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Saudi science students' experiences and perceived benefits of participation in the Innovation Olympiad

Prepare

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Abstract:

This case study examined male Saudi high school students' experiences and the perceived benefits of participation in Science Olympiad. It used a semi-structured interview protocol adopted from Kulbago et al., (2015) for a Saudi context. The participants were 15 male high school students who participated in at least one Science Olympiad competition in the city of Makkah in Saudi Arabia. These interviews were analyzed to identify emergent themes. The main themes included developing social, life and research skill, learning and increased interest in science, and STEM and career choice. A conceptual model was developed to describe Saudi Science Olympiad experiences and perceived benefits of participation in the competitions. The theory of social interdependence, along with the Social Cognitive Career Theory, represent the theoretical framework for this study (Johnson & Johnson, 1989; Lent, Brown & Hackett, 1994). Major implications of the Saudi Science Olympiad experiences shed light on the importance of these activities on students' social skills, STEM majors, career choice, inquiry instruction, and science acquisition.



Introduction

The Science Olympiad represents potentially important and meaningful extracurricular activities that would help students to use and apply their scientific understandings meaningfully. Through these activities, students experience and deal with more advanced content knowledge and inquiry skills activities that help them to obtain further understanding of their everyday science content knowledge, as well as surpass the content knowledge assigned in their science curriculum. These competitions, therefore, exemplify important extracurricular activities that help students become engaged in real time stimulating and challenging problems in order to expand and apply their understanding of science, while comparing such understandings to their counterparts.

Despite the importance of these extracurricular activities on enhancing students' experiences of science, most of the research about science Olympiad is done on western contexts. Different western studies have highlighted the experiences of students' participation in different directions. For example, the competitive nature of these competitions has been proven to help students remarkably (Forrester, 2010; McGee-Brown, 2006; Oliver & Venville, 2011; Wirt, 2011; NRC, 2009; 2011). Campbell and Walberg (2011) emphasized that these competitions are important to challenge outperforming students who need extra attention as the school curriculum does not offer real opportunities that could match their talents in science. They analyzed how 345 American Olympiad individuals benefited from their participation in science Olympiad. They distributed a questionnaire for the purpose of investigating those individuals' experiences after their participation in the Olympiad and whether the Olympiad contributed meaningfully to their career choice, science acquisition, helping society, and serving the national purpose. Over a course of 12-year period of collecting and analyzing data, the authors discovered that science Olympiad did contribute meaningfully to American individuals' major choice. They emphasized that individuals who participated in the science Olympiad majored in science related majors in prestigious universities such as Harvard, MIT, Princeton, University of



California. Other findings were related to career choice where many individuals who participated in the Olympiad pursued occupations related to science. The authors highlighted how the Olympiad was helping those individuals to pursue their science interest. They reported that seventy-percent of participants expressed that they would not be able to achieve as much without the Olympiad.

Moreover, along with increasing students' willingness to pursue science related majors and careers, these competitions have many advantages for advancing students' learning and interest in science (Kulbago et al., (2015); Top, Sahin & Almus, 2015; NRC, 2009), that may get transformed into passion of science (Forrester, 2010; McGee-Brown, 2006; Oliver & Venville, 2011; Wirt, 2011). Such interest and passion of science that by these informal science opportunities is very important. It would help students to pursue Science, Technology, Engineering, and Mathematics (STEM) majors (Rittmayer & Beier, 2008; Calkins & Welki, 2006; National Research Council, 2011; Ricks, 2006; Sahin, 2013; Richardson & Houston, 2006; Top, Sahin & Almus, 2015) and science related career choice (Writ, 2011; Abernathy & Vineyard, 2001; Sahin, Gulacar & Stuessy, 2014).

In addition, science Olympiad has contributed not only to students' interest and passion of science but also to other aspects including enhancing students' skills in various ways. Many western studies have highlighted how these extra curricular activities influenced students' social and life skills (Kulbago et al., 2015; Top, Sahin & Almus, 2015; Forrester, 2010; Zeldin, Britner & Pajares, 2008). For example, Top, Sahin & Almus (2015) investigated the perceived benefits of participation in science Olympiad with a sample of 273 individuals. They used a mixed method approach that included chi-square test in addition to qualitative analysis. Along with the benefits related to major and career choice, this study emphasized that informal learning was a contributing factor to students' major and career choice related to science. The authors highlighted six themes that were assigned as main themes for students' experiences in these competitions. these themes included getting a new experience, enhancing self-confidence, socialization



and communication, broadening vision. They also highlighted how science Olympiad contributed significantly to students' academic experiences and understandings. This study sampled male and female students, however, it was important to add in depth interviews to the data collection phase in order to gain more comprehensive views of students' experiences with science Olympiad to explain in more detail how such activities influenced their life and social skills.

Theoretical framework

The previous preview revealed important dimensions that must be considered when discussing science Olympiad experiences among students. Previous research has used different theoretical frameworks that aimed at investigating students' behaviors within these competitions and the influence such behaviors make to their and experiences in science Olympiad (Kulbago et al., 2015). Therefore, the theory of Social Interdependence would serve as a basic element to illustrate students' behaviors and the reasons behind such behaviors. Some other studies have focused more on the potential such activities make to students' future career and major choice (Sahin, Gulacar & Stuessy, 2014). In this respect the Social Cognitive Career Theory serves as a basic element to illustrate students' willingness to major in science and to seek occupations related to science after participation in these competitions.

This study, consequently, is grounded on these two distinct, but related theoretical frameworks, the theory of social interdependence (SIT) (Johnson & Johnson, 1989) as well as the Social cognitive Career Theory (SCCT) (Lent, Brown & Hackett, 1994). These two theories are used interchangeably to highlight the major themes that were discovered in the Saudi students' experiences after their participation in these activities. Even though these two theories have been used separately in many previous studies, up to the researcher's knowledge there is no one study highlighted a combination of these two theories. Including these two theories in the framework is important for many reasons. First, previous research has identified various responses of students when



competing in these extracurricular activities, which would draw attention to different dimensions pertaining to students' willingness to participate with individuals within or outside their teams. It is important therefore to use the theory of social interdependence to explain such behaviors. Some other studies have highlighted the potential such activities make to students' future willingness to major in science and seek occupations related to science (Rittmayer & Beier, 2008; Calkins & Welki, 2006; National Research Council, 2011; Ricks, 2006; Sahin, 2013; Richardson & Houston, 2006; Top, Sahin & Almus, 2015; Writ, 2011; Abernathy & Vineyard, 2001; Sahin, Gulacar & Stuessy, 2014). Therefore, extra attention has to be given to how such activities influence students' career and major choice. In this respect, the Social Cognitive Career Theory (SCCT) would serve as a basic ground for explaining students' increased interest in majors and careers related to science after participation in the Olympiad. These theories will be discussed in more detail below.

Social Interdependence Theory (SIT). This theory is important as participation in these competitions requires a great deal of cooperation within and between groups and team members. Such interplay of cooperation and competition within and between these groups would highlight the importance of offering a competitive environment to encourage students to expand their learning through comparing their learning to their counterparts', which would highlight the importance of teamwork practices on students' experiences of these competitions.

One of the major outcomes that in students' experiences was the influence these activities make to their social and life skills, such as cooperation, making friends, communication and the benefits these competitions added to their social skills. In this respect, SIT would serve as an important dimension to illustrate such experiences (Johnson & Johnson, 1989). This theory has three main constructs. First, positive interdependence, where everyone believes that his or her ability to achieve a goal is related to others. Therefore, everyone enhances each other's effort to reach their common goals and contributes to the success of the whole group. Negative interdependence is the second construct of this theory where



everyone believes achieving his or her goals relates to other failures. Therefore, individualism plays a considerable part where each individual tries to obstruct the effort of the others for his or her own success. The third construct of this theory is the construct of no interdependence where individuals believe that each persons' effort is not connected and does not influence goal achievement (Johnson & Johnson, 1989).

SIT has many implications on students' participation in the Science Olympiad. In the Saudi version of Science Olympiad (Innovation Olympiad), this theoretical framework is helpful to explain Saudi students' experiences of participation in these activities. Many Saudi students fall into the first construct where achieving the group goals is the priority to all students, with little attention given to each individual student's goals. Many students believed that teamwork is a powerful tool toward success in each activity. Therefore, they considered working collaboratively, as critical towards their success in the Olympiad. Recognizing this framework to describe Saudi students' perception of the benefit of participating in Innovation Olympiad provides a new lens for looking at how this kind of extracurricular activity will enhance scientific understanding more meaningfully.

The Social Cognitive Career Theory (SCCT). This theory was revised mainly from Bandura's (1977) social cognitive theory (SCT), which emphasized that people's knowledge can be achieved through means of observation, mimicking, and noticing others in a social context. SCCT, however, tried to expand this understanding to include the influence that such interactions would have on individuals' aspiration and career choice. SCCT is based on three main constructs that were assigned as basic elements for developing a career choice. The first construct is the formation and establishing of career relevant interest. The second construct is about the options relevant to selecting academic and career choices. The third construct is concerning individuals' performance and pursuit in educational and occupational interests. However, the authors focused on three aspects to understand the influence of the previous constructs and how they function with individuals. One of these



aspects is self-efficacy that focuses on individuals' belief of their ability to achieve specific tasks. Expected outcomes is the second aspect that focuses on how individuals comprehensively see the consequences of a specific behavior. Finally, individuals' goals that focus on their decision-making process to begin a particular task or activity (Lent, Brown, Hackett, 1994).

Saudi Science Olympiad

The Saudi version of the Science Olympiad is called the National Olympiad of Scientific Innovation or "Innovation Olympiad." This Olympiad contains two distinctive tracks: scientific research and creativity. The scientific research track aims to encourage students toward organized thinking to provide valuable contributions to the field of science. The creativity track aims to encourage students to provide innovative ideas, then implement and transform them into a product that can compete in the business market. Participants must offer individual or group projects in one of these two tracks, which have almost 17 scientific domains to choose from. These domains include animal science, plant science, energy and transportation, environmental science, earth and planets sciences, chemistry and physics, cellular and molecular science, as well as many others. These projects will be judged later by a group of specialists and academics according to specific features.

Thousands of students register every year for these competitions, but few are chosen at the final stages to present their projects nationally. One of the many goals of Innovation Olympiad is to help students redesign and reformulate their interest related to knowledge and learning paths. Another goal is shaping their research abilities and encouraging their creativity to incline toward issues related to science (Mawhiba, 2015). The Innovation Olympiad also aims to provide a competitive environment for students to satisfy their interest and enhance creativity and talents pertaining to science and technology. It is desired that students will discover their capacities and abilities related to science and improve talents through the stimulation and encouragement of learning and self-development. Students also are encouraged by using scientific



competitions to represent the Kingdom of Saudi Arabia in international competitions outstandingly and distinctively (SSCT, 2015). Students go through three stages in these competitions. These competitions begin locally through 44 departments of education all over the country. Winning students will be able to present their projects at the Saudi Science and Creativity Festival (SSCF), which is a yearly gathering that aims to enhance science and technology for students and for the whole Saudi society in general. Some of these winning projects will be chosen later to represent the country internationally (Mawhiba, 2015; SSCF, 2015).

Investigating Saudi students' experiences on science Olympiad has many advantages. First, it adds another nonwestern view of how these activities function in different cultures as is the case with the Saudi culture. Therefore, expanding the discussion internationally would give a distinctive addition to the literature about these important extracurricular activities

Second, science instruction in Saudi Arabia may benefit from the discussion of this study and its findings by focusing more on these important extra-curricular activities on students' experiences of science. Third, investigating the directions that have been emphasized previously on western contexts, specifically the interaction within and between teams and the potential for improving students' major and career choice related to science, would show the similarities and differences between Saudi students and their counterparts of western countries. Informed by a focal question concerning Saudi students' experiences and perceived benefits of participation in the Saudi Innovation Olympiad, this study intends to investigate how and in what ways such competitions would influence students from other cultures. The main purpose of the present investigation is to explore Saudi students' science Olympiad experiences and perceived benefits of participation in Innovation Olympiad. Research on Saudi students, therefore, would fill a gap in the literature pertaining to non-western contexts related to the importance of these competitions on students' experiences of science.



Methodology

This case study sampled 15 high school students from the city of Makkah in Saudi Arabia. Those students participated several times in recent or previous competitions and went through different stages in these competitions. Because of Social restriction in Saudi Arabia set in place for the protection of females and preservation of the family unit, this study recruited only males to avoid logistical issues. The sample was diversified to get supplementary views about these competitions. A conceptual framework was designed to explain and discuss Saudi students' experiences with Innovation Olympiad. This framework was based on the main themes that were investigated in previous research. This included the interplay between cooperation and competition, as well as the influence of these competitions on students' learning, their skills. This framework is also based on the potential for changing Saudi students' views of majoring in science and of preferring to work in science related careers after participation in science Olympiad.

Sampling and Data collection. The first author (2015) collected data using a semi-structured interview protocol, modified slightly from that of a previous study and translated into Arabic to investigate and collect Saudi students' experiences and perceived benefits of participation in the Saudi Science Olympiad. A request was sent to the Department of Education in the city of Makkah to ask for schools and students that would be willing to participate in this study. After schools and students were identified, the first author selected 15 students based on their grade level, focusing on high school students only. Each interview lasted approximately 30 minutes. An interpretive analysis was conducted to identify themes that included competition versus cooperation, learning, students' skills, and STEM tracks and career choice where themes later were translated into English by the first author with an auditor who speaks both languages.

Data analysis. The main method used for data analysis in this study was interpretive analysis, specifically comparative analysis informed by Hatch (2002) and Lincoln & Guba (1990). Hatch



(2002) identified specific guidelines for doing interpretive analysis. The first author applied these guidelines and later discussed directions of the data analysis along the way with the rest of the authors. These guidelines include: 1. Making sense of the data through skimming and getting a first impression of the directions that might lead toward the final assertions. 2. The first author developed memos for the data being gathered and shared them with the rest of the authors for more accurate views of the directions of the data. 3. Then the first author identified first impressions and initial thoughts based on the memos that have been gathered. 4. These impressions and initial thought were then compared to responses from previous studies to find similarities and differences. 5. After comparing these initial thoughts to previous studies the authors developed codes and later themes to illustrate Saudi students' responses and experiences of participation in the Saudi Olympiad. 6. In this phase the whole group gathered and discussed the themes and finally developed the final ones.

These themes were then discussed and compared to previous research (Abernathy & Vineyard, 2001; Author, 2015 Rittmayer & Beier, 2008; Calkins & Welki, 2006; Forrester, 2010; McGee-Brown, 2006; Sahin, 2013; Richardson & Houston, 2006; Top, Sahin & Almus, 2015; Wirt, 2011) to identify differences and commonalities. The final conceptual framework was organized to explain and illustrate Saudi students' experiences participating in the Innovation Olympiad.

Results

Many themes have been associated with Saudi Innovation Olympiad. These themes included: Social and life skills, Learning science, Interest in Science (STEM tracks, Career choice). The nature of Innovation Olympiad, as is the case with similar science Olympiad competitions, requires a great deal of competitiveness among participants using specific guidelines that are assigned for students who ultimately would advance to present their works at the SSCF each year, obtain medals, and represent Saudi Arabia internationally. This competitive environment therefore leads to the



first theme that was designed to explain the influence of such competitiveness on their social, research and life skills and their relationships with their counterparts within and between groups and team members. This theme includes students' abilities to work together to achieve their common goals as well as their abilities of making new friends, managing time wisely, altruism, and developing good communication skills. The second theme was students' increased interest in science that led to increased learning. Developing and enhancing students' interest in science included possessing a greater desire to study and learn science, and the desire to pursue science-related majors and careers. The third and final theme was the influence of these science Olympiad on students' majors and careers related to science. students expressed greater desire to pursue and focus on STEM pathways as well as open their minds to the potential of working in science related occupations. STEM tracks and pathways included options in which students developed a sense of the correlation between science and other disciplines such as engineering and math. This included an interest in ways by which these disciplines influence and get influenced by each other, as well as a sense of how such domains pertain to their future career choice.

The first theme Social, research and life skills. The competitive nature of science Olympiad has helped Saudi students extensively to gain more advanced skills, which lead to increased appreciation of these activities among them. Competition enhanced Saudi students' ability to compare their achievements with other teams and to do their best. One student emphasized that the Innovation Olympiad was an honest competition where every student tries to achieve his goals first and then helps others if they need any help. Likewise, another student commented, "the competitive environment and perceived experiences are among the most important outcomes of these activities." Students' internal desire to do well against other teams served as a great incentive for their performance in these competitions.

However, despite students' internal desires to win the medals in these competitions and to have a chance to present their works at



the SSCF, several students mentioned having a strong position against any incidents that would bring conflicts or disputes. When asked about experiences of competing with other teams, some students emphasized that these competitions should not be a source of hate. One student said, “even though we try to succeed in these honest competitions, we do not hate or discourage other groups. Instead, we try to help them as much as they need our help. Saudi students understanding of competition, therefore, seem to conflict with their notions of friendship and respect, which has to be considered when discussing these activities in a Saudi context.

Even though these competitions included a great deal of competitiveness, students mentioned a greater willingness to help and cooperate with other students inside or outside their teams. In an example of cooperation within teams, one student commented, “The important thing in working with groups is cooperation; anything else is nothing. We have to forget ourselves and focus on our teams to succeed in the competitions.” The desire to cooperate and help others was a significant part of students’ experiences. They valued helping others more than winning or getting medals. Similarly, another student affirmed, “the best thing in these competitions is cooperation between teams and within each team.” In general, students appreciated the cooperative aspect of their participation and considered their friendship with other students as one of the most significant outcomes of participation in these competitions.

Moreover, despite students’ abilities to work individually, which has been the case with one student, most students preferred to work in groups. Students saw the benefits of working in groups as helping to conquer many obstacles in the competitions. A student commented, “We love to work in groups, not only because we like to do so but because we believe that to succeed in these competitions, we need huge efforts that cannot be attained if we work independently.” Similarly, another student who started the Olympiad individually and joined a group later commented, “First I was working alone but I decided to work in a group where every student has a task to accomplish to benefit the whole group.” Saudi students associated cooperation with success and considered it to be



an essential relationship between these two components.

Throughout their participation in science Olympiad, students developed different social, research and life skills because of their participation in these competitions. Social, research, and life skills are among the 21st century skills that have been emphasized throughout many recent publications (McComas, 2014; Saavedra & Opfer, 2012). Social skills such developing good communication and friend making abilities were among many other skills that have been reported as a result of Saudi students' participation in the Innovation Olympiad. When asked about the benefits of participating in the Innovation Olympiad, a student said, "These competitions allowed me to share and discuss my ideas with my team members and to focus on my role as a way to succeed in these competitions." It seems like Saudi students developed good communication skills and had genuine opportunities to share their ideas within their groups freely and constructively. Students also developed different life skills, such as time management and responsibility. Through their participation, students were required to organize their groups and time spent on each task. They also had chances to defend their projects verbally. One student stated that the Innovation Olympiad, "Was not only challenging the content of science we possess but also how to present such an understanding of science in an appropriate manner." Students realized how important it is to be able to present their works clearly and precisely, which is clearly associated with developing a sense of responsibility and accountability. Another student commented, "What I learned in these competitions is how to speak about myself (the things that I did) and my ideas. When we were told to present our project, we were asked to do it in a very concise way, which is very hard because of the many stages that we need to talk about. I also got a lot of information and feedback from my presentations and realized how important it is to be able to organize them." These competitions, therefore, increased not only Saudi students' sense of responsibility and accountability but also increased confidence of their learning and how to present and show such learning.

Saudi students developed good research skills in science Olympiad. These skills included analytical thinking, developing hypotheses, testing, and discussing them. Saudi students developed many of these skills throughout their participation in these competitions. When asked about how these competitions influenced their ideas about science, a student said, “These competitions forced me to use scientific method meaningfully, especially when we form hypotheses and think analytically to be able to prove or disprove them. These competitions helped me to use analytical thinking, ask scientific questions, and discuss my ideas in an appropriate manner with my colleagues.” Students therefore expanded and enhanced their inquiry skill because of their participation in the Innovation Olympiad.

The second theme: the increased interest and learning of science

Along with developing social, research, and life skills, Saudi students reported that learning science was much easier during these competitions. One student reported, “These competitions helped me to gain a deeper understanding of many scientific explanations that were ambiguous or at least not clear for me before participating in these competitions.” The nature of these competitions requires greater focus on students’ interests, which would lead to get more engaged in looking for the information they need. When asked about how learning was different during these competitions, a student who was interested in biology said, “These competitions helped me to know more about the human body and the different biological functions that happen inside our bodies.” Students’ internal desire to learn science increased during these competitions. Several students have reported how science was interesting and compelling during the science Olympiad. When asked about his enjoyment participating in these competitions, a student said, “Participation in these competitions helped me to change usual understanding about science. It helped me to realize how science is fun and engaging. I had many false ideas about science, and I did not have real opportunities to correct them before my participation in the Olympiad where I had a chance to freely discuss them with my coaches and my friends. I believe I would not be able to do so



without my participation in these competitions.” Therefore, it seems that these competitions have provided a friendly and engaging environment for learning that helped students freely and openly discuss and negotiate their science ideas spontaneously.

Some students enjoyed their participation during these competitions because of the generative and productive environment that helped them to enjoy not only learn science. One student compared his experiences of Innovation Olympiad to science he obtains from school by saying,

“The way we study science in schools is boring where the main focus is on passing school exams. In contrary, these competitions gave me a chance to see how science is easier and engaging than I thought. It was so nice to be internally looking for the information I need and asking specific questions pertain to my (our) project. It was also nice to see that you are the person responsible for your learning. In schools we do not have such freedom.”

When students have a generative environment, which fuels their desire to learn, they perform better in these competitions and therefore learn science better and easier, even when the content areas covered in these competitions are way beyond their everyday science in schools.

The third theme: STEM Tracks and Career Choice

The increased learning of science during these competitions was a direct result of students’ increased interest in science. A significant outcomes of students’ increased interest in science is the influence it has on their understanding and interest of STEM. Many scholars have emphasized such positive correlations between students’ positive interest in science and their selection of STEM pathways (Calkins & Welki, 2006; Richardson & Houston, 2006, Top, Sahin & Almus, 2015). Similarly, the outcomes of this study support such positive views of STEM pathways. Students in the Saudi Innovation Olympiad have the chance to choose from 17 different themes that include significant attention to Science, Technology, Engineering, and Math disciplines. Such exposure



provided students with genuine opportunities to see the correlations between these different themes and science. When asked about the long-term benefits of participation in this Olympiad, a student said, “These competitions helped to shape my identity as an engineer. I love innovation and construction and my participation in the Innovation track enhanced my desire to pursue this choice specially when I form or design shapes for our projects.” The Innovation Olympiad provided great opportunities for students to expand and shape their passion of science and to help them to choose their future interest wisely and practically. Similarly, another student said, “I had interest in mechanical engineering before participation in the Olympiad, however, my project during the Olympiad helped me to expand my ideas about engineering and to get increased interest in pursuing this major in the university.” Innovation Olympiad helped Saudi students to expand their views and exposure to STEM pathways and encouraged them to think broadly about future career choices in more practical ways.

Discussion

Saudi students’ performance and experiences during these competitions revealed great outcomes in many directions. One great outcome was increasing Saudi students’ interest in science. Such interest in science helped them to see science in different ways, especially the realization of how fun and engaging science can be. Learning was another aspect that was influenced during these competitions as compared to their everyday science classes. While previously critical of their daily science lessons at schools for not providing such engaging and productive science learning opportunities, students reported greater acquisition of science during and after their participation in these competitions. Saudi students also showed greater interest in the STEM pathway. Students also showed an inclination to pursue science related majors and scientific careers after their participation, which could be associate with their increased interest in science (Calkins & Welki, 2006; Richardson & Houston, 2006). These different assertions are discussed in detail below.



Assertion 1. Science Olympiad developed a generative environment that helped students to develop more interest and passion of science. science Olympiad provided a decent environment for students to share and challenge their limits. Such environment was the main reason for several students to increase interest in science. their natural curiosity along with their desire to learn freely, as opposed to being forced to learn in the actual classroom setting, opened greater vents for them discover their talents of science and to enjoy not only learn science. Therefore, science Olympiad seems to enhance students' performances and achievements without being forced to achieve specific goals as is the case with everyday classroom science. such environment helped students to see other aspects of science as fun, engaging and enjoyment. It is therefore important and strongly recommended that high schools in Saudi Arabia encourage students to participate in these activities and to provide incentives and support for them along the way especially for those students who show greater willingness and interest in science.

Assertion 2. Students who were more interested and passionate about these competitions developed more in depth understanding of STEM majors. The disciplines that were assigned by the science Olympiad committee in Saudi Arabia were varied and covered varied disciplines of science. Such depth helped students not only to find their most related topic but also to show how science is a huge topic that covers different aspects and disciplines. However, one of the issues pertaining to this aspect is teachers and coaches lack of content knowledge related to some aspects of science Olympiad (Sahin, Gulacar & Stuessy, 2014). More focus therefore has to be given to science teachers and coaches in Saudi Arabia to cover these disciplines of science and be able to expand students' understandings of these disciplines.

Assertion 3. Students who were more interested and passionate about their participation in the Olympiad developed more interest in STEM majors. The more students engage in these competitions, the more they develop passion and interest of science. Their passion leads them to discover different STEM majors and see



the overlapping relationships between these different disciplines. One student mentioned how these activities helped him to develop his engineering identity. He emphasized that without such exposure to science Olympiad, he would not be able to expand his passion and interest in engineering. The relationship between students' passion of science increased interest in STEM majors has been reported by different studies. For example, Maltese and Tai (2011) found that students in their study had strong interests in STEM majors after their participation in science Olympiad.

Assertion 4. Students who were more interested and passionate about their participation in the Olympiad developed increased interest of science related careers. Students' self-efficacy fueled with formation of career relevant interest as well as the variety of disciplines provided by the Saudi science Olympiad helped students to shape their future career choice. Saudi students fall under the premise of the SCCT that stated the importance of forming and establishing of career relevant interest along with providing options for students to select what best fit their desires (Lent, Brown, Hackett, 1994). Moreover, most students in their high school years struggle to find their future career choice related to their interest specially to STEM pathways (Wang, 2013), the Saudi science Olympiad assisted Saudi students in redefining their options and to expand their inclination to pursue science related interest in the future. One student showed some advantages of the Olympiad to his ambition as he stated, "We need to find solutions to solve people's problems, which is the main goal of innovation." Science Olympiad not only helped Saudi students to see science in more practical and meaningful way, but also to use their understanding wisely for a high purpose that is to help humanity.

Assertion 5. Students who developed more connections to their counterparts developed more advanced social skills such as communication and friendship. Science Olympiad helped Saudi students to develop good social, research, and life skills. It seems like Saudi student fall under the first premise of Social interdependence theory that positive interdependence where students believed that their success is not correlated with others' failure.



Therefore, they were able to develop good social and life skills in these competitions (Johnson & Johnson, 1989). These skills are part of the 21st century skills that have been highlighted by different scholars (Saavedra & Opfer, 2012; McComas, 2014). Engaging in science Olympiad helped Saudi students to develop good skills including social skills like making friends and communication, life skills like responsibility and leadership, and research skills like analytical thinking and asking scientific questions. It is the responsibility therefore for schools, science teachers, and coaches to provide an adequate environment and provide the needed resources for students to experience and develop such great skills.

Limitations

This study relied solely on the responses of students. However, this study tried to fill a gap in the literature pertaining to nonwestern students' experiences and perceived benefits of participation in science Olympiad, which is one step in a continuous process that should include further research and comprehensive studies that would include teachers and parents. Another limitation of this study is the recruitment process. Specifically, recruiting only male students is a huge barrier of this study. Due to the social barriers that have been discussed previously in this study, such limitation cannot be avoided. Therefore, more work is needed to investigate female students' responses and experiences of participation in the Saudi science Olympiad is needed by female researchers in Saudi Arabia.

Conclusion

With the increase attention for more advanced learning of science, it is important for educators to focus on extracurricular activities that enhance the applicable dimensions of science and enhance students' learning of it. Dimensions like the love of science, its different majors, and pursuing science careers in the future were among the main benefits through participation in the science Olympiad. Saudi students through their participation in the Olympiad showed more interest in these dimensions; therefore, by enabling such activities we are providing our students with a great opportunity to make science more fun.



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