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The roles of parents in cultivating children's interest towards science learning and careers

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ABSTRACT

This research investigated the opportunities provided by parents to their children with the aim of facilitating science learning and promoting careers related to science. This exploratory qualitative research used the semi-structured interview method with seven parents who were purposively sampled for the study. Their children (16 years old) had just enrolled to study pure science subjects (science stream) such as Physics at the upper secondary level of a rural school. The interview data were transcribed, coded, and categorized based on identified themes. An overall finding was that the parents had positive values toward science. Six themes were identified and were further categorized into two major factors a) parental support and b) parental academic expectations. The parental support factor included being supportive in i) their children choosing the science stream at the upper secondary level, ii) providing assistance in increasing the children's achievement in science subjects, iii) involvement in increasing interest in science iv) involvement in science-related activities, and v) supportive in science-related career choices. The parental academic expectation factor identified the sixth theme, namely the parents' continuous profound interest in their children's achievements in science. These identified factors can help the stakeholders to plan effective educational intervention involving parents' collaboration in increasing the interest of children toward science learning and careers.

Introduction

The current problem faced by the country and in most parts of the world (Kennedy, Lyons, & Quin, 2014) is the critically decreasing number of students opting for the science stream in secondary schools and higher education institutes, regardless of high academic performance in science. The decrease in the number of students in science streams (that is students are channeled to do science at high school) provoked a new polemic in the field of education in Malaysia. Like any other developing country, Malaysia aims to become a developed country and has targeted to produce 50,000 scientists by 2020 to achieve the status of a developed, high-income nation. This target will be difficult to achieve if the students' interest in the field of science declines.

It was found that students refused to opt for the science stream due to factors such as lack of budget and technology, lack of guidance from adults who are knowledgeable and involved in the field of science-related careers, psychological restraints whereby students believe that the field of science is difficult (Kier, Blanchard, Osborne, & Albert, 2014; White & Harrison, 2012), lack of role models in the field of

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science (Kier et al., 2014), and the assumption that science is an uncreative endeavor (White & Harrison, 2012).

To revive student interest toward science and to address the negative perception toward science, respective stakeholders need to take necessary actions and play their roles within their authority. Thus, the roles of parents are also deemed crucial to complement the formal efforts of educational institutions. The support of parents in the academic field has the ability to increase the self-efficacy, attitude, and a strong expected outcome toward the science subject and careers in the future (Buday, Stake, & Peterson, 2012; Lent, Brown, & Hackett, 2000; Nugent et al., 2015; Rice, Barth, Guadagno, Smith, & McCallum, 2013). Therefore, this research explored the roles of parents in promoting students' interest toward science learning and science-related careers.

Literature Review

Parental and family attitudes towards science in everyday life are known to play an important role in shaping children's science aspirations (Buday et al., 2012; Maltese & Tai, 2011; Nugent et al., 2015; Rice et al., 2013; White & Harrison, 2012). Thus, parents should provide broader and wholesome support in order for their children be able to compete in this era of globalization. Parents' support influences their children's education development because parents not only have influence in allowing their children to choose science courses in school but also the family history will influence the tendency of the students in choosing certain field or courses (Yahya & Ismail, 2011). Tenenbaum and Leaper (2003) additionally inferred that parental beliefs about science can significantly influence children's interest and motivation in science. The inspirational attitudes towards science among children thus result in expanded enrollment in the science stream and likewise impact science achievement and interest in science careers (George & Kaplan, 1998; Maltese & Tai, 2011).

However, there are parents who put high hopes on and aim for their children to grow up into individuals who are popular, thus forcing them to study in a field that is neither of their children's choice nor interest. This in turn decreases their thinking ability and their motivation to study (Yahya & Ismail, 2011). Thus, it is important for parents to understand the interests of their children and to keep up with their development, so that effective actions can be planned and taken to improve the ability of their children in their future career.

Similarly, parental advice was also sought frequently and was useful when making job, career, and course decisions compared to advice sought from teachers and friends (Cridge & Cridge, 2015; Millward et al., 2006; Nugent et al., 2015; Sahin, Gulacar, & Stuessy, 2015; White & Harrison, 2012). Parents who are successful in influencing their children's career choices are those who have sufficient information, share that information with their children, and help their children in the process of making proper career and courses decisions (Lukas, 2015).

Previous research showed that during early child age, parents serve as the most important motivation factor in their children's lives and this includes career decisions. Previous findings also showed that the parents' level of education has a significant correlation with students' ambition. During early child age, parents provide guidance to their children by developing their skills and observing their academic improvements. Parents provide support by sending their children to tuition classes in order to improve their achievement in science and mathematics during the early education stage (Cridge & Cridge, 2015).

Sawitri, Creed, and Zimmer-Gembeck (2014) examined the longitudinal relationships among social intellectual career variables during high school years which is known as a dynamic phase of career decision-making. They examined two important factors that have been found to influence individual career advance. The first was parental career expectations, which can have an effect upon choices identified regarding educational and occupational goals, occupational choice, level of commitment, and exertion (Fouad et al., 2008). The second parental contextual variable was parental support, which incorporates encouragement, modeling desired behaviors, and enthusiastic backing. Both cross-sectional and longitudinal studies with participants from collectivist societies have shown that parental support influences children's career selection (Garcia, Restubog, Toledano, Tolentino, & Rafferty, 2012; Sawitri et al., 2014).

When children begin their secondary education, parents influence their career decision making by providing financial support to the students. During the university period, parents who are not aware of the higher education needs and financial burden will only provide negative enforcement, especially if the student has enrolled in a tough and competitive course. Therefore, attention should be given to educating the parents about the importance of their roles in empowering their children with career decision making by providing them with adequate knowledge on career choices. This shows that the attitude of parents also plays a vital role in the career decisions of their children, including the aspects of career exploration, gender typing, and future career planning (Hall, Dickerson, Batts, Kauffmann, & Bosse, 2011).

Research Methodology

Study Context

This research aimed to explore the roles played by the parents in cultivating interest toward science subjects and careers. Thus, this study aimed to answer one general question namely: How do parents play their role in promoting and facilitating their children's interest in science learning and career choices? In order to achieve the aims of the research, the parent were interviewed on the following questions: a) Do you spend time on helping with your children's homework and monitor their achievement? b) Do you bring your children to science fairs, and involve them in science-related activities inside and outside of school and at home? c) Do you think science education is important? and d) Do you want your child to enter a science-related career?

This descriptive case study utilized the semi-structured interview method to obtain data from the parents of Form 4 (16 years old) science stream students. These students had

opted to do science courses at the upper secondary level. The location of the study was in one of the schools in Temerloh, Pahang, Malaysia. The school involved in this study was considered as a rural school.

Participants

The process of determination and selection of participants was based on the purpose and questions of the study. Qualitative research often focuses on a small number of samples to gain in-depth information and samples are selected purposively to acquire in-depth information for the study (Miles & Huberman, 1994). In this study, purposive sampling was utilized to ensure that the participants were able to provide the information required to answer the research questions (Patton, 2001).

In total, seven parents of Form 4 science stream students were purposively selected as research participants. The selection of the participants was based on the willingness of the parents to be actively involved in the interview. They are known as R01, R02, R03, R04, R05, R06, and R07 respectively. The respondents varied in terms of their educational background, income, and employment. Some held a professional job with an income ranging from MYR 4,000 to MYR 5,000 per month. Their academic qualifications were having a first degree. There were some respondents with a diploma qualification and an income bracket of MYR 2000–MYR 3000, while the school certificate leavers and parents who conducted small scale businesses had an income of MYR 500 to MYR 1,500 per month.

Data Collection Procedure

The researcher held a preliminary meeting with the participants to explain the purpose of the study and to get their permission to conduct the interview. The researcher confirmed the date and time of the interview with the participants according to the availability of the participants. The researcher began by building rapport with the participants first so that the participants were prepared mentally and physically to provide the information based on the research questions. The researcher also informed the participants that the study required that the interview be recorded. Therefore, a letter of authorization and acknowledgment as a participant had to be signed voluntarily by the participant. Preparations were made to ensure that the interview went well. Therefore, all equipment was provided such as audio-video recording equipment, stationery, and notebooks.

Data Analysis Procedure

Data analysis is a critical process in which the data were collected through various methods of analysis. All data were obtained from semi-structured interviews. After the interview was conducted, the researcher created a verbatim transcript of the interview that was further analyzed manually. The researcher built open coding for each verbatim transcript and then incorporated the same code into several categories. The process continued until the themes and sub-themes of the parents' role in promoting and facilitating their children's interest in science learning and career choices were formed.

Findings

The research findings showed that the parents had positive values toward science. Their values regarding science education influenced their roles in terms of promoting and facilitating opportunities that influenced their children's interest toward science learning and careers.

Science Education Values

Science education can produce students who possess scientific skills that can be applied in the work field later on. Among the perceptions of the parents regarding the values of science education that can be obtained by their children were problem solving skills (R01, R06) and high-order thinking skills (R03), which are related to daily life. It is important to enable students to master the science process skills in their daily life activities. The following responses reflect their values of science education:

" ... Cultivates thinking skills in finding solutions to problems" (R01).

"Show to people that science is able to solve various problems in life such as boiling water, washing clothes, rearing fish and a cat" (R06).

"Produce high-order thinking skill for example (s)he can think how a disease can infect a person" (R03).

Parents also play a vital role in educating their children regarding the importance of science in daily life. Through scientific knowledge, many inventions have been made. Parents need to educate their children from a young age to appreciate science and to instill an interest in science and science-related careers.

According to the parents, science is important because science qualifications widen one's jobs prospects (R05, R06). However, one parent, R07, viewed the importance of science from the aspect of the value of the science itself and knowledge appreciation. The following findings show the opinions of the parents regarding the importance of science.

"Science education is very important. Nowadays science is very important because I see that in schools in the past, the job opportunity for the friends who work in science field was easy to get. Because during my school time ... Most of the students doing the arts stream became teachers but the science stream students had various jobs" (R05).

"Science is very important in the lives of people. Science can open up many opportunities in the career field such as scientist, astronaut, or doctor" (R06).

"I think that science education is very important for the future of our children because this field constantly makes

them think and they can refer to facts left behind by the scientists in their respective fields" (R07).

Role of Parents in the Development of Interest Toward Science Learning and Careers

Six themes were identified and these themes were further categorized into two factors: a) parental support and b) parental academic expectations.

a. Parental Support

i. Supportive in choosing science stream

The positive opinions of parents regarding the future of science drove them to support their children to choose science stream even though their children were not interested in science initially. Parents felt that science stream and qualification offered broader opportunities; be it in universities or in the science career field; compared to the arts stream (R01, R03, R07). Parents also considered the s c i e n c e stream as the field for brilliant individuals (R05). Thus, the positive perceptions of the parents toward science played an important role for students in choosing the science stream.

"I really support my children going into the science stream because it is broader compared to the arts stream. When they enter university, there are many opportunities and (s) he can also choose between the science stream and arts stream, but if (s)he opts for arts stream (s)he can't go for the science stream so the science stream has more opportunities in the future" (R01).

"I indeed encouraged him to go for the science stream, although he do not want it but when forced he had to, we encouraged him because I want him to be in a wider field compared to the arts stream that is more narrow and he can progress" (R03).

"I support my son choosing science because it gives motivation for him to learn science" (R04). "I encouraged and supported him to choose the science stream because I feel that science is for brilliant people and because he also had an interest toward it" (R05).

"I really support my son choosing the science stream during form four because that is the starting point for him to determine his career path in the future. It is during form four that they will learn the basics of physics, chemistry, and biology" (R07).

ii. Supportive in giving assistance in order to improve science achievement

The involved parents took initiatives in helping their children to improve their achievements in science by providing tuition classes and encouraging their children to study every night as stated by respondents (R03 and R07)

"Thus, so far, I help in such ways I can by encouraging my child to study every night and funding tuition classes at end of the year" (R03).

"I will give attention to and finance my child for tuition classes" (R07).

iii. Supportive in increasing interest toward science

Parents provide all the necessities and facilities including financial support in order to make sure that their children's education development is consistently promising and this will increase their interest towards science. The research findings showed that parents provided financial support to increase their children's interest in science by sending them to tuition classes to learn science (R01), involving them in science activities (R01, R07), encouraging them to participate in tours to science centers organized by the school (R01, R06), or by taking the children themselves to science centers (R01, R03). There were also parents who cultivated an interest in science in their children by motivating them to learn things related to the field of science (R06).

"I support financially; if my child is attending any science activities, I will give him money and send him for tuition to learn science and apart from that, I encourage my child to participate in school tours to the science center and I myself have brought him twice to Petrosains and Planetarium"(R01).

"I took my child to the science center, Planetarium, and he was OK with it. He really liked it and his curiosity was obvious"(R03).

"I always encourage, motivate and support children in the science field…also encourage my child to participate in the school tour to the science center"(R06).

"I help by buying needed activity books related to science subjects. Apart from that, I encourage him to participate in programs related to the knowledge of science that are being organized by the school" (R07).

Parents also helped to increase and promote interest toward science through media like television programs such as National Geographic and young scientists (R06) as well as by providing books related to science (R01, R02, R07) and science activity books (R07).

"I provide science-related reading material such as science encyclopedia and books on how to conduct easy experiments and I encourage him based on the reading material to carry out experiments at home. I also borrow reading material from the library and we also have a library at home" (R01).

"...when the books are insufficient, we buy them"(R02).

"I encourage my children to watch science-related programs such as National Geographic and young scientists" (R06).

"I provide science reading material for my children"(R07).

iv. Participation of parents in science activities

Cultivating an interest toward science is much easier and effective if the parents participate in the science activities with the children. Based on the

research findings, parents participated in science activities such as doing simple experiments at home by fixing and repairing electrical appliances (R01), participating in science activities (R02), preparing orchid fertilizer (R05), and by planting trees (R06).

"… Since his father is working in the field of science by working in the electrical department, his father will tell him to carry out simple experiments such as fixing electrical appliances at home, repairing broken appliances, and fixing plugs and switches" (R01).

"We involve ourselves...if there are science activities, we will join as well" (R02). "... I make fertilizer for the orchids. Mira knows because she observes how I do it, until the fermentation rises, changing it, and then we can sell it" (R05).

"Trees planting and keeping the surrounding area clean" (R06).

v. Parental support in choosing science-related careers

The demand for science careers is increasing gradually with the vision of achieving the status of a developed nation. Opting to do science courses at the upper secondary level will be the catalyst to the chosen career. Therefore, parents need to support and encourage, so that more children will choose science-related careers. Based on the research findings, parents stated their support for getting their children into science-related careers in the future (R06, R07). There were also parents who stated their support by providing books related to careers that were of interest to their children (R04).

"...want to work in the science field because that is his interest because since young I observed it. For example like the astronomy book...at night he would look at the stars" (R04).

"I really support my children to have science-related careers because science is very important in our lives and by having more science knowledge, our lives will be easier" (R06).

"I really support my son in being involved in a science-related career because the knowledge is so vast" (R07).

b. Parental academic achievements' expectations

i. Concerned about the their children's achievement in science

The findings indicated that the parents showed concern about their children's interest in science and followed up on their performance on the subject of science. Thus, they were aware of the development of their children in science subjects. This was proven by the data obtained from the interviews with R01, R02, R03, and R07:

"His performance increased and I observed that he is more interested although in the beginning he couldn't cope but now he is more interested with the science subject" (R01).

"The achievement cannot be said to be good because he is new in this stream. But he should be able to cope …"(R02).

"The science subject achievement is currently moderate"(R03).

"The achievement is not so good at this time. However, I am not so worried because maybe he still can't understand the related subject" (R07).

Discussion and Implications

Parents involved in this research had positive values toward science and believed that science was a prestigious field and had the ability to solve routine life problems. These values are important in developing motivation to learn science and have science-related careers (Wang, 2013; Wigfield & Eccles, 1992) if it is cultivated in children from early age by the parents. The positive values toward science that are held by the parents have the ability to reduce the challenges and the negative perceptions in learning and choosing science careers (Byars-Winston & Fouad, 2008).

Parents who were involved as the respondents of this study viewed the field of science as one holding more opportunities compared to the arts. Thus, they encouraged their children to explore the field of science and motivated their children to choose science-related careers. This paralleled the opinion of Yahya (2007) who stated that the positive perceptions of the parents toward science will encourage and facilitate their children to choose a science field. Positive support such as providing developmental advice was also deemed as increasing the confidence of the children in making decisions related to science (Yahya, 2007). This finding proved that adequate, clear information related to science education and the demands of science careers will influence the beliefs of parents and influence the children to choose the science stream and science careers in the future (Lukas, 2015). Thus, information related to opportunities and demands in the country should be promoted and disseminated so that parents can get clear and current information.

The involvement of the research respondents in science activities at home was deemed as good support because, as stated by Maltese and Tai (2011), parents play an important role in providing early experience to the children in skills development through science-related activities. Thus, parents need to inspire the culture of science at home by helping their children to develop skills by conducting simple experiments at home. Thus, universities and institutes should take the initiative to create affordable laboratory kits for home use.

In addition, informal parental support in encouraging their children to participate in science activities such as visiting science centers was deemed as a smart way to cultivate an interest in science. This was due to the fact that informal science learning not only helps to develop interest, but also provides experience, skills, attitude, and desire to be involved in STEM careers (Archer et al., 2012; Ayar, 2015; Gwen, Bradley, Neal, & Greg, 2016; Mills & Katzman, 2015; Sahin et al., 2015). Therefore, informal science education should provide concessions to parents bring their children to museums and other informal learning settings.

Media such as television, magazines, and science books also need to play crucial roles in promoting the culture of science through programs and information that are appropriate according to the ability of the students and parents (Cavas, Cakiroglu, Cavas, & Ertepinar, 2011; Venville, Rennie, Hanbury, & Longnecker, 2013). Hence, parents need to be smart in selecting reading material and programs for their children. This will enable the parents and the children to mutually discuss science topics at home and to cultivate a culture of science at home. In addition, the government should give more incentive to parents by increasing the tax exemption for spending on science-related materials and books for their children.

The parents need to be involved in the learning of science at home by providing their children with homework that requires the participation of the parents. With this, indirectly, parents will play their role in helping their children learn science and cultivate an interest in science in the family institution. In addition in Malaysia, a parental program (known as *SARANA*), that promotes the involvement of parents in the education of their children during and after school, was an effective initiative to increase the participation of parents in the education of their children (Ministry of Education, 2015).

Based on the research findings, an alternative model is suggested regarding parental roles in cultivating an interest toward science and science-related careers as shown in Figure 1. In order to cultivate the interest in science and science-related careers in children, the parents need to have positive values toward science as then they will play their role in supporting their children to choose the science stream, show concern about their children's achievements and interest in science, be supportive in increasing the interest in science, involvement in science activities by their children, and be supportive of science-related career choices.

Conclusion

The positive perceptions and values of parents toward the subject of science propel parents to cultivate their children's interest in science and science-related careers. The supportive efforts to promote and facilitate an interest in science and a science-related career are shown by actions such as sending children to tuition classes, providing financial support for science activities, encouraging a culture of science at home, and encouraging children to explore science-related careers. Thus, this study demonstrated that parents can play a vital role in cultivating an interest in science and a science-related career among students. Thus, the development of science culture through policies and programs should not only involve those in formal institutions (such as schools and students) but also the parents who can be exposed to the programs as well as given incentives (such as discounted science fair fees or tax deductions for their involvement) to their current efforts in promoting their children to show an interest in science. Parents are one of the factors necessary for the successful adoption of a science-friendly culture. Future research should investigate the role of urban parents, their academic qualifications, and their careers in inculcating an interest in science learning and a science-based career for their children. It is assumed that the background of the parents also influences the value in promoting their children's education and science education in particular.

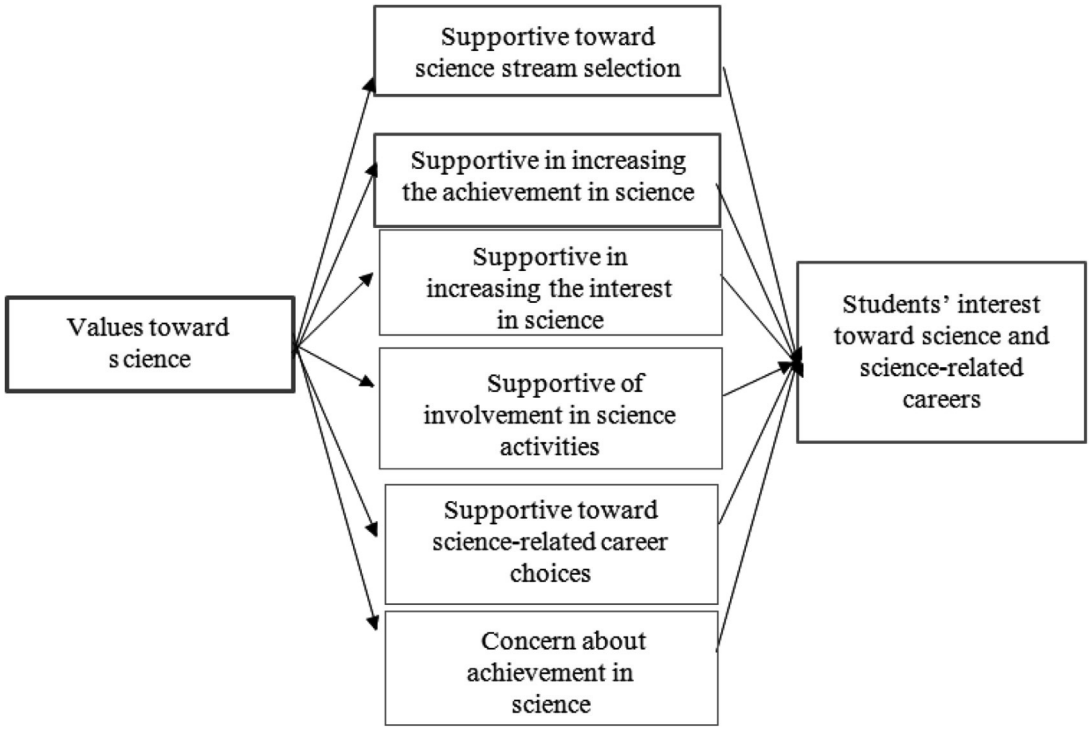

Figure 1 Alternative model of parental role in cultivating interest towards science and science-related careers

Conflict of Interest

There is no conflict of interest.

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References

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science aspirations, capital, and family habitus: How families shape children's engagement and identification with science. *American Educational Research Journal, 49*(5), 881–908.

Ayar, M. C. (2015). First-hand experience with engineering design and career interest in engineering: An informal stem education case study. *Educational Sciences: Theory & Practice, 15*(6), 1655–1675.

Buday, S. K., Stake, J. E., & Peterson, Z. D. (2012). Gender and the choice of a science career: The impact of social support and possible selves. *Sex Roles, 66*, 197–209.

Byars-Winston, A. M., & Fouad, N. A. (2008). Math and science social cognitive variables in college students: Contributions of contextual factors in predicting goals. *Journal of Career Assessment, 16*(4), 425–440.

Cavas, B., Cakiroglu, J., Cavas, P., & Ertepinar, H. (2011). Turkish students' career choices in engineering: Experiences from Turkey. *Science Education International, 22*(4), 274–281.

Cridge, B. J., & Cridge, A. G. (2015). Evaluating how universities engage school students with science: A model based on the analysis of the literature. *Australian University Review, 57*(1), 34–44.

Fouad, N. A., Kantamneni, N., Smothers, M. K., Chen, Y.-L., Fitzpatrick, M., & Terry, S. (2008). Asian American career development: A qualitative analysis. *Journal of Vocational Behavior, 72*, 43–59.

Garcia, P. R. J. M., Restubog, S. R. D., Toledano, L. S., Tolentino, L. R., & Rafferty, A. L. (2012). Differential moderating effects of student- and parent-rated support in the relationship between learning goal orientation and career decision-making self-efficacy. *Journal of Career Assessment, 29*, 22–33.

George, R., & Kaplan, D. (1998). A structural model of parent and teacher influences on science attitudes of eighth graders: Evidence from NELS: 88. *Science Education, 82*(1), 93–109.

Gwen, N., Bradley, B., Neal, G., & Greg, W. (2016). Robotics camps, clubs & competitions: Results from the US robotics projects. *Robotics & Autonomous System, 75*, 686–691.

Hall, C., Dickerson, J., Batts, D., Kauffmann, P., & Bosse, M. (2011). Are we missing opportunities to encourage interest in STEM fields? *Journal of Technology Education, 23*(1), 32–46.

Kennedy, J., Lyons, T., & Quin, F. (2014). The continuing decline of science and mathematics enrolment in Australian high schools. *Teaching Science, 60*(2), 34–46.

Kier, M., Blanchard, M., Osborne, J., & Albert, J. (2014). The development of the STEM career interest survey (STEM-CIS). *Research in Science Education, 44*, 461–481.

Lent, R. W., Brown, S., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology, 47*(1), 36–49.

Lukas, M. (2015). Parental involvement in occupational education of their children. In *ISSN: 2367-5659 2nd International multidisciplinary scientific conference on social sciences and arts. Conference proceedings* (pp. 715–722), ISBN 978-619-7105-45-2.

Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among U.S. students. *Science Education, 95*(5), 877–907.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. London, UK: Sage.

Mills, L. A., & Katzman, W. (2015). Examining the effects of field trips on science identity. In *12th international conference on cognition and exploratory learning in digital age (CELDA 2015)* (pp. 202–208), ISBN 978-989-8533-43-2.

Millward, L., Houston, D., Brown, D., & Barrett, M. (2006). *Young people's job perceptions and preferences*. London, UK: DTI. Retrieved from http://www.berr.gov.uk/files/file28575.pdf.

Ministry of Education. (2015). *Paradigm*. Bulletin of education transformations of Malaysia. Retrieved from http://www.padu.edu.my/files/anjakan/anjakan_feb_2015.pdf.

Nugent, G., Barker, B., Welch, G., Grandgenett, N., Wu, C., & Nelson, C. (2015). A model of factors contributing to stem learning and career orientation. *International Journal of Science Education, 37*(7), 1067–1088.

Patton, M. Q. (2001). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Rice, L., Barth, J. M., Guadagno, R. E., Smith, G. P. A., & McCallum, D. M. (2013). The role of social support in students' perceived abilities and attitudes toward math and science. *Journal of Youth Adolescence, 42*, 1028–1040.

Sahin, A., Gulacar, O., & Stuessy, C. (2015). High school students' perception of the effects of international science Olympiad on their STEM career aspirations and twenty- first century skill development. *Research Science Education, 45*, 785–805.

Sawitri, D. R., Creed, P. A., & Zimmer-Gembeck, M. J. (2014). Longitudinal relations of parental influences and adolescent career. *Journal of Research on Adolescence, 25*(3), 551–563.

Tenenbaum, H. R., & Leaper, C. (2003). Parent-child conversations about science. *Development Psychology, 39*(1), 34–47.

Venville, G., Rennie, L., Hanbury, C., & Longnecker, N. (2013). Scientists reflect on why they chose to study science. *Research in Science Education, 43*(6), 2207–2233.

Wang, X. (2013). Why students choose STEM majors: Motivation, high school learning, and postsecondary context of support. *American Educational Research Journal, 50*(5), 1080–1121.

White, E. L., & Harrison, T. G. (2012). UK School students' attitudes towards science and potential science – based careers. *Acta Didactica Napocensia, 5*(4), 1–10.

Wigfield, A., & Eccles, J. S. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review, 12*, 265–310.

Yahya, A. (2007). *A happy family formation: How to make decision and solutions for excellence*. Skudai, Malaysia: UTM Press.

Yahya, A., & Ismail, N. (2011). Factors in choosing courses and learning problems in influencing the academic achievement of students' technical courses in three secondary schools in the state of Negeri Sembilan. *Journal of Technical, Vocational & Engineering Education, 2*, 93–106.