties, easy making, low prices.	Strong friction, no noticing to the sharp of vehicle.
2 Figure 16e	Grade 5 assemble engineering module	3,3 m	Simple designs; make use of the available details; quick assembly; having beauties.	Short moving line; easy to be out of way; too small vehicles; strong friction → not good design.

Analysis results of the group's potential energy vehicles showed that students completed and mastered in technical actions but it is still low level and many limitations. Students were positive and self-reliant but technical and creative skills were still low.

Evaluation of students results were carried out on two ways: first, the evaluation based on the project products (70% in distance and 30% in reported paper), is the result the evaluation of each group in combination with teacher assessment. The average score for each group was multiplied by the number of students in the group, the total of which was distributed to the groups, the team leader responsible for coordinating the scores for each student in the group, and feedback. personal points for teachers; second, evaluation was through by the final test project. The results were shown in figure 20 and figure 21.

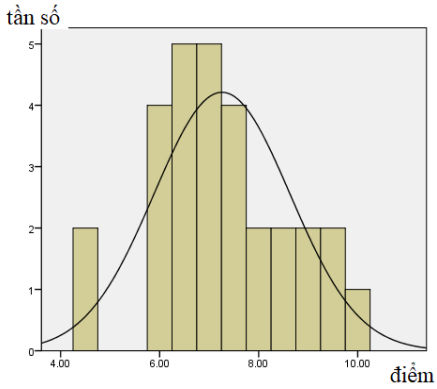


Figure 20. *Distribution of the final – test marks of project, average mark is 7,26*

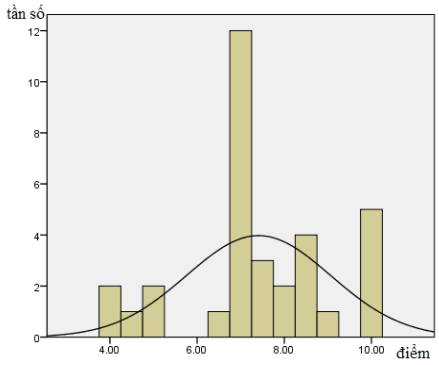


Figure 21. *Distribution of the evaluating to process mark of project, average mark is 7,41*

The Shapiro-Wilk test results show that the process score distributions and the end-of-project test are standard distributions. The results of the T - test on SPSS software showed that the mean scores of these two tests were not statistically significant. The final result of the project is consistent with the result of the process evaluation, reflecting the student's learning outcomes after participating in the project. This result confirms the students have gained the scientific knowledge of mechanical, dynamic, knowledge of materials, manufacturing technology, *etc*. through the STEM potential energy vehicle project.

Although there are many shortcomings, the STEM car project has promoted the positive effects of HS, HS express self-reliance, creative, proficient technical operation and achieve knowledge goals.

Activities in the STEM theme at Hoa Sen Secondary School helped us discover and foster the team to test the car, achieve high performance. Specifically, the third prize - the contest of potential vehicles in the framework of traditional camps 9/8, Ho Chi Minh City 2018; 4 Olympic gold medals 30/4 expansion Ho Chi Minh City 2018, applied STEM - the potential energy vehicle. This result partly reflects the positive effect of the STEM theme of the potential energy vehicle.

3. Conclusion

Applying active teaching methods such as project based learning, open learning design, group learning to organize STEM teaching themes on potential energy vehicles at different levels such as assembling, making with directions, self-making vehicles is possible. It is not only promote the positive of students but also develop the student's STEM capacity, which are good at processing skill, reading, design drawing skill, proficient in reading and drawing technical drawings, accurate evaluation of technical solutions, material search skills.

❖ ***Conflict of Interest:*** *Authors have no conflict of interest to declare.*

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