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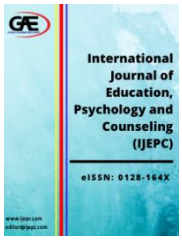

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EVALUATION OF STUDENTS' PERCEPTION OF BIOLOGY CLASSROOM LEARNING ENVIRONMENT

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Abstract:

Students' feedback about their classroom learning environment can be used to provide information about the strengths and problems that need to be addressed. This study assessed the students' perceptions of their biology learning environment. The difference between male and female students' perceptions of their learning environment was also investigated. Learning environment instrument What is Happening in this Class (WIHIC) questionnaire was employed to evaluate the perception of 437 Form Four students who took Biology as one of their subjects in a local district. The data were analysed based on the Rasch (1961) measurement model using the Winsteps software. Overall, the students perceived quite favourably on their biology classroom learning environment. Apart from that, there is no difference between the boys and girls in their general perception of the biology classroom learning environment. Further analysis on each scale showed the scales of Students Cohesiveness and Cooperation were perceived positively in the Biology classroom. However, students find it difficult to agree on the scale of Investigation and Involvement. DIF analysis of the items revealed some differences in their perceptions in the scales as well as some of the items between male and female students. Several suggestions were given in the hope of improving and create an effective classroom learning environment. With such feedbacks, Biology teachers and the school administration can strive to improve and create an effective classroom learning environment, provide useful background information for further evaluation phases and inform on the best approach to carry out Biology lessons in the classroom.

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Keywords:

Biology, Classroom Learning Environment, Evaluation, IRT, Perception, WIHIC

Introduction

Biology is one of the elective science subjects offered at the upper secondary level in Malaysian schools apart from Chemistry, Physics and Additional Science. These subjects serve to prepare scientifically inclined students to pursue the study of science at post-secondary level (Ministry of Education, 2005). Hill (2010) notes that the emphasis of examination especially centralised public examination plays an important role on shaping the teaching and learning in secondary schools in Asia-Pacific region which is also evident in this country. This has led to teaching and learning that only focuses on examination topics while aspects of the curriculum which are not tested are ignored. Teaching to fulfil the examination requirements is a highly valued teaching strategy by most of the school administrators, teachers, students and parents. The tendency of teachers is to complete the syllabus as fast as possible and followed by revisions and preparation for examinations.

Learning Environment

Various attempts and strategies employed by the school and teachers in order to improve students' achievement in learning. One of them is to ensure the teaching and learning is effective in the class. According to Khine (2001), how students learn and achieve their goals depends of the nature of the classroom physical environment and the psychosocial interactions between them. This is because classroom is like a 'miniature society' as students spend most of their time interacting among themselves and the teachers, using various ways and resources in pursuing learning activities (Khine, 2001: 54). Therefore, the learning environment of a student in the classroom is important for effective learning to take place. It is a context for learning to happen.

Hiemstra (1991) cited Galbraith (1990) who suggests that educational learning environment consists of both the physical and the psychological aspects. Hiemstra (1991) continues to describe that a learning environment consists of the physical, psychological or emotional conditions and the social or cultural influences which affect the learning of a person. Therefore, classroom learning environment generally is made up by the physical environment and psychosocial environment in which the psychosocial environment is made up of the psychological and the social aspects. Fraser (1998c: 3) focuses on the psychosocial aspect of learning environment and refer to classroom learning environment as 'social, psychological and pedagogical contexts in which learning develops and which affect students' achievement and attitudes.' In regard to this study, the classroom learning environment focused on the psychosocial aspect which is the relation of the individual's emotional needs to the social environment.

There are many and varied applications of classroom learning environment instruments in research. Fraser (2002) categorizes the researches into six groups; researches that focus on the associations between student outcomes and environment, evaluation of educational innovations, differences between students' and teachers' perceptions of the same classrooms,

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determinants of classroom environment, combining qualitative and quantitative methods and cross-national studies. In this section, a few studies on Biology classroom learning environment will be highlighted.

In the assessment of the perceptions of the actual and preferred biology learning environments among the students using *What Is Happening In this Class?* (WIHIC) questionnaire, Rita and Martin-Dunlop (2011) found that students preferred a better environment than the one they were experiencing. However, gifted students perceived their actual learning environment more positively than non-gifted students. In addition, they also investigated the perceptions of the learning environment and its associations with cognitive achievement among gifted biology students. The result revealed that there was a statistically significant association between the actual learning environment and achievement on a standardized biology test for the majority of scales. Teacher Support, Investigation and Equity in the WIHIC scale were all statistically significant independent predictors of student achievement, while Student Cohesiveness had a negative association with achievement. In another study, Telli et al. (2009) carried out a study on how Turkish students perceive their biology classroom environment by using the WIHIC questionnaire. The results showed that Turkish students perceived lowly in terms of Teacher Support and high in terms of Task Orientation in the WIHIC scale. Cluster analysis was then carried out to create a typology of Biology classroom learning environment in Turkey which categorized the classroom learning environment into six profiles: the 'self-directed learning classroom', 'task oriented cooperative learning classroom', 'mainstream classroom', 'task-oriented individualized classroom', 'low-effective learning classroom' and 'high-effective learning classroom'. Despite of all these studies, students' perception of their learning environment for different subjects in each school is unique. The context of learning environment of various subjects differs from one school to another, or perhaps differs between classes within the same school. Therefore, the students' feedback about their learning environment and attitude should be collected and used to provide information about the problems and needs that need to be addressed.

Purpose and Significance of Study

This study evaluates the students' general perceptions of their biology learning environment. Besides that, the difference between male and female students' perception of their learning environment will also be investigated. According to Fraser (1998b), students are at a good position to make judgement about their learning environment because they have encountered many different learning environments and have enough time in a class to form accurate impressions. Students' perception on their learning environment can be used as a source of process criteria in the evaluation of educational innovations. Therefore, the evaluation of Biology learning environment from the students' perspective would provide the teachers with information on the needs, problems and situations in the Biology class. Besides, it might also help Biology teachers to identify some of the strengths in the learning environment. With such feedbacks, Biology teachers and the school administration can strive to improve and create effective classroom learning environment as well as students' attitude towards biology related learning activities and their achievement. Furthermore, this context evaluation would provide useful background information for further evaluation phases such as input, process and output evaluation in the future. The findings will further inform teachers on the best approach to carry out Biology lesson in the classroom.

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Method

This study employed the quantitative approach that evaluates the context of Biology learning environment using *What is Happening in this Class?* (WIHIC) questionnaire as the learning environment instrument among form four students.

Sampling

The evaluation involves purposive sampling method in criterion sampling strategy whereby individuals are intentionally selected based on the researcher's judgement or knowledge about them which can contribute rich information in a study (Patton, 2002). In this case, 437 form four students who take Biology as one of their subjects of in a local district were selected.

Instrument

This study used the WIHIC questionnaire to evaluate students' perception of their Biology class learning environment. It consists of validated survey instrument that address the psychosocial dimensions of secondary school classrooms. The initial version of this instrument consist of 90 items was developed by Fraser, Fisher and McRobbie (1996) and further refined into 56 items by Aldridge and Fraser (2000). For the purpose of this study, permission has been obtained from the authors through email. WIHIC is used in this study because the questionnaire is a comprehensive instrument which combines modified versions of scales from a wide range of existing questionnaires with additional scales that accommodate the contemporary educational concerns such as equity and constructivism (Fraser, 1998a). The vast application of this instrument in various learning environment researches indicated its reliability and validity (eg. Afari et al., 2013; Chionh & Fraser, 2009; Fisher et al., 2010; Fisher, Rickards, den Brok, & Eric Bull, 2005; Opolot-Okurut, 2010). Besides, Dorman (2003) carried out a cross-national validation of WIHIC using confirmatory factor analysis which suggested the usefulness of this questionnaire as a valid measure of classroom psychosocial environment in multicultural and heterogenous school setting. The 56 items in this questionnaire are divided equally into seven scales which are Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equity). Each scale contains 8 items which make up the 56 items in the questionnaire. The items are answered twice on a five point Likert-type scale (1 = almost never, 2 = seldom, 3 = sometimes, 4 = often and 5 = almost always). All of the items from the seven scales are based on the students' personal perspective.

Data Analysis

The data analysis in this study was conducted based on Rasch (1961) measurement model. Rasch measurement model is one of the models that belong to Item Response Theory (IRT). IRT describes that item characteristics are independent of the respondents and the respondents' ability or proficiency is independent of the test (Pang, 2005a; Martin et al., 1990). This opposes the characteristics of classical assessment approaches in which the item difficulty is dependent on the particular respondent samples and comparison of the ability of the respondents is based on the same test items in the same situation. The item characteristic curve in Rasch Model is defined by the logistic distribution and has the same form for all items differing only on the difficulty of the item (Tormakangas, 2011). Thus, the focus concepts of IRT rest upon the individual items rather than upon some aggregate of the item response (Thorpe & Favia, 2012). Therefore, the Rasch Model is a very accurate and objective way to describe individual items and persons as it is more than just a statistic description. In the study of learning environment, Rasch Model was used by Pang (2005a) in an aspect in the context evaluation of the

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implementation of Smart School curriculum in Malaysia. Besides that, Cavanagh (2015) also employed the Rasch model in testing the assumption of uni-dimensional construct of engagement in classroom learning and perceptions of the classroom learning environment. For this study, it generated meaningful output which can describe the perception of the students towards their learning environment as well as describing the items in terms of their mean measures. Therefore, by using the Winsteps software (Linacre & Wright, 2012) as the main analysis tool, person-item reliability, item fit, Item-person distribution, Differential Item Functioning (DIF) analysis were performed. DIF was computed to indicate whether one group of respondents was scoring better than another group on an item. For DIF, the Rasch analysis is considered a useful method for comparing abilities across groups (Runnels, 2013).

The independent variable in this study was gender based on dichotomous scale of male (M) and female (F). The dependent variable was the students' perception of their biology learning environment based on the WIHIC scales. For the DIF analysis, out of the 437 respondents, 50 were dropped due to incomplete responses, leaving 387 student responses. In analysing DIF, Winsteps performs two–tailed t-test to test for significant differences between two difficulty indexes. Confidence level of 95% and the critical t value at ±2.0 are used for all DIF analysis. DIF Size plots generated with Winsteps are used to show the difference between the two lines representing with and without each of the qualities. The size of DIF which is less than 0.5 logit or more than -0.5 logit is considered to be negligible. The indicators of DIF are (1) t value ± 2.0 ($t \geq +2.0, \leq -2.0$), (2) DIF contrast ± 0.5 (DIF Contrast $\geq +0.5, \leq -0.5$), and (3) $p < 0.05$ (Bond & Fox, 2007). The output tables were generated and interpreted.

The means of scales in the WIHIC between the male and female students are compared based on the effect size measures to identify which scale has the larger effect. Effect size is one of the procedures to determine whether the difference between the mean score of two groups is meaningful (Creswell, 2005). It provides a measure of the strength of the differences or relationships which can be used to compare with results from other studies (Muijs, 2005). From this value, this study can identify the magnitude of any difference between the means of the actual and preferred learning environment scales. For the effect size interpretation, Cohen (1988) suggested the use of the following categories shown in Table 1.

Table 1: Interpretation of Effect Size

Value of Effect Size	Effect
ES < 0.2	Nil
0.2 ≤ ES < 0.5	Small
0.5 ≤ ES < 0.8	Medium
ES ≥ 0.8	Large

Findings

The findings are presented in two main categories which are person-item distribution and DIF analysis. Person-item distribution focuses on the connection between person ability and item difficulty. Further analysis also looks into the person-scale distribution. DIF analysis shows the mean measures of male and female students in their perception of the biology classroom learning environment. Besides, DIF analysis of each item reveals some differences in their perceptions across the seven scales, as well as some of the items.

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Person-Item Distribution

Figure 1 shows the Wright Map, that represents the connection between person ability and item difficulty on the same scale. The mean measure of item is .00 logits and for person is .79 logits. Bottom items are the items that are easily endorsed, and the top items are difficult to be endorsed. The person's ability distribution is higher than the item difficulty distribution. This suggests that on average, respondents are more likely to agree to all the items. However, items cover a range of -1.69 to 1.05 logits and persons cover a range of -1.95 – 7.03 logits. In other words, not all items can cover the range of traits measured. 26 out of 56 items shows positive measure implying the items were difficult to be agreed upon by the students. Item 20 "My ideas and suggestions are used during classroom discussions" was the most difficult to be agreed upon, followed closely by item 30 "I carry out investigations to answer the teacher's questions," with a measure value of 1.05 and 1.03 respectively. On the other hand, item 2, "I know other students in this class" has the lowest measure value of -1.69, indicating students were more likely to agree on this item.

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TABLE 1.2 WIHIC gender combined                    ZOU623WS.TXT  Dec 16 22:25 2019
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Figure 1: Wright Map of Person-item distribution

International Journal of Education, Psychology and Counseling
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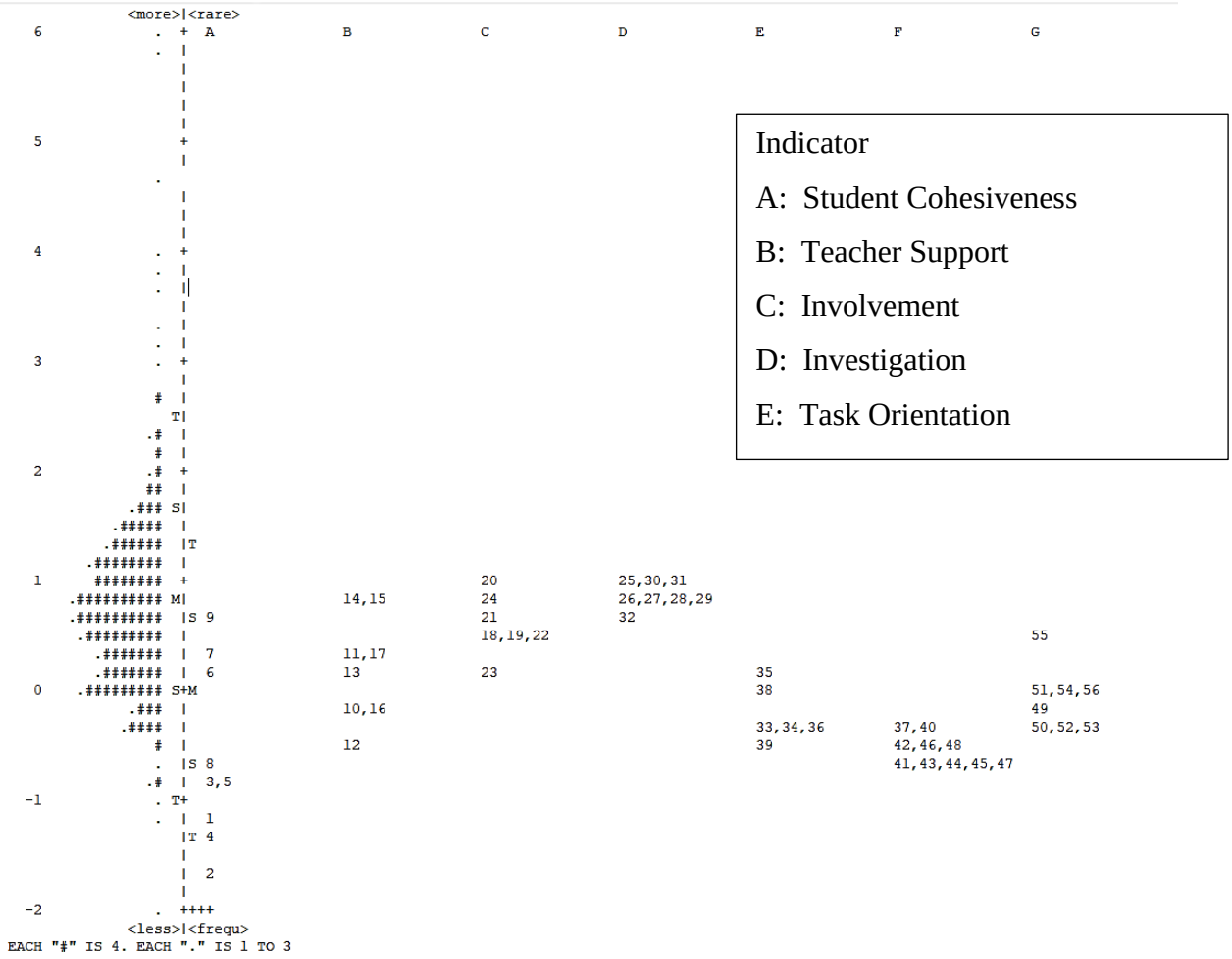

Figure 2: Wright Map Of Person-Scale Distribution

Figure 2 shows the person – item scale distribution map, while Table 2 presents the mean measures for the seven scales. The scale of Investigation has the highest mean measures of 0.86 followed by the scale of Involvement with the mean measures of 0.56. This indicates that students find it difficult to agree with these two scales in their biology classroom. On the other hand, the scale of Student Cohesiveness is the easiest to be agreeable by the students in their perception of their biology classroom with lowest mean measure of -0.75.

Table 2: Mean Measures For The Seven Scales

Scale	Mean measures
Student Cohesiveness	-0.75
Teacher Support	0.26
Involvement	0.56
Investigation	0.86
Task Orientation	-0.27
Cooperation	-0.63
Equity	-0.08

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DIF Analysis

Table 3 presents a summary of mean measures of male and female students in their perception of the biology classroom learning environment. Female students score a mean measure of 0.85 compared to 0.71 by male students. Boys seem to be slightly more positive in their perception of the biology classroom learning environment compared to the girls. There is a negligible effect size between the mean measures implying there is no significant difference in the perception of their biology classroom environment between the two genders. However, DIF analysis of each item reveals some differences in their perceptions across the seven scales, as well as some of the items.

Table 3: Mean Measure Based on Gender

Gender	Mean Measure	Mean SD
Female (n= 252)	0.85	0.86
Male (n=135)	0.71	0.99
Effect Size	0.15	
Effect	Nil	

Student Cohesiveness

Table 4: DIF Analysis Of The Scale Of Student Cohesiveness

No	Item	DIF Measure F n = 252	DIF Measure M n =135	DIF contrast	t value
1	I make friendships among students in this class	-1.31	-0.92	-0.39	-2.59
2	I know other students in this class	-1.84	-1.57	-0.27	-1.57
3	I am friendly to members of this class	-0.77	-0.86	0.09	0.65
4	Members of this class are my friends.	-1.39	-1.22	-0.17	-1.11
5	I work well with other classmates	-0.8	-0.64	-0.16	-1.19
6	I help other classmates who are having trouble with their work	0.22	0.11	0.11	0.12
7	Students in this class like me.	0.31	0.42	-0.11	-0.95
8	In this class, I got help from other students	-0.86	-0.39	-0.47	-3.47
	Mean	**-0.81**	**-0.63**	**Effect Size**	**0.25**
	SD	**0.75**	**0.66**	**Effect**	**Small**

Table 4 shows the DIF analysis of the scale of Student Cohesiveness between male and female students. The small effect size implies that there is a small difference between the perception of male and female students in this scale. Both gender finds it easy to agree on all the items in

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this scale compared to the other scales. Overall, female students seem to be more positive than the boys in this scale with the mean measure of -0.81 and -0.63 respectively. Two items reveal significant different between female and male students. Item 1 "I make friendships among students in this class" and item 8. "In this class, I got help from other students" with t value of-2.59 and -3.47 respectively. Female students find it easier to agree on both items compared to the boys.

Teacher Support

Table 5: DIF Analysis Of The Scale Of Teachers Support

No	Item	DIF Measure F n = 252	DIF Measure M n =135	DIF contrast	t value
9	The teacher takes a personal interest in me.	0.71	0.49	0.22	1.9
10	The teacher goes out his/her way to help me.	-0.13	-0.13	0	0
11	The teacher considers my feelings	0.33	0.37	-0.04	-0.35
12	The teacher helps me when I have trouble with the work	-0.55	-0.29	-0.26	-1.92
13	The teacher talks with me.	0.25	0.1	0.15	1.2
14	The teacher is interested in my problem.	0.8	0.58	0.22	1.79
15	The teacher moves about the class to talk with me.	1.01	0.63	0.38	3.19
16	The teacher's questions help me to understand.	-0.17	-0.03	-0.14	-1.07
	Mean	0.28	0.22	Effect Size	0.13
	SD	0.54	0.35	Effect	Nil

Table 5 shows the DIF analysis of the scale of Teacher Support between male and female students. There is no significant difference between the perception of male and female students on this scale with a mean measure of 0.28 and 0.22 for female and male students respectively. However, there is one item reveals significant different between the female and male students. Item 15 "The teacher moves about the class to talk with me" with t value of 3.19. Male students find it easier to agree on this item compared to the girls.

Involvement

There is a small effect size implying a small difference between the perception of male and female students in the scale of Involvement, as presented in Table 6. Female students find it relatively more difficult to agree on all the items in this scale with a mean measure of 0.62 compared to the boys with a mean measure of 0.49. Two items reveal significant differences between the female and male students. Item 20 "My ideas and suggestions are used during classroom discussion" and item 24, "I am asked to explain how I solve problem" with t value

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of 2.05 and 2.8, respectively. Female students find it more difficult to agree on both items compared to the boys.

Table 6: DIF Analysis Of The Scale Of Involvement

No	Item	DIF Measure	DIF Measure	DIF contrast	t value
		F	M		
		n = 252	n =135		
17	I discuss ideas in class	0.27	0.27	0	0
18	I give my opinion during class discussion	0.5	0.35	0.16	1.29
19	The teacher asks me questions.	0.48	0.35	0.13	1.07
20	My ideas and suggestions are used during classroom discussion	1.15	0.9	0.24	2.05
21	I ask the teacher questions	0.8	0.59	0.21	1.79
22	I explain my ideas to other students	0.63	0.51	0.12	1.04
23	Students discuss with me how to go about solving problem	0.12	0.24	-0.12	-0.99
24	I am asked to explain how I solve problem	1.02	0.69	0.33	2.8
	Mean	0.62	0.49	Effect size	0.44
	SD	0.35	0.23	Effect	Small

Investigation

Table 7: DIF Analysis Of The Scale Of Investigation

No	Item	DIF Measure	DIF Measure	DIF contrast	t value
		F	M		
		n = 252	n =135		
25	I carry out investigations to test my ideas	1.08	0.72	0.36	3.06
26	I am asked to think about the evidence for statements	0.91	0.67	0.23	1.97
27	I carry out investigation to answer questions coming from discussions.	1.03	0.54	0.49	4.07
28	I explain the meaning of statements, diagrams and graphs.	0.89	0.58	0.31	2.63
29	I carry out investigations to answer questions that puzzle me.	1.06	0.6	0.46	3.9
30	I carry out investigations to answer the teacher's questions.	1.12	0.85	0.28	2.32
31	I find out answers to questions by doing investigations.	1.1	0.75	0.35	2.32

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32	I solve problems by using information obtained from my own investigations.	0.75	0.52	0.23	1.94
	Mean	0.99	0.65	Effect size	2.82
	SD	0.13	0.11	Effect	Large

In the scale of Investigation, there is a large effect size between the perception of female and male students on this scale, as shown in Table 7. Both genders find it relatively difficult to agree on this scale compared to the other scales. However, within this scale, female students seem to find it more difficult to agree on all the items compared to the boys. There is a significant difference between the perception of the girls and boys in six of the items with t value > 2.

Task Orientation

Table 8: DIF Analysis Of The Scale Of Task Orientation

No	**Item**	**DIF Measure** F n = 252	**DIF Measure** M n =135	**DIF contrast**	**t value**
33	Getting a certain amount of work done is important to me	-0.54	-0.12	-0.42	-3.19
34	I do as much as I set out to do	-0.31	-0.14	-0.17	-1.35
35	I know the goals for this class.	0.16	0.03	0.13	1.07
36	I am ready to start this class on time.	-0.38	-0.23	-0.15	-1.16
37	I know what I am trying to accomplish in this class.	-0.48	-0.31	-0.17	-1.29
38	I pay attention during class	-0.03	-0.16	0.13	1.04
39	I try to understand the work in this class.	-0.56	-0.51	-0.06	-0.42
40	I know how much work I have to do.	-0.31	-0.34	0.03	0.2
	Mean	-0.31	-0.22	Effect size	0.43
	SD	0.25	0.16	Effect	Small

Table 8 presents the DIF measure for the scale of Task Orientation in which there is a small effect size between the perception of female and male students. Female students are more positive on this scale with a mean measure of -0.31 compared to -0.22 for the boys. There is a significant difference in mean measure for item 33 “Getting a certain amount of work done is important to me,” whereby girls are more positive in this item compared to the boys.

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Cooperation

In the scale of Cooperation, female students are more positive compared to the boys with a mean measure of -0.74 and -0.37 respectively, as presented in Table 9. Seven out of the eight items show significant difference between the perceptions of the two genders in this scale. Thus, there is a large effect between the mean measure of female and male students in this scale.

Table 9: DIF Analysis Of The Scale Of Cooperation

No	Item	DIF Measure F n = 252	DIF Measure M n =135	DIF contrast	t value
41	I cooperate with other students when doing assignment work.	-0.8	-0.44	-0.37	-2.69
42	I share my books and resources with other students when doing assignments.	-0.63	-0.33	-0.29	-2.2
43	When I work in groups in this class, there is teamwork.	-0.91	-0.38	-0.53	-3.9
44	I work with other students on projects in this class.	-0.82	-0.24	-0.58	-4.32
45	I learn from other students in this class	-0.82	-0.51	-0.31	-2.27
46	I work with other students in this class.	-0.57	-0.36	-0.21	-1.55
47	I cooperate with other students on class activities.	-0.82	-0.48	-0.34	-2.44
48	Students work with me to achieve class goals.	-0.55	-0.2	-0.35	-2.67
	Mean	-0.74	-0.37	Effect size	2.94
	SD	0.14	0.11	Effect	Large

Equity

Table 10: DIF Analysis Of The Scale Of Equity

No	Item	DIF Measure F n = 252	DIF Measure M n =135	DIF contrast	t value
49	The teacher gives as much attention to my questions as to other students' questions.	-0.21	0.05	-0.26	-1.13
50	I got the same amount of help from the teacher as do other students.	-0.38	-0.25	-0.13	-0.99
51	I have the same amount of say in this class as other students.	-0.2	0.02	-0.22	-1.7
52	I am treated the same as other students in this class.	-0.46	-0.26	-0.2	-1.52

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 5 Issue 36 (September 2020) PP. 94-113
DOI 10.35631/IJEPC.536007

53	I receive the same encouragement from the teacher as other students do.	-0.38	-0.3	-0.08	-0.61
54	I get the same opportunity to contribute to class discussions as other students.	-0.03	-0.14	0.11	0.84
55	My work receives as much praise as other students' work.	0.45	0.47	-0.02	-0.2
56	I got the same opportunity to answer questions as other students.	0.06	0.06	0	0
	Mean	-0.14	-0.04	Effect size	0.36
	SD	0.30	0.25	Effect	Small

Table 10 shows the DIF analysis of the scale Equity in which there is a small effect size between the girls and boys on this scale. Girls find it slightly easier to agree on this scale compared to the boys with mean measure of -0.14 and -0.04 respectively. There is no significant difference on any of the items in this scale between the female and male students.

Table 11: Summary Of Mean Measure Of Female And Male For The Seven Scales

Scale	Mean measure Female (252)	Mean Measure Male (135)	Effect size	Effect
Students Cohesiveness	-0.81	-0.63	0.25	Small
Teacher support	0.28	0.22	0.13	Nil
Involvement	0.62	0.49	0.44	Small
Investigation	0.99	0.65	2.82	Large
Task Orientation	-0.31	-0.22	0.43	Small
Cooperation	-0.74	-0.37	2.94	Large
Equity	-0.14	0.04	0.36	Small
Overall	0.85	0.71	0.15	Nil

Despite of a negligible effect between the perception of female and male in the overall perception of their biology learning environment as presented in Table 3, there are some differences between the two genders across the seven scales as presented in Table 11. The scales of Investigation and Cooperation showed large effect size between the perception of the boys and girls. In the scale of Investigation, male students find it easier to agree the items compared to the girls, whereas girls were more positive in the scale of Cooperation compared to the boys. Both genders have similar perception of the scale of Teacher Support. The rest of the scales show a small effect in the differences of perception between boys and girls.

Discussion

This study employed WIHIC questionnaire, a multi-dimensional structure to comprehensively profile student perceptions of their biology classroom learning environment, in particular their learning, learning with classmates, and teacher's instructions. This discussion focuses on the scales with the lowest and highest means score, as well as the scales with the two highest

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 5 Issue 36 (September 2020) PP. 94-113
DOI 10.35631/IJEPC.536007

difference between the genders. Several recommendations are given to improve the current Biology learning environment.

Overall, students seemed to perceive positively regarding the scale of Student Cohesiveness and Cooperation in their actual environment. Student Cohesiveness is a scale in the WIHIC designed to measure the extent to which students know, help, and support each other (Khine, 2001; Waldrip, Fisher, & Dorman, 2009). In other words, it refers to the closeness and the friendships among the students in the class. Students at this age group (16 to 17 years old) place a great emphasis on peer relationships in exploring their identity (Tan, Parsons, & Sardo-Brown, 2001). This has an influence on their learning as classmates who are motivated, easy to get along with, and supportive will promote learning in the class (Chang, 2007). Therefore, Student Cohesiveness can promote a positive peer effect on learning. Peers' effect is an influence where we make choices by comparison with those physically or socially near to us (James, 2009). This study indicates that the students perceived their biology class to be a coherent unit in the learning process. The closeness among them may serve as a support and motivation to learn and to achieve. The difference between the male and female on this scale is negligible.

Cooperation is the degree to which students cooperate rather than compete with one another on learning tasks (Khine, 2001). This seems to be related to Student Cohesiveness, whereby students learn by helping and supporting each other. This may reflect that good interaction and relationship resulted in a high level of Cooperation among them in their actual learning environment. Therefore, it was not surprising that the students have a positive perception of this aspect in their biology classroom learning environment. However, there is a large size effect of the difference between female and male students on this scale. It accounts for the largest effect size of the seven scales. Female students seem to be more positive in terms of Cooperation compared to male students. For example, female students tend to agree with the item “I work with other students on projects in this class” and “When I work in groups in this class, there is teamwork” compared to the boys. These two items have the greatest mean measure difference between the two genders. This indicates that female students find it easier to learn through group project work. This seems to agree with the findings by Yip, Chu, and Ho (2004) that state that girls favoured collaborating with others through discussion while boys prefer to work independently and fast. However, this may due to other factors as the physical setting biology learning environment in the class is not mentioned in this study. Classrooms that are set to be verbal-emotive, sit-still, note-taking, listen-carefully are to be more suitable for multi-tasking girls compared to single-task focus boys who are more inclined to spatial-kinesthetic learning (King & Gurian, 2006). Thus, more study needs to be carried out to ascertain the reasons for this difference.

Another scale that is noteworthy in this study is the scale of Investigation. The students did not seem to have a positive perception on this scale in their biology classroom learning environment. It has the overall highest mean measure that indicates that students find it difficult to agree on this scale. Out of the 56 items, item 30 “I carry out investigations to answer the teacher’s questions” was one of the most difficult to be agreed upon by all the students. Closely related to this scale is the scale of Involvement which accounts to the second highest mean measure. Similar to the scale of Investigation, students did not perceive positively on this scale. This may imply that there was a lack of investigation activities and

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 5 Issue 36 (September 2020) PP. 94-113
DOI 10.35631/IJEPC.536007

students' involvement during the biology class. Investigation is a scale that measures the degree to which the emphasis is on the skills and process of inquiry and their use in problem-solving and Investigation, while Involvement is the scale that measures the degree to which students have the attentive interest, participate in discussions, do additional work and enjoy the class (Khine, 2001). Students did not seem to perceive this positively and find it difficult to agree in all the items on this scale. One of the items in this scale, Item 20 "My ideas and suggestions are used during classroom discussions' has the second highest measure value of 1.64. Students may find that there is a lack of participation in their biology teaching and learning.

All these may be due to the lack of students-centered learning activities such as investigations and discussions. Teachers may have to shift and transform their orientation and pedagogical methods in delivering science-related subjects in class. Currently, there is an increasing emphasis of the Science, Technology, Engineering, and Mathematics (STEM) education that integrate the STEM subjects through hands-on learning and exploration, project-based learning based on the contextual problems by the Ministry of Education (KPM, 2016, 2018). In learning through exploration and hands-on, inquiry-based science education (IBSE) is one of the ways to enhance students' learning and understanding. It is a process whereby students engage in constructing scientific knowledge through questioning, Investigation and experimenting facilitated by the teacher instead of the rote memorization of science concepts and facts (Sikas, 2017). Hmelo-Silver, Duncan, and Chinn (2007) argued that problem-based and inquiry learning employ scaffolding extensively and thereby reducing the cognitive load of the students. This allows students to learn more effectively, whereby they are not only gaining content knowledge but also various thinking and manipulative skills.

The other reason for the high mean score for the Investigation scale may be due to the lack of interest in the students in carrying out investigation activities. In comparison between the female and male students, male students find it easier to agree on this scale than the girls. This scale accounts for the second largest effect size after Cooperation in this case. This may indicate that the male students were more inclined to carry out investigation activities in the Biology classroom. For instance, in a recent research conducted by the researcher in implementing a science project in an all-girls class, one of the main problems encountered was the lack of motivation to complete the task. Among the reasons may be due to the value students placed on the project and also the characteristics of the project's implementation (Loh, Pang, & Lajium, 2019). Conducting experimentation activities in the Biology laboratory or doing outdoor fieldwork may excite boys more than girls as these require physical movement and space orientation. These access boys' neurological strengths that keep them energized and attentive (King & Gurian, 2006).

Recommendations

Teachers can tap on the strength of the Students Cohesiveness in the Biology class to enhance the teaching and learning process in this case. Activities that involve interaction and group work in the class may facilitate students' engagement in learning Biology. To reduce the difference in perception between the girls and boys on the scale of Cooperation, teachers may have to take note of the setting of the Biology classroom environment. A variety of methods or a combination of them can be used as instructional strategies that cater to the needs of the

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 5 Issue 36 (September 2020) PP. 94-113
DOI 10.35631/IJEPC.536007

boys who are generally more spatial kinesthetics, and girls who most of them are more verbal-emotive.

Student-centered activities can be carried out more frequently in the classroom, such as questioning, group discussions, and activities to encourage more participation during teaching and learning. More importantly, hands-on inquiry-based learning such as laboratory experiments, fieldwork, and project-based learning can be carried out more frequently to promote a meaningful learning process. At the same time, teachers may have to find ways to motivate students through carefully planned instructions that can engage all the students to participate. This is also in line with the current STEM education initiatives by the Ministry of Education that promotes hands-on learning and project-based learning to solve real-world problems.

Conclusion

This evaluation is based on quantitative approach which may only provide a certain level of indication on the biology learning environment in a secondary school here. Overall, the students in this school perceive quite favourably on their biology classroom learning environment. This study also helped identify some of the strengths in the biology classroom environment. For instance, there is a favourable level of Student Cohesiveness and Cooperation in the classroom as both these scales displayed the lowest mean measures. However, the scale of Investigation and Involvement have the highest mean measures compared to all the scales. Generally, there is no difference between the boys and girls in their perception of biology classroom learning environment. However, DIF analysis of the items reveals some differences in their perceptions in the scales as well as some of the items. For instance. the male and female students differ most in their perception of the scale of Equity as it has the largest effect size in terms of mean measures. Besides, four of the 56 items show significant DIF with $t \geq 2.0$ logits. Several suggestions were given in hope to improve and create effective classroom learning environment. Therefore, this evaluation has provided some useful information to inform teachers and administrators in selecting the best interventions to improve the teaching and learning of biology in the school. Apart from that, the findings can be used for further evaluation studies such as input, process and product evaluation in the future.

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