International Journal of Business & Management Study – IJBMS 2018
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Volume 5 : Issue 1 - [ISSN : 2372-3955] - Publication Date: 25 June, 2018

ADOLESCENTS' INTERESTS AND ASPIRATIONS IN SCIENCE AND SCIENTIFIC CAREERS, INQUIRY LEARNING AND SCIENCE IDENTITY

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ABSTRACT - From psychological perspective, identity relates to self-image and individuality. For science, this concern, among others, characteristics like showing particular skilled ways of performing scientific activities and holding beliefs that are associated with science. The aim of this study is to demonstrate relationships and comparison between students' interest in science and attitude towards science, inquiry learning, and aspirations to engage in science careers with age and gender. Using a correlational and causal comparative design, a set of Science Interest Instrument by Dillon et al. (2008) was adapted and translated to Malay Language and administered to a total of 1025, 11-year-old and 12-year-old and a total of 938, 13-year old and 14-year old students. The data were analyzed descriptively in terms of percentage, and inferentially using t-Test, Chi-Square Test, and Pearson Correlation. The results indicated that there was a large positive correlation between interest in and attitude towards science, and inquiry learning, a strong relationship between high interest in and attitude towards science, and aspiration to become scientists or taking up science jobs. Also, there was a significant difference between students' inquiry learning and choice of job. It was found that there was no difference in interests and attitudes towards science between gender, but there was a significant difference between age. The implication from this study is that by addressing identity issues and allowing students to adopt science identity as their self images, science education could become more relevant for students' personal lives, development, and their way of lives.

Keywords - interest in science, aspirations in science careers, inquiry learning, science identity, adolescents

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I. Introduction

From psychological perspective, identity relates to self-image (a person's mental model of self), self-esteem, and individuality. Adolescence, between ages 12 and 18 is the stage at which we form our self-image. According to Erikson, people who emerge from this stage with a strong sense of self-identity are equipped to face adulthood with certainty and confidence [1]. Since identity is a virtual thing, it is impossible to define it empirically. Discussions of identity use the term with different meanings and many scholars demonstrate a tendency to follow their own preconceptions of identity. In tandem with that, science identity, is the concern, among others, characteristics like showing particular skilled ways of performing scientific activities and holding beliefs that are associated with science.

An enduring issue of students engagement with science has been particularly of interest in the science education community. Yet, on what views young students hold about science as well as trying to understand learning as tied to processes of identity construction [2]; [3] offer new perspectives and has not been researched widely. [4] devote a whole chapter of their review on attitudes to science to the considerable body of work, which shows that interest in science is a product of student experiences by age 11, drawing on work conducted as early as 1874. [5] later confirmed that finding using data collected between 1988 and 2000 by the longitudinal analysis of National Assessment of Educational Progress (NAEP). Further survey by the Office for Public Management [6] found evidence that children's life-world experiences prior to 14 are the major determinant of any decision to pursue the study of science. Out of 1,141 science, engineering, and technology practitioners' reasons for pursuing scientific careers, 28% first started thinking about a career in science, technology, engineering, and mathematics before the age of 11, and a further 35% between the ages of 12 and 14. Similarly, [7] who had conducted a small-scale longitudinal study that followed 70 Swedish students from age 12 to age 16, found that their career aspirations and interest in science were largely formed by age 13. Thus Lindahl concluded that to engage older students in science would become progressively harder. Likewise, such data demonstrate the importance of the formation of career aspirations of young students long before the point at which many make the choice about which subject to pursue at high school and then college [3].

Students' interests in science, and aspirations in science and scientific careers therefore seem to have been formed in late childhood and early adolescence. Thus, we would contend that effort could be productively expended by (a) understanding what are the formative influences on students' career aspirations between the ages of 10 and 14 and (b) attempting to foster and maximize the interest of this cohort of students irrelevant of gender differences.

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II. Study Design and Sample

The aim of this study is to develop an understanding of the factors underlying the formation of students aspirations and their engagement with science by demonstrating relationships and comparison between students' interest in science and attitude towards science, inquiry learning, and aspirations to engage in science careers with age and gender. Correlational and causal-comparative were the study design, data were collected using a set of Science Interest Instrument by Dillon et al. (2008) which was adapted and translated to Malay Language. It was a questionnaire with closed and open questions. The booklet contained 67 substantial questions. Twenty-nine items were on science interest and attitude towards science learning, 10 items on inquiry learning, 9 items on identifying science and scientists, 12 items on aspirations to engage in science careers, and 7 items on doing science activities when not in schools. The duration of time needed to complete the questionnaire was about 40 minutes. Overall reliability index of Cronbach Alpha of the instrumen was 0.776, and for each construct was between 0.704 to 0.852. It was administered to 1025 primary students at age 11 (448 students) and 12 (577 students), and subsequently to 938 secondary students at age 13 (556 students) and 14 (382 students). From the age group of 11 and 12 , 459 were males and 566 were females. From the age group of 13 and 14, 397 were males and 541 were females. The students came from a mix of urban and rural schools in the states of Kelantan, Perak and Selangor in Malaysia. The data were analyzed descriptively in terms of percentage, and inferentially using Pearson Correlation, t-Test, and Chi-Square Test.

III. Results

A. *Students' Interest and Attitude in Relations to Inquiry Learning, and Aspirations to engage in science careers*

The relationship between interest in and attitude towards science and inquiry learning among the age group of 11 and 12 was investigated using Pearson product-moment correlation coefficient (Table I). According to [8] who suggested r = .10 to .29 as small, thus there was a small positive correlation between the two variables [r= .20, Ω=1025, p<.0005], with high interest and attitude towards science was associated with high inquiry learning. Table I also showed the relationship between interest in and attitude towards science and aspiration to engage in science careers. According to [8] who suggested r = .50 to 1.0 as large, thus there was a large positive correlation between the two variables [r= .58, Ω=1025, p<.0005], with high interest and attitude towards science was associated with higher aspiration to engage in science careers. Likewise, there was a large positive correlation between the two variables [r= .513, n=938, p<.0005], with high interest and attitude towards science was associated with high inquiry learning among the age group of 13 and 14. Also there was a large positive correlation between the two variables [r= .545, n=938, p<.0005], with high interest and attitude towards science was associated with higher aspiration to engage in science careers.

TABLE I. CORRELATION BETWEEN INTEREST IN AND ATTITUDE TOWARDS SCIENCE, INQUIRY LEARNING, AND ASPIRATION TO ENGAGE IN SCIENCE CAREERS AMONG THE AGE GROUPS OF 11 & 12 AND 13 & 14

Age group of 11 and 12		**Inquiry learning**	**Aspirations to engage in science careers**
Interest in and attitude towards science	***Pearson Correlation***	.20**	.58**
	Sig. (2-tailed)	.00	.00
	N	1025	1025
Age group of 13 and 14		**Inquiry learning**	**Aspirations to engage in science careers**
Interest in and attitude towards science	***Pearson Correlation***	.513**	.545**
	Sig. (2-tailed)	.000	.000
	N	938	938

**Correlation is significant at the 0.01 level (2-tailed)

B. *Comparison of Students' Interest and Attitude Between Gender and Age*

An independent-samples t-test was conducted to compare the students' interest and attitude scores for males and females. There was no significant difference in score for males (M=106.57, SD=11.51), and females (M=107.92, SD=11.87) in the age group of 11 and 12 as shown in Table II. Also there was no significant difference in score among the age group of 13 and 14 males (M=96.95, SD= 9.777), and females [(M=97.87, SD=8.942); t (936)= -1.488, p= .05].

TABLE II. COMPARISON OF INTEREST IN AND ATTITUDE TOWARDS SCIENCE BETWEEN GENDER AMONG THE AGE GROUP OF 11 & 12 AND 13 & 14 USING THE T-TEST

Dimension	**Age group of 11 and 12**	**Mean**		**Standard. Deviation**	**Sig. (2-tailed)**		
Interest in and attitude towards science	***Male***	106.57		11.51	.07		
	Female	107.92		11.87	.07		
Dimension	**Age group of 13 and 14**	**N**	**Mean**	**Standard. Deviation**	**Sig. (2-tailed)**	**t**	**df**
Interest in and attitude towards science	***Male***	397	96.95	9.777	.137	-1.488	936
	Female	541	97.87	8.942	.143	-1.467	808.054

(* Significant at α = 0.05)

An independent-samples t-test was conducted to differentiate students' interest and attitude scores for age. It was found that there was no significant difference in scores for

11-year old (M=106.98, SD= 12.04), and 12-year old (M=107.58, SD=11.48) While there was a significant difference in scores for 13-year old (M=98.40, SD= 9.192), and 14-year old [(M=96.14, SD=9.331)); t (936)= 3.681, p= .05] as shown in Table III.

TABLE III. COMPARISON OF INTEREST IN AND ATTITUDE TOWARDS SCIENCE BETWEEN AGE AMONG THE AGE GROUP OF 11 & 12 AND 13 & 14 USING THE T-TEST

Dimension	Age	Mean	SD	Sig. (2-tailed)
Interest and attitude towards science	*11 years old*	106.98	12.04	.42
	12 years old	107.58	11.48	.42

Dimension	Age	N	Mean	SD	Sig. (2-tailed)	t	df
Interest in and attitude towards science	*13 years old*	556	98.40	9.192	.000	3.681	936
	14 years old	382	96.14	9.331	.000	3.671	810.954

(* Significant at α = 0.05)

C. *Comparison Between Students' Choice of Work and Age.*

Table IV illustrated the frequency and percentage of 13-year old and 14-year old interest in working in the future. The former gave higher affirmation (67.8%) to work in the field of science compared to the latter (64.4%). However, the difference was not significant.

TABLE IV. FREQUENCY, PERCENTAGE AND CHI-SQUARE TEST OF STUDENTS' CHOICE OF WORK BETWEEN AGE

			Question: Interested to work in the field of science?		
			No	*Yes*	Total
Age	13 years	*Count*	179	377	556
		% within Age	32.2%	67.8%	100.0%
	14 years	*Count*	136	246	382
		% within Age	35.6%	64.4%	100.0%
Total		*Count*	315	623	938
		% within Age	33.6%	66.4%	100.0%

Chi-Square Test of pupils' choice of work between age

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.179[a]	1	.278		
Continuity Correction[b]	1.031	1	.310		
N of Valid Cases[b]	938				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 128.28.

b. Computed only for a 2x2 table

D. *Comparison of Students' Inquiry Learning and Choice of Work*

An independent-samples t-test was conducted to compare the students' inquiry learning scores for choice of work whether in the field of science or not. It was found that there was a significant difference in scores for negative affirmation (M=28.28, SD= 6.080), and affirmation [(M=31.66, SD=5.845)); t (936)= -8.256, p= .05] as shown in Table V.

TABLE V. COMPARISON BETWEEN INQUIRY LEARNING AND INTERESTED TO WORK IN THE FIELD OF SCIENCE USING THE T-TEST

Dimension	Interested to work in the field of science	N	Mean	SD	Sig. (2-tailed)	t	df
Inquiry learning	No	315	28.28	6.080	.000	-8.256	936
	Yes	623	31.66	5.845	.000	-8.150	608.920

(* Significant at α = 0.05)

IV. CONCLUSION

This study indicates that high interest in and attitude towards science is associated with high aspirations to engage in science careers among the adolescents between the age of 11 to 14. However, high interest in and attitude towards science starts to decline by age 14 and the adolescents are less interested to choose science-based careers. This supports the findings by [4], [5], [6], and [7]. Learning science through inquiry is positively correlated to high interest in and attitude towards science, as such students give affirmation to work in science fields in the future. This confirm how science is taught in school is a significant determinant of students' aspirations to engage in science careers. Yet despite philosophical support for the processes and skills of science, inquiry-based approach to science teaching are few and far between. Another finding is, students' interest in and attitude towards science between gender is not different, signaling gender as not a factor in the development of their science

identity. According to [9] the typical hard sciences teachers are perceived as being less similar to adolescents' own self image; in a more negative way and more distant from the image they see of themselves. However, in this age group this study shows no difference in their science identity between gender. Conclusively, how do we maintain the adolescents' aspirations to engage in science careers? We suggest, science teachers with appropriate science identity create learning to be both experiential and inquiry oriented to transform students' science identity. Furthermore [10] has found that the best educational designers can do, whether for students in the classroom or for teachers in professional development, is provide "opportunities" for participants to have extraordinary experiences, create extraordinary stories, and build extraordinary identities. Whereas [11] posits designated identities are based on what people expect to be the case, if not now, then in the future. Designated identities have the potential of becoming part of people's actual identities, and they express wish, commitment, obligation, or necessity. People may expect to "become" a certain kind of person perceiving this becoming as good for them.

About Author (s):

"…science teachers with appropriate science identity create learning to be both experiential and inquiry oriented to transform students' science identity."

ACKNOWLEDGMENTS

This research was funded by Sultan Idris Education University. Nik Azmah thanks Professor Justin Dillon from University of Bristol for giving permission to use the Science Identity Instrument.

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