THE IMPACT OF ROBOTICS COMPETITIONS ON THE LEVEL OF TECHNOLOGY IN INSTITUTIONS OF HIGHER LEARNING IN KENYA

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Abstract
In line with vision 2030, which aims at making Kenya a middle income industrialized nation and be technologically competitive globally, Science Technology and Innovation are key pillars. Accordingly, the Ministry of Education Science and Technology introduced Robotics Competition with a bid to making students innovative, creative and competitive in the area of Technology. This event takes place annually, since 2008, especially during the Science week organized by National Council for Science Technology and Innovation (NACOSTI). This study aims at examining the impact of the Robotics Competition on curriculum development, students' final year projects and practical lessons/laboratory exercises done in the institutions and more so the level of technology involved, achievements of the participants in robotics competitions in any economic activities and towards the achievement of sustainable development goals i.e. Build resilient infrastructure, promote sustainable industrialization and foster innovation. Interviews and discussions were done in five Higher Learning Institutions which have been participating in Robotics Competition since 2008. A Statistical Package for Social Science (SPSS) software was employed in the analysis. The results of this study shall assist in indicating the effectiveness of the Robotics Competitions in improving use of technology (and the level) in Kenya.

Key words: Curriculum development, practical's, projects, creativity and innovation, industrialization

Introduction

1.1 Background Information

Robotic Competition is a way of combining the practical skills of Science and Technology with fun, intense energy and excitement of a sporting event. Scientific competitions provide a platform for scientific comparison and exchange (Laurer and Riedmiller, n.d). In addition, Robot competitions teach students other skills such as; leadership, teamwork, management of engineering projects and communication and therefore are used as a vehicle to improve technical and social skills, (Kandhofer and Steinbaner, 2014). Robotics has been demonstrated as an extension of traditional methods; a textbook, lectures through its key role as a learning collaborator, a platform and a focus (Calnon et al 2012).

Robotics competitions are exciting and clearly give the importance of Science and Engineering; students get hands on and have an inside look at the Engineering profession (in the process of design and construction of champion robot). The end result; students have fun, excitement, and are stimulated; participants discover the important connection between classroom lessons and real world applications. (Opliger, 2001), (Kandhofer and Steinbaner, 2014). Robot Competitions enhance partnerships between Schools, Colleges, Businesses and Universities in that they exchange resources and talents highlighting mutual needs and build cooperation and expose students to new career choices (Opliger, 2001).

One of the pillars of the Vision 2030, which is to make Kenya an Industrial based country is Technology and Innovation which drove the then Cabinet Secretary in the Ministry of Higher Education Science and Technology to approach the Japanese Government through JICA to assist in development of technology in the country. To meet the workforce needed in the 21st century students need training in science, technology and engineering (Deken et al, 2013). The then Director of JICA, the late Dr. Makino, suggested that the only way technology may grow in Kenya is through students having hands on experience in design and construction of robots, he therefore suggested the starting of Robotics Competitions in Kenya. A national Technical Committee was formed, composed of two members of staff from each participating institution (Kenya Polytechnic University College; currently Technical University of Kenya, Mombasa Polytechnic University College; currently Technical University of Mombasa, Kisumu Polytechnic, Eldoret Polytechnic and Kenya Technical Teachers College).

Kathy et al (2012) confirms that creativity can be induced, strengthened and encouraged, and that educational robotics aims at arousing interest of students in subjects related to technology and therefore educational robotics can be used as an excellent tool to help in explaining, identification and development of the technological talent in children and the youth. However, the psychological conditions should match the social and educational conditions.

Design competitions have become common especially in the field of mobile robots (Murphy, 2000). The First Robotics Competition in Kenya was held in December 2008 at The Technical University of Kenya, the then Kenya Polytechnic University College.

1.2 Problem Statement

Robotics Competitions was introduced in Kenya by the Ministry of Education Science and Technology with a view of making Kenya be globally competitive technologically to achieve vision 2030 and by extension achieve the Sustainable Development Goals SDGs. What is not clear is whether the robotics competition has made any impact in the institutions of Higher Learning. This research aims at examining whether Robotics Competition has had any impact on curriculum development, students' final year projects and practical lessons/laboratory exercises done in the institutions and more so the level of technology involved, the achievements of the participants in robotics as far as economic activities are concerned and towards the achievement of sustainable development goals i.e. Building resilient infrastructure, promote sustainable industrialization and foster innovation.

1.3 General Objective

Evaluate the effectiveness of Robotics Competitions in Institutions of higher Learning in Kenya

1.3.1 Specific Objectives

Determine the awareness and attitude of the existence of robotics competition to staff and students
Determine any change in deliverables in laboratories geared towards support of robotics
Determine whether new courses have come up in support of the robotics competition
Determine whether institutions have acquired any equipment in support of robotics
Determine if students are motivated to take up projects in the line of robotics
Determine whether participants have acquired skills to assist them in money generating activities

2.0 Materials and Methods

In this research, discussions with key personnel from the ministry of education science and technology, staffs who have been participating in robotics competitions, key group leaders in the higher learning institutions, not

forgetting the students who have taken part in the competitions will be held. Questionnaires will also be used to get more information from the majority of the students with whom it was not possible to have discussion with. Robotics teams normally are made up of 5 to 10 students and therefore 2 to 3 students in each of the five higher learning Institutions were interviewed.

Results

CODEBOOK A2 [n] B2 [n] C2 [n] A3 [n] B3 [n] C3 [n] A4 [n] B4 [n] C4 [n] A5 [n] B5 [n] C5 [n] A6 [n] B6 [n] C6 [n] A7 [n] B7 [n] C7 [n]					
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B2					
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C2					
		Value	Count	Percent	

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	Role	Input			
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Missing Values	System		3	20.0%	
A3					
		Value	Count	Percent	
Standard Attributes	Position	6			
	Label	NEW EQUIPMENT SUPPORTING ROBOTS			
	Type	Numeric			
	Format	F8			
	Measurement	Nominal			
	Role	Input			
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	2	DISAGREE	4	26.7%	
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	4	AGREE	0	0.0%	
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Missing Values	System		3	20.0%	
B3					
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	Format	F8			
	Measurement	Nominal			
	Role	Input			
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	3	NEUTRAL	3	20.0%	
	4	AGREE	2	13.3%	
	5	STRONGLY AGREE	1	6.7%	
Missing Values	System		3	20.0%	
C3					

		Value	Count	Percent	
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	Type	Numeric			
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A4					
		Value	Count	Percent	
Standard Attributes	Position	9			
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	Type	Numeric			
	Format	F8			
	Measurement	Nominal			
	Role	Input			
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	2	DISAGREE	3	20.0%	
	3	NEUTRAL	1	6.7%	
	4	AGREE	6	40.0%	
	5	STRONGLY AGREE	0	0.0%	
Missing Values	System		3	20.0%	
B4					
		Value	Count	Percent	
Standard Attributes	Position	10			
	Label	MICROCONTROLLERS PROGRAMMING			
	Type	Numeric			
	Format	F8			
	Measurement	Nominal			
	Role	Input			
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	3	NEUTRAL	2	13.3%	
	4	AGREE	5	33.3%	
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Missing Values	System		3	20.0%	

C4

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Standard Attributes	Position	11		
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	Format	F8		
	Measurement	Nominal		
	Role	Input		
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	3	NEUTRAL	2	13.3%
	4	AGREE	4	26.7%
	5	STRONGLY AGREE	1	6.7%
Missing Values	System		3	20.0%

A5

		Value	Count	Percent
Standard Attributes	Position	12		
	Label	INCREASE PRACTICALS SURPPOTING ROBOTICS		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
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	2	DISAGREE	0	0.0%
	3	NEUTRAL	4	26.7%
	4	AGREE	5	33.3%
	5	STRONGLY AGREE	3	20.0%
Missing Values	System		3	20.0%

B5

		Value	Count	Percent
Standard Attributes	Position	13		
	Label	STUDENT MOTIVATION ON PRACTICAL		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	STRONGLY DISAGREE	0	0.0%
	2	DISAGREE	0	0.0%

	3	NEUTRAL	3	20.0%	
	4	AGREE	5	33.3%	
	5	STRONGLY AGREE	4	26.7%	
Missing Values	System		3	20.0%	

C5

		Value	Count	Percent	
Standard Attributes	Position	14			
	Label	EMPHASIS ON SOFTWARES			
	Type	Numeric			
	Format	F8			
	Measurement	Nominal			
	Role	Input			
Valid Values	1	STRONGLY DISAGREE	2	13.3%	
	2	DISAGREE	1	6.7%	
	3	NEUTRAL	4	26.7%	
	4	AGREE	5	33.3%	
	5	STRONGLY AGREE	0	0.0%	
Missing Values	System		3	20.0%	

A6

		Value	Count	Percent	
Standard Attributes	Position	15			
	Label	RELATION BETWEEN LECTURES AND ROBOT BUILDING			
	Type	Numeric			
	Format	F8			
	Measurement	Nominal			
	Role	Input			
Valid Values	1	STRONGLY DISAGREE	2	13.3%	
	2	DISAGREE	2	13.3%	
	3	NEUTRAL	5	33.3%	
	4	AGREE	3	20.0%	
	5	STRONGLY AGREE	0	0.0%	
Missing Values	System		3	20.0%	

B6

		Value	Count	Percent	
Standard Attributes	Position	16			
	Label	ROBOT FOCUS ON AREAS OF STUDY			
	Type	Numeric			
	Format	F8			
	Measurement	Nominal			
	Role	Input			

Valid Values	1	STRONGLY DISAGREE	0	0.0%	
	2	DISAGREE	4	26.7%	
	3	NEUTRAL	4	26.7%	
	4	AGREE	4	26.7%	
	5	STRONGLY AGREE	0	0.0%	
Missing Values	System		3	20.0%	

C6

		Value	Count	Percent	
Standard Attributes	Position	17			
	Label	ROBOTS AND REAL LIFE SITUATION			
	Type	Numeric			
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	3	NEUTRAL	1	6.7%	
	4	AGREE	9	60.0%	
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Missing Values	System		3	20.0%	

A7

		Value	Count	Percent	
Standard Attributes	Position	18			
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	Type	Numeric			
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	Role	Input			
Valid Values	1	STRONGLY DISAGREE	0	0.0%	
	2	DISAGREE	2	13.3%	
	3	NEUTRAL	5	33.3%	
	4	AGREE	4	26.7%	
	5	STRONGLY AGREE	1	6.7%	
Missing Values	System		3	20.0%	

B7

		Value	Count	Percent	
Standard Attributes	Position	19			
	Label	STUDENTS USE OF MICROCONTROLLERS IN PROJECTS			
	Type	Numeric			
	Format	F8			

	Measurement	Nominal			
	Role	Input			
Valid Values	1	STRONGLY DISAGREE	0	0.0%	
	2	DISAGREE	3	20.0%	
	3	NEUTRAL	2	13.3%	
	4	AGREE	5	33.3%	
	5	STRONGLY AGREE	2	13.3%	
Missing Values	System		3	20.0%	

C7

		Value	Count	Percent	
Standard Attributes	Position	20			
	Label	STUDENTS PROJECTS ON MOBILE ROBOTS			
	Type	Numeric			
	Format	F8			
	Measurement	Nominal			
	Role	Input			
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	2	DISAGREE	3	20.0%	
	3	NEUTRAL	4	26.7%	
	4	AGREE	3	20.0%	
	5	STRONGLY AGREE	2	13.3%	
Missing Values	System		3	20.0%	

5.0 Discussion

From the table above, its clear that institutions really support the robotics competition and students are positive about it. Training of personnel needs to be done and maybe short courses be introduced which are geared towards construction of robots. There ias an increase in students doing projects on Mobile robots and emphasis on microcontroller programming has gone up

From observation, the morphology of the robots constructed for competitions have been changing from time to time. More advanced Automatic robots have been constructed. The sensor technology used has advanced with time. From using simple LDR and infrared technology to the application of Cameras etc. The rules of the robotics competition have been increasing in complexity with time. Robot game rules were initially based on pick and place but as time went by game robots were supposed to negotiated around obstacles in the in addition to performing other tasks as per the game rules.

Discussion with key informants in the Ministry of Education Science and Technology revealed that policies are to be formed by the Ministry of Education Science and Technology in support of the robotics competition. A case in mind is that mechatronics subject is introduced as a compulsory unit for students doing electrical and electronic engineering in technical institutes. and more emphasis to be put in control engineering and automation and also programming.

Discussion with some institution heads has revealed that, some institutions have seen the need of acquiring state of the art machinery eg the Fabrication laboratories (FABLABS) which can be used in precision machining of mechanical devices to be used in construction of Robots, and also taken their staff for training especially in area of Control and Automation and also use of FABLABS. Repair of Equipment which may assist in the construction of Robots have been done in some institutions (CNC).

Students who participated in robotics have made impact in the companies they are working for and even formed their own enterprises as consulting firms. They are concerned with solving Technological problems facing a company, as a result of the additional knowledge they got in participating in robotics competition. Some students engage in commercial production of goods such as the displays for business, the knowledge they got in programming of microcontrollers which has been as a results of participating in robotics competitions, which was not the case before. In some instances students have bought their own programming kits to practice programming of Micro controllers due to the roused interest in the programming of micro controllers. Businessmen selling electrical components have got their fair share in selling the components to institutions participating in robotics competition.

Participants have earned projects sponsored by NACOSTI due to the knowledge they acquired in participation robotics. Visits to foreign countries have made staff come up with new ideas that when implemented will not only be good for their institutions but for the country as a whole. Income generating activities which leads to poverty eradication and hence achievement of sustainable Development Goals (SDGs) which stress on inclusive and sustainable industrial development as the primary source of income generation, allows for rapid and sustained increases in living standards for all people, and provides the technological solutions to environmentally sound industrialization.

Conclusions and Recommendations

Robotics competition has had an impact on the level of technology though not to a larger extent. This is due to the face that only a few students get involved in the construction of games robots. Efforts have to be out in so as more students can participate in the competitions. Just like any other sporting event, robot competitions should start in the colleges where students compete amongst themselves before the regionals are Nationals competitions are done. Tokens should be introduced in order to encourage students' participation in the activity, this will build their morale and in the process get hands on experience therefore become better performers when serving in their duties after college education.

Robot construction is an expensive affair due to the fact that some components have to be purposely be imported from abroad. Efforts need to be done so that components be made available and at an affordable price.

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