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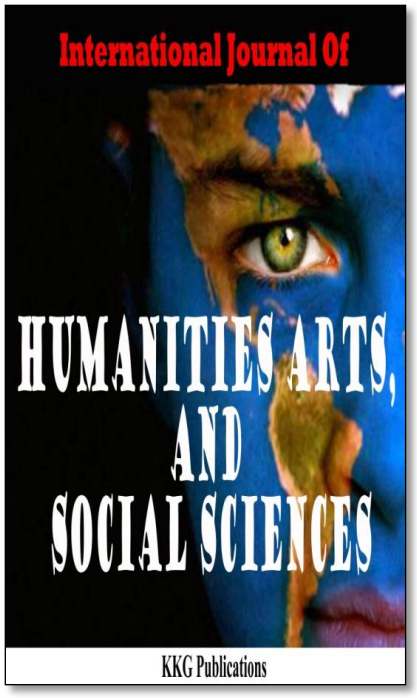

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SPACE WEATHER INNOVATION COMPETITION FOR SCHOOL STUDENTS IN MALAYSIA

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Abstract. In line with the government's vision to create space weather awareness among the public, the space weather innovation competition was organized in 2013 by Space Science Center, Institute of Climate Change, Universiti Kebangsaan Malaysia (UKM) together with National Space Agency (ANGKASA) and supported by the Ministry of Education. This paper presents the flow of the competition. The competition was designed for secondary school students age between 16-17 years of age all over Malaysia, and conducted online through a website. The participants were selected based on the results of the test that was given. The selected participants were then provided with a SID teaching kit inclusive of software, electronic components and a PCB. This competition conducted in group consists of four students. Each group are required to design and build a very low frequency (VLF) antenna, assemble the electronics components on the PCB to build the preamplifier and analyze the data that they received. They were also required to prepare, upload their progress and final technical reports to be evaluated by a panel of judges. The final evaluation was done by visits to the top five schools where the students presented their reports. This competition is beneficial to increase awareness among school students in space weather knowledge. The essence of this is to increase student in science subject in the hope to increase the number of students to select science stream subject at higher education.
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INTRODUCTION

Learning science is collectively creating knowledge rather than accumulating information packaged by teachers or textbook (Bereiter, 1994).

According to Piaget (1968) and Vygotsky (1978) people build conceptual understanding on their experience. Real experiences allow people to construct their own understanding in a meaningful way. Projects involving hands-on experience enhance students' opportunities for construction and acquire of knowledge (Crawford, 2000).

This competition can create students' awareness about space science.

This competition also encouraged students to learn through the discovery of phenomenon that occurs in the environment. Students get opportunity to investigate the phenomenon, draw conclusion, and practice the scientific skills in handling apparatus that lead to meaningful science learning and also develop their critical thinking skills during their hands-on activity (Yakar & Baykara, 2014).

LITERATURE REVIEW

The Need to Improve in Science Education

It is hoped through this competition, students' interest and awareness towards science subject would increase, and the number of students selecting science subject would also increase. This is important becauseof the decreasing trend enrolment of science students at secondary level as reported by the Ministry of Science, Technology and Innovation (MOSTI, 2012). According to MOSTI (2012) the current enrolment ratio of 20 to 80 for science and arts students is extremely low compared to the targeted ratio of 60:40. The low ratio indicates that the supply of human resource has never been inclined towards science and technology even through the target ratio was already introduced since 1967.

The Higher Education Planning Committee aims for 60% science stream and 40% art stream students at upper secondary school. This issue is clearly evident when only 20% of the 472,541 students who sat for the Malaysian Certificate of Education

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or commonly known as SPM (a national examination taken by all grade 11 students in Malaysia) in 2012 were science-stream students. This percentage is far away from target to have 270 000 science stream students ready to enter science and technology courses at tertiary level by 2020 (MOSTI, 2012). At tertiary education, statistics indicated that the inclination of students' interest is toward the social sciences, business, and law courses (Ministry of Higher Education, 2011).

Malaysia has participated in Trends in the International Mathematics and Science Study (TIMSS) since 1999. Unfortunately, the result shows that the declining students' attitude towards science education internationally (Fadzil & Saat, 2014). The average scale scores for science in TIMSS 1999 and TIMSS 2003 were 492 and 510, which were higher than the international average of 488 and 473, respectively. TIMSS 2007 and TIMSS 2011 shows that the average scale score declined to 471 and 426, respectively and these average score were lower than the TIMSS 2007 and TIMSS 2011 scale average of 500 (Chew, Idris & Leong, 2014).

Malaysia also participated in International Student Assessment (PISA) started from 2009. Malaysia was ranked 52nd in science literacy among 74 countries which participated in the program for conducted by the Organisation of Economic Cooperation and Development (OECD) in 2009. The average score for Malaysian students was 422 which was much lower than the international average of 463 and even much lower than the OECD average that is 501 (OECD, 2010).

The declining interest among young people to learning science is partially due to school system and curriculum. This problem also involved in teaching and learning science, unattractive career path and lack of incentive (MOSTI, 2012). Science education needs to be more relevant and the program should be able to adapt to the changes in the development of science and technology.

One of the most distinctive features of science that may ignite students' interest is practical work (Sorgo & Spernjak, 2012). Practical work in this context is defined as any scientific activity in which learners are needed to be actively involved to observe physical phenomena, hands-on and minds-on (Allen, 2012). Throughout this competition, students' not only need to study about space weather but also about science subject in general indirectly.

Space Weather Competition

The practical aspect applying students' knowledge in this competition can attract students' more interest towards science and also to create space weather awareness among secondary school students. The main reason of this competition is because space weather has become prominent to many countries including Malaysia.

The space-based technologies are easily affected by space weather such as communications, navigation, weather reporting, treaty monitoring, scientific observation, and other critical activities. Consequently, our daily life is more disposed to the dynamic processes in our Sun-Earth environment.

Since the success of the launch of Malaysia's first satellite, RazakSAT in 2009, the government sees the need for Malaysia to continue this venture to ensure returns of maximum benefits and thus providing leadership to others on space-based applications especially in South East Asia region.

In 2013, the National Space Agency (ANGKASA) has taken the opportunity to create the awareness among the public by organizing the space weather competition among secondary school students together with Space Science Centre, Institute of Climate Change, Universiti Kebangsaan Malaysia and supported by the Ministry of Education. This competition was initiated due to the participation of Malaysia in International Space Weather Initiative (ISWI) in 2010 whereby ANGKASA is one of the committee members.

This initiative is a program of international cooperation to advance space weather science by a combination of instrument deployment, analysis and interpretation of space weather data from the deployed instruments in conjunction with space data, and communicate the results to the public and students (ISWI, May 2014).

Through this initiative, UKM has been selected as one of the universities to receive a SuperSID monitor. The SuperSID monitor was originally built by Stanford SOLAR Center. However, for this competition, the schematic pre-amplifier circuit of the original SuperSID was modified to aid learning for secondary school students and thus renamed as the UKM-SID monitor (Mardina et al., 2013). UKM-SID is a low cost monitor that is sensitive to sudden ionospheric disturbances and appropriate for student use such as solar flare. The SuperSID use Very Low Frequency (VLF) techniques in order to sense the disturbances.

In this paper, the flow of the "Space Weather Innovation Competition" is presented where the main learning activities were based on self-learning program. Throughout this competition, the students learnt about space weather, designed and built their own antenna and assembled the electronics component on the PCB. This competition was based on self-learning technique where the students learn about space weather by their own efforts with guidance from the mentors.

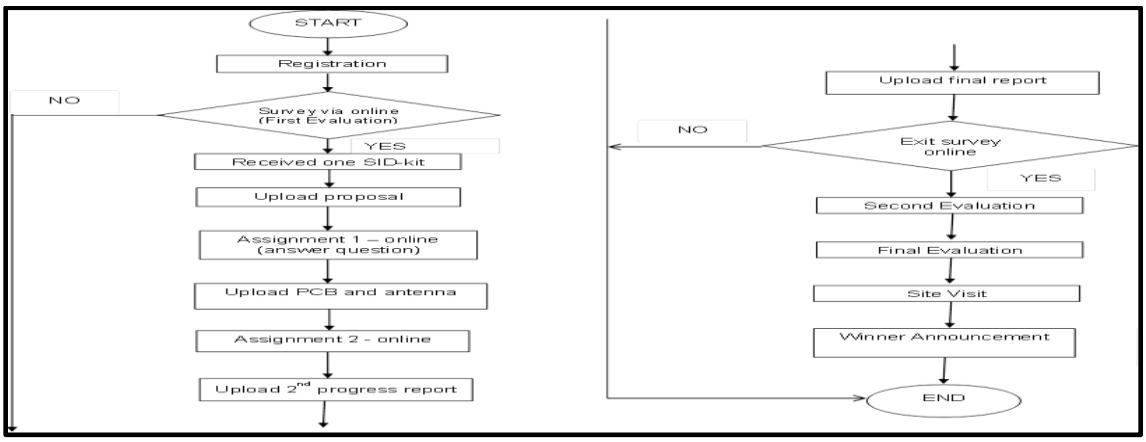
Section 2 presents a detailed description of the program including the activities for the one-year program consisting of the preparation of the competition module, selection of the participants and evaluation. The discussion and conclusion is presented in section 3.

Description of the Competition

The competition was opened to high school students between 16-17 years of age all over Malaysia and conducted online through

website. This competition has been divided into three main phases; development of the competition module, selection of participants and the evaluation.Figure 1 shows the flow chart of the competition.

FIGURE 1
Flow Chart of the Competition



Phase 1: Module Preparation

The module for this competition was prepared based on the original SID module provided by Stanford University written in Malay language. Representatives from Universiti Kebangsaan Malaysia, National Space Agency and Ministry of Education were involved in the preparation of the module in order to ensure that the level of technicality is suitable for secondary school students.

Phase 2: Participant Selection

The competition began with announcements made by National Space Agency through their website, television and other mass media. The participants were required to register online via website that was specially developed for this competition. Only four students supervised by two teachers were allowed to register. As the main objective of this competition is to develop space weather interest among the school students by cultivating and challenging their innovative skills, the test about space weather was conducted. About 58 schools registered but only 43 schools were selected based on the test result.

Phase 3: Workshop

Two workshops were held within the duration of this competition. The first workshop was conducted for engineering undergraduate students that have been selected as mentors for this program. The workshop was meant to provide the mentors with a brief introduction on the program objectives and how to conduct the experiment. The second workshop was conducted for high school students and teachers at the National Space Centre, National Space Agency. During this workshop, the SID module and teaching kit inclusive of software, electronic components and a PCB were distributed to the participating schools. The main partsofUKM-SID systemwascomposed ofan antenna, pre-amplifier circuit anda computerwitha sound card. Figure 2 shows the UKM-SID kit that was provided to the participants.

FIGURE 2
UKM-SID kit

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Phase 4: Activity and Report Submission

Students were required to design and build a very low frequency (VLF) antenna, assemble the electronics components on the PCB to build the preamplifier and analyze the data. The instructions on how to build the VLF antenna was given through the website. Students were challenged in terms of creativity to build their antenna out of recycled materials and accurately interpret the acquired data. Figure 3 shows the examples of VLF antenna built by students.

FIGURE 3
Examples of VLF Antenna Builds by Students

Students were also required to prepare and, upload a proposal, 2 progress reports and a final technical report online to be evaluated by a panel of judges. Upon submission of the reports, students were also required to answer a few technical questions regarding space weather.

Phase 5: Judgment of Competition

There were three levels of evaluation involved in this competition. The first evaluation was done based on the result of test. The second evaluation was based on the reports and online assignment. An expert from Universiti Kebangsaan Malaysia, National Space Agency and Ministry of Education were invited to evaluate the report and assignment done by the participants. The evaluation was done based on the online assignment. An only participant that sends all the progress report and answer all the assignment online is selected to the next phase. The final evaluation was done by visiting the top five scorer schools. A panel, consisted of experts from space science, engineering and education is invited to make an assessment based on the reports that have been submitted to the UKM.

There are two parts of evaluations for this competition. A total of 5 schools made it into the final round of the competition. The evaluation was based on the proposal, two progress reports and a final report that had been submitted by the participants. For the second evaluation, the panel had visited these 5 schools and evaluated student monitoring station. Students in each team had been given 15 minutes to present their VLF antenna, UKM-SID kit and the results. They also need to answer the question from the panel. The judgment is based on creativity and design skills. Another element into judgment is an oral presentation, communication skills and cooperation among group members, as well as impressions in the question and answer session. Only three from five schools were selected as a winner in this competition where they were invited to attend the ceremony giving prize during National Space Research Symposium 2013 at National Space Centre, Banting, Selangor, Malaysia.

DISCUSSION AND CONCLUSION

This competition has received positive response from school students. Students enjoyed participating in this competition. Through the feedback received, students' gained a lot of knowledge especially about space weather, which they usually do not have the chance to learn in daily classes. They also managed to learn and apply teamwork because without full cooperation from all members, the project would not succeed. This competition also demonstrated high level of interest and positive attitude towards science especially in space weather. Some schools set up theirown space weather gallery. This isto ensure that students interest towards space weather are not stopped after the competition. This gallery also would attract interest of other student towards space weather knowledge.

Studies in space weather have become more prominent due to the fact that many countries including Malaysia are moving forward in the usage of space-based instruments or gadgets. It is hoped that this kind of competition would create awareness in space weather among the public especially school students. The outcome of this competition demonstrated that the secondary school students are very enthusiastic about the topic and very

positive about the effort. have shown positive enthusiasm towards space weather, able to conduct research and enhance their soft skills. This competition has encouraged students to work collaboratively to foster team work, providing them with skills that are relevant to science research. This competition hope to ensure our future generation continues to be aware about space weather while developing their innovative skills. Finally, the mastery of science and technology especially in space science among school students is vital to produce knowledgeable and competent human capital with adequate capabilities and creativity to lead this nation in attaining the status of a developed nation.

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