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Factors of Decision Making in Science Stream Course in Higher Learning Education

Northaqifah Hasna Mohamad Khir, Zaidatul Salwa Mahmud, Siti Sumaiyah Sheikh Abdul Aziz, Muhammad Shaffiq Zainal Osman Shah, Nurul Aimi Zakaria

Faculty of Applied Sciences, Universiti Teknologi MARA, Cawangan Perak Kampus Tapah, 35400 Tapah Road, Perak, Malaysia.

Corresponding Author Email: zaidatulsalwa@uitm.edu.my

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Abstract

The declination of science interest appears to be a significant concern as becoming a global trend issue. As the government will face negative impact from this issue, the government encourage any contribution effort from the universities and industries to increase the social interest. Thus this study was conducted for the purpose of investigating the influencing aspects in students' stream choice of either physics or biology stream. 36 respondents chosen are students from third semester for 2017/2018 session of Diploma in Science from Universiti Teknologi MARA (UiTM) Perak Branch Tapah Campus. Data collection was done quantitatively from questionnaires participated by all respondents through an academic program named 'Running Physicists' which organized by the faculty. Demographic and contributing factors from family background, peer, and passion were measured as the prompting aspects in student's stream choices. Cronbach's Alpha for demographic factor is 0.815 of consistency value gives reliable value for measuring respondents' opinion. The contribution factors show significant relation on family, peer, and passion with mean value of 3.59, 2.95 and 4.32 respectively for physics respondents and mean value of 3.71, 2.71 and 4.43 correspondingly for biology respondents. The enrolment of respondents in stream choice is dominated by personal abilities and passion with the subject's background.

Keywords: Stream Choice, Demographic Factor, Contribution Factor, Cronbach's Alpha SPSS

Introduction

Science, Technology, Engineering and Mathematics (STEM) in higher education is broadly defined as one of key drivers of national development plans (Drori et al., 2003; Hwang, 2006). This agreed by almost all countries in the world as reported in national education reports submitted to UNESCO World Conferences (UNESCO IBE, 2016). However, Ministry of Education of Malaysia have reported that recent statistics show reduction of students' enrolment in higher education particularly STEM. This trend spark worries to the government as the country will face problem to meet the industrial needs of highly advanced technical skills (Ismayatim, 2019). The declination of Science interest issue happened also in

global trend. US Secretary of Energy, Spencer Abraham said the consequences of the declining number of American scientists could give negative impact to both corporate America and the Energy Department, which employs thousands of nuclear physicist, astronomners, crytohraphers and other specialists (Campaign promotes career in science, 2004). Jon Miller, MSU Hannah Professor of Integrative Studies, and colleagues (University of Michigan State, 2010), said that, "Failure to build and maintain a competitive scientific workforce in the decades ahead, will inevitably lead to a decline in the American standard of living." Hence, Malaysia's government encourages universities and industries to contribute any effort that would increase students' interest in Science. In effort to this, the university faculty require to understand the factors that influence the students' decision-making. The study of the factors will improve the understanding of how prospective students choose their study course, which can then help the faculty members increase their effectiveness in term of attracting more candidates with the appropriate credentials.

Diploma in Science is one of STEM based undergraduate program in Universiti Teknologi MARA (UiTM). This program offers students with two major stream to choose from: Physics and Biology. The students enrolled in this program will have to decide which of the two major Science subject to enroll in for their 4^{th} semester study. The faculty members have carried out several extensive measures to attract students for both Physics and Biology streams. Several actions done by the faculty including annual seminars on the courses' background to spread awareness on career opportunities, educational competitions, course content revision, assessment methods updates and the application of different teaching methods. Study will facilitate the faculty focus in attracting the students' interest. This paper discusses the decision making factor of the students in choosing physics or biology, with analysis scope limited to the two main factor: environmental and emotional factors.

Literature Survey and Conceptual Framework

As stated by Dietrich (2010) people's decision-making process is influenced by their past experience, cognitive biases, individual differences (age and socioeconomic status), beliefs in personal relevance and an escalation of commitment. The conceptual framework of this study was developed from summary investigation of theoretical models applied by (Herrera et al., 2012; Master and Meltzoff, 2016; Tandrayen-Ragoobur et al., 2022). This framework also referred to Bandura's general social cognitive theory (Bandura, 1998) to gauge into how individual academic is related interests in Science are influenced by the interaction of personal, environmental and behavioural variables. This study focuses on the predictive value of certain characteristics of the curriculum, the self-interest and the environment of the choice variable as summarized in Figure 1.

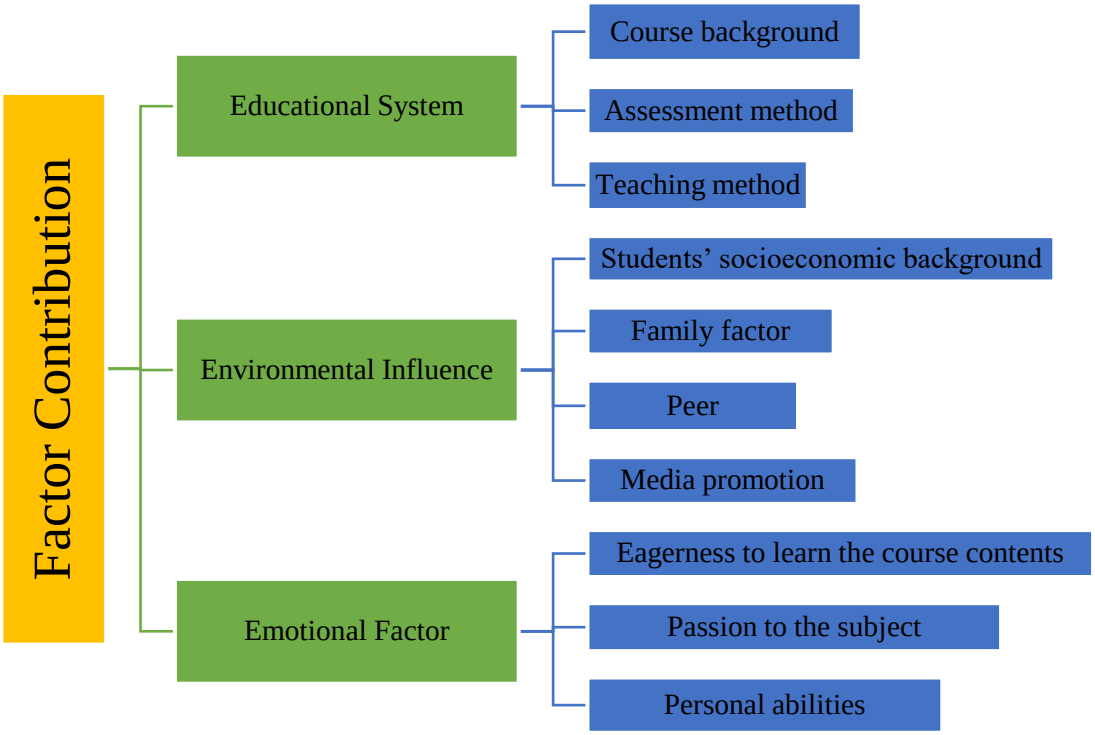

Figure 1: The conceptual framework of stream-choice in science higher learning institution

Educational system factor includes the course background, assessment method and teaching method. Stokking (2000) predicts that the decision-making by students is connected with certain characteristics of physics curriculum. Background of the physics code is expected to be the possibilities for some students to eager to experience physics and any physics-like contents. A study report by Institute of Physics, IOP (2018), interviewed a Planetary Scientist, Jane MacArthur, she stated, "Having maths and physics opened up doors everywhere and reassured people you can 'pick other stuff up'". Another interviewee by IOP (2018) Jessica Cliff, Physics Graduate believes that her choice to take physics opens her option for career choice, due to the background of physics that involves maths, computer coding and problem solving. The physics knowledge that link very well with math gives wide opportunity for various career field in future as also reported by the IOP (2018), whereas other Physics graduates are now working in a range of sectors, including academic research, finance and consultancy.

On the other hand, there is this perception among students where physics has the image of being difficult and objective and has an emphasis on concepts, laws, and calculations rather than human, historical and social aspects of science (Angell et al., 2004; Carlone, 2003). Students also claimed Physics as a demanding subject with high workload and difficulty (Henriksen et al., 2004; Prosser et al., 2000). Consequently, students spend extra time focusing on formulas and practice problems to pass the subject, rather than enjoying understanding the knowledge deeply that is supposed to be the main attraction of the subject (Elby, 1999).

Meanwhile, environmental influence depends on the students' socioeconomic background and their environment (parents, siblings, friends, and mass media). These influences can be categorized their 'advisers' that lead to their decision. Stephanie Yardley, Postdoctoral Research Fellow, stated that he was encouraged by his physics teacher to take physics mainly because he got good grades in the subject (Institute of Physics, 2018).

However, these 'advisers' are considered as weak factor in the students' decision making (Henriksen et al., 2004).

Personal or emotional factors include the personal abilities from past achievement in the related field and interest (passion) to the subject that lead more towards the decision making. It was found that physics students put relatively more emphasis on their personal interest and abilities (Henriksen et al., 2004). Students see physics as an interesting subject. A study by Zakaria et al (2018) recorded nearly 89% of their student's subjects agreed that physics is an interesting course, enjoyed learning the course and felt that working in the laboratory is exciting. This observation is similar to the one in a study by Angell et al (2004), where they conclude that physics is interesting to students because it describes the world and everyday phenomena. Students get more interested in subjects that are closer to their life-world such as astrophysics rather than mechanics. Rebekah Endersby, an Electrical Engineer at National Grid PLC stated that she did not receive much careers advice on Physics at school, however she chooses the Physics field based mostly on home support and her interest and enjoyment on the subjects (IOP, 2018). From Lapp (1996), a physics teacher studied his action in making physics subject interesting, and the result proves that his efforts has multiplied the school's physics stream enrollment. The strategies employed by the teacher include conducting outdoor lab instead of indoor, designing physics button to be worn both on and off campus, and having Physics Solidarity Day whereas the Physics students need to wear designed Physics button both on and off campus which makes the students feel special for taking the course.

This paper discusses the decision making factor of the students in choosing physics or biology, with analysis scope limited to the two main factor: environmental and emotional factors.

Methodology

This study uses quantitative data collection from the survey of 36 students of Diploma in Science from UiTM Perak Branch Tapah Campus. The respondents are studying in their third semester study. A survey was undertaken where a questionnaire was handed out to the students during an academic program held by the faculty, and collected directly after the program ended. The questions were scaled by 1 to 5 with strongly disagree to strongly agree, respectively. The questionnaire consists of questions on demography (age, gender, Cronbach's alpha, and sibling), family background, peer and passion that would influence a student's stream choices for their study. The data was analyzed using Statistical Package System Software 24.0 (SPSS 24.0) based on frequency, percentage, mean scores and standard deviation.

Analysis

Demographic

The Cronbach's Alpha value for this study is 0.815 of consistency value. Therefore, the item-scale measure is reliable for measuring respondents' opinion. Most of the students' age ranged between the age of 19 to 20 years old. From the data surveyed, the 72% is female students with the other 28% is male students. Most of the students came from a large family, as 41.7% of them have more than 5 siblings. The number of siblings might give significant affect in their decision making for the course selection either physics or biology courses.

Contribution Factor

The feedback on contribution factor is based on family, peer and passion as shown in Table 1. Students need to choose from strongly disagree, 1 to strongly agree, 5. The largest contribution factor is passion (M=4.43, SD =.646) for biology students and (M=4.32, SD =.0.945) physics students. Both mean values are higher than 4.0 which is in the range of agree and strongly agree. However, the smallest contributing factor is peer for biology students (M=2.71, SD =1.204) and physics students (M=2.95, SD =1.463).

Table 1
Value of means and standard deviation of contribution factor for physics and biology choosers

	Family, Peer and Passion			
	Physics		Biology	
	Mean	Standard Deviation	Mean	Standard Deviation
Choose course Family	3.59	1.333	3.71	1.326
Choose course Peer	2.95	1.463	2.71	1.204
Choose course Passion	4.32	0.945	4.43	0.646

Family

As stated for both biology and physics choosers in Table 1, students do agree that family factor contributes to their decision making process with mean value of 3.51 and 3.71 for physics biology choosers accordingly. Advices from the family members influence the students' decision –making process as reflected from their agreement with item "Advised by family", with mean value of 3.27 and 3.21 for physics chooser and biology choosers respectively. However, the stream selection was made with their own will as they disagree with item "Parents pushes me for enrolment" with for both physics and biology chooser with mean value of 2.55 and 2.86 respectively. A research by Jon Miller, MSU Hannah Professor in Michigan State University founds that parental influence and family encouragement give strong contribution to students' enrolment in science field (University of Michigan State, 2010).

Parents' occupation gives aspiration to their children as observed in Table 2. The highest percentage for physics choosers recorded at 13.9%, have parents with occupation in educational field as stated in

Table 1. A study by Breakwell (1992) reported that the educational aspirations is part of influencer in attracting science students. This describes the behaviour of students with parents from educational field to be more interested to pursue their study in physics.

Table 2
Parents' occupation based on students' stream choice

		Parent's Occupation			
		Physics		Biology	
		Count	Table N %	Count	Table N %
Parent's Occupation	Education	5	13.9%	1	2.8%
	Engineer/technician	2	5.6%	3	8.3%
	Medical staff	2	5.6%	0	0.0%
	Business	4	11.1%	4	11.1%
	Administrative	2	5.6%	3	8.3%
	Arts music's	1	2.8%	0	0.0%
	Others	6	16.7%	3	8.3%

Meanwhile for biology choosers, 11.1 % majority having parents with career in business field. Students of parents from the business field have more awareness of career that would guarantee a promising income in their future career. These students that focus on the career aspects and income promise would rather choose biology than physics. As stated from Table 3, agreement on item "Improve family standard" by the Biology choosers was recorded at 4.0 mean value, compared to only 3.68 mean value by Physics choosers. Students believe that graduating in biology stream promises profession with high payment salary, which this belief may be contributed by the influence from the media and television programs. Globally, most television programs demonstrate careers of biology background such as medical staff, forensics etc. This can be related with a study by Breakwell (1992), that television program does influence youth in making decision for their science studies. Pietro (2016) investigated the impact of television programs on teenage career aspirations, and he observed that the television programs able to portrayed a profession as exciting and glamorous.

However, referring to Table 3, the parents career influence becomes a weak contributor as reflected from students' disagreement of item "Follow my parents career path" with mean value of 2.45 and 2.29 for Biology and Physics choosers respectively.

Table 3
Family influencer items for physics and biology choosers

	Family			
	Physics		Biology	
	Mean	Standard Deviation	Mean	Standard Deviation
Advised by family	3.27	1.453	3.21	1.251
Parents pushes me for enrolment	2.55	1.535	2.86	1.657
Family members in similar field	2.82	1.500	2.71	1.383
Follow my parents career path	2.45	1.335	2.29	1.204
Improve family standard	3.68	1.129	4.00	1.038

Peer

Referring to Table 4, peer plays a major role in students' choice of stream. The group members will motivate another student to study. This is shown by the data as the value of mean for physics students is 3.73 and 3.86 for biology student. The other factors that contributed less to the stream selection are 'not confident if not in the same group with current group members' with the factor of majority of friends' decision, both of which contribute the same mean value for physics student that is 2.95. For biology students the least contributing factor is factor of majority of friends' decision with mean value of 2.64.

Table 4
Peer influencer items for physics and biology choosers

	Peer			
	Physics		Biology	
	Mean	Standard Deviation	Mean	Standard Deviation
Follow majority friends decision	2.95	1.588	2.64	1.151
Not confident if not in the same group with current group members	2.95	1.527	3.21	1.424
Group members motivates me to study	3.73	1.077	3.86	1.099

Passion

Table 5 describes the contributing factor of stream selection based on passion. The data displays that the students who selected physics as their primary choice excelled in not only physics but also in biology during the national examination, Sijil Pelajaran Malaysia (SPM). On the other hand, not many of biology students scored A for physics in SPM. This is a significant factor that shows that some biology students do not have an intention to take physics as their first selection due to their average grade in physics in SPM. Based on a conducted study by Juliusson et al (2005), students are likely to select the course of their interest in the future based on their excellent achievement in the past.

The factor of passion was not only being observed and measured based on the past achievement but also students' interest in that field. Based on Table 6, with the mean value of 4.27, most physics students stated that physics matched their interest and skillset and similar mean value is shown for the factor of enjoying solving problem more than just reading. Meanwhile, the carrier aspiration fulfillment with the mean value of 4.18 is less significant to the student who selected physics stream and the least significant contributors is interesting and motivating course content with mean value of 4.14. A study by Zakaria, Aziz, Zainuddin, and Wahab (2018) found that most of the physics student made a lot of inquiry and improved their problem-solving skill set after they had gone on a trip that related to physics. This would be a strong justification that physics student likes problem solving activities rather than reading which is what biology subject require. In contrast with physics students, most biology students selected interesting and motivating course content as the factor to choose biology field with the mean value of 4.43. In addition, the students wanted to fulfil their career aspiration as shown in the table with the mean value of 4.36.

Table 5
Factor contribution of past examination results based on passion

		Passion			
		Physics		Biology	
		Count	Column N %	Count	Column N %
Physics SPM Result	A	8	36.4%	2	14.3%
	B	6	27.3%	5	35.7%
	C	7	31.8%	7	50.0%
	D	1	4.5%	0	0.0%
Biology SPM Result	A	8	36.4%	5	35.7%
	B	9	40.9%	2	14.3%
	C	4	18.2%	7	50.0%
	D	1	4.5%	0	0.0%

Table 6
Factor contribution items based on passion

	Passion			
	Physics		Biology	
	Mean	Standard Deviation	Mean	Standard Deviation
Course content interesting motivates me to learn	4.14	0.640	4.43	0.646
Enjoyed solving problems more than reading	4.27	0.703	4.14	1.167
Fulfill career aspiration	4.18	0.795	4.36	0.745
It matches my interests and skillset	4.27	0.827	4.29	0.726

Conclusions and Implications

The enrolment of students in either physics or biology stream is dominated by their own personal abilities and passion with the subject's background. Their past achievement on subjects that are nearly similar to the subject to be enrolled gave them indications of their own personal abilities. Thus, to attract students for enrolment of either physics or biology stream, the faculty should take actions in making sure the students examination results in the related subject is in satisfying range. Also, programs that attract their interest on the subject is very helpful to boost students' enrolment. Students with high passion in their field of study are keener to improve themselves in the field even after they graduated. In the meantime, it will realize the 3rd-shift of Malaysia Education Blueprint 2015-2025 (Higher Education) to produce lifelong learner nation. Graduates of science stream will become an important resource in the world of increasingly complex science and technology. They are an important feeder in nation's future economic development and competitiveness. This study is hope to give additional information in assisting higher learning institutes to transform their learning education delivery system, as part of the 10th shift of Malaysia Education Blueprint

References

Angell, C., Guttersrud, O., Henriksen, E. K., & Isnes, A. (2004). Physics: Frightful, but fun. Pupils' and teachers' views of physics and physics teaching. *Science Education, 88*(5), 683–706. https://doi.org/10.1002/sce.10141

Bandura, A. (1999), "Social cognitive theory of personality", Handbook of Personality, Vol. 2, pp. 154-196.

Bennett, J., & Hampden-Thompson, G. (2013). Science teaching and learning activities and students' engagement in science. *International Journal of Science Education, 35*(4), 663–689. https://doi.org/10.1080/09500693.2011.608093

Breakwell, G. M. (1992). Scientists of the next generation. *Education + Training, 34*(1), 17-19. https://doi.org/10.1108/00400919210007692

Campaign promotes careers in Science. 2004. Anti-Corrosion Methods and Materials, Vol. 51 No. 6. https://doi.org/10.1108/acmm.2004.12851fab.013

Carlone, H. B. (2003). Innovative science within and against a culture of "achievement". *Science Education, 87*(3), 307–328. http://dx.doi.org/10.1002/sce.10071

Dietrich, B. C. (2010). Decision making: factors that influence decision making, heuristics used, and decision outcomes. *Inquiries Journal/StudentPulse, 2*(02), 1–8. http://www.inquiriesjournal.com/a?id=180

Drori, G. S., Meyer, J. W., Ramirez, F. O., & Schofer, E. (2003). Science in the modern world polity: Institutionalization and globalization. Stanford, CA: Stanford University Press.

Elby, A. (1999). Another reason that physics students learn by rote. *American Journal of Physics, 67*(7), 52–57. https://doi.org/10.1119/1.19081

Henriksen, E. K., Angell, C., Lavonen, J., & Isnes, A. (2004). Why choose physics – in Norway And Finland?. *Journal of Baltic Science Education 3*(1), 5–12. http://oaji.net/articles/2016/987-1482419239.pdf

Hwang, H. (2006). Planning development: Globalization and the shifting locus of planning. In G. S. Drori, J. W. Meyer, & H. Hwang (Eds.), Globalization and organization: World society and organizational change (pp. 69–89). Oxford: Oxford University Press.

Institute of Physics. (2018, May). Why not physics? A Snapshot of girls' uptake at A-level. Retrieved June 10, 2020, from https://www.iop.org/publications/iop/2018/file_71495.pdf

Ismayatim, W. F. (2019). Kerajaan risau penurunan pelajar pilih alira STEM. Berita Harian, Nasional. Retrieved August 8, 2022, from https://www.bharian.com.my/berita/nasional/2019/09/611487/kerajaan-risau-penurunan-pelajar-pilih-aliran-stem

Juliusson, E. A., Karisson, N., & Garling, T. (2005). Weighing the past and future in decision making. *European Journal of Cognitive Psychology, 17*(4), 561-575. https://doi.org/10.1080/09541440440000159

Lapp, D. R. (1996). Multiplying physics enrollment - strategies that work. The Physics Teacher, 34(2), 102. https://doi.org/10.1119/1.2344358

Michigan State, Uni. (2010). Parental influence on child's science-career decision. Retrieved July 9, 2022, from https://phys.org/news/2010-02-parental-child-science-career-decision.html?utm_source=TrendMD&utm_medium=cpc&utm_campaign=Phys.org_TrendMD_1

Ministry of Education Malaysia. (2015). Executive summary: Malaysia education blueprint 2015-2025 (Higher education): 2025. Retrieved June 10, 2020, from

https://www.um.edu.my/docs/um-magazine/4-executive-summary-pppm-2015-2025.pdf

Prosser, M., Trigwell, K., Hazel, E., & Waterhouse, F. (2000). Students' experiences of studying physics concepts: The effects of disintegrated perceptions and approaches. European Journal of Psychology of Education, 15, 61–74. https://www.jstor.org/stable/23420408

Shin, L. W., & Phang, F. A. (2012). Physics studies and generic attributes. *Procedia - Social and Behavioral Sciences, 56*, 691–702. https://doi.org/10.1016/j.sbspro.2012.09.705

Stokking, K. M. (2000). Predicting the choice of physics in secondary education. *International Journal of Science Education, 22*(12), 1261–1283. https://doi.org/10.1080/095006900750036253

Sheng, X. (2017). Cultural capital, family background and education: choosing university subjects in China. *British Journal of Sociology of Education, 38*(5), 721-737. https://doi.org/10.1080/01425692.2016.1158638

Tandrayen-Ragoobur, V., and Gokulsing, D. (2022), "Gender gap in STEM education and career choices: what matters?", Journal of Applied Research in Higher Education, Vol. 14 No. 3, pp. 1021-1040. https://doi-org.ezaccess.library.uitm.edu.my/10.1108/JARHE-09-2019-0235

United Nations Educational, Scientific and Cultural Organization, International Bureau of Education. (2016). National reports on the development of education submitted by countries since 1933. Retrieved on 12 August 2022, from http://www.ibe.unesco.org/en/ibedocs/national-reports

Zakaria, N. A., Aziz, S. S. S. A., Zainuddin, L. W., and Wahab, R. A. A. (2018). The Impact of Field Trips on Students' Perspective towards Physics. *Advanced Science Letters, 24*, 3391-3393. https://doi.org/10.1166/asl.2018.11383