

Exploring Vietnamese Students' Participation and Perceptions of Science  
Classroom Environment in STEM Education Context

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**Abstract**

One of the concerns for applying STEM education in the classroom is students' participation. In this study, the Engagement and Participation in Classroom – Science (EPIC-S) questionnaire was applied to explore Vietnamese students' participation behaviors and their perceptions of the science classroom environment. The main goal of our study was to investigate the impact of students' classroom participation on their perceptions of the science classroom environment as assessed by the EPIC-S questionnaire. Our survey was conducted on 884 students in some public secondary schools in Vietnam and the collected data was analyzed using SPSS 20. Students were classified into two groups—verbal and silent—based on how they participated in several facets of the science classroom environment. We found no statistically significant difference between these two groups in their perception of the relationship with the teacher. Nevertheless, there are differences in their perceptions of peer support, fear of embarrassment, and teacher openness. Our results will contribute to the theoretical background for STEM education in Vietnam.

**Keywords:** Students' Participation, Science Classroom Environment, STEM Education

## INTRODUCTION

The classroom is one of the most familiar environments for the formal learning process. It is a crucial context where teachers and students may interact face-to-face. Classroom environment refers to the physical, psychological, and social contexts which have “impacts on the performance of students in the classroom” (Fraser *et al.*, 1996; Fraser, 1998). Prior studies showed that several facets of classroom environment had significant impact on students’ participation and motivation in the classroom. Some factors such as class size, instructor’s personality, relationship and connection with classmates affected whether or not students would speak up in class or engage in classroom discussion (Abdullah *et al.*, 2012; Davis, 2003; den Brok *et al.*, 2010; Ghalley & Rai, 2019; Kaylene *et al.*, 2011). Students’ perception of the classroom environment is crucial to students’ participation in the classroom (Ryan & Patrick, 2001; Susak, 2016).

On the other hand, students may benefit more on learning in the class if they are active in the classroom (Jurik *et al.*, 2013; Wade, 1994). Some studies have also stated that active students who are verbally engaged in classroom would have better academic achievement and revealed higher

satisfaction in the learning process compared to passive students (Freeman *et al.*, 2014; Ghalley & Rai, 2019; Pratton & Hales, 1986; Tsay & Brady, 2010; Webb, 2009; Wells & Arauz, 2006). Students’ participation in the classroom can be recognized via their explicit behaviours or performance during the class time. One of the ways students participate in the class is using words or verbal performance in which students use language to express their thoughts and ideas (Jurik *et al.*, 2013; Liu, 2001). In other way, students may also take notes, listen, pose questions, express opinions, or answer teacher’s questions (Abdullah *et al.*, 2012b; Bas, 2010). In terms of verbal engagement, students who participate in class by asking questions, giving opinions, answering questions, engaging in classroom talk are classified as verbal students, while those who just listen and take notes are classified as silent students (Jen *et al.*, 2017; Mustapha *et al.*, 2010).

The expectation of engaging students to have verbal performance more and more in classroom is of great importance (Chang & Brickman, 2018; Chin, 2006; Pimentel & Mcneill, 2013). It is noteworthy that Asian students are usually silent in class (Kim, 2011; Liu, 2001). For example, according to a survey sponsored by the Ministry of

Science and Technology of Taiwan, 88% of the students were found to be unwilling to ask or respond to questions during the class (Chien *et al.*, 2016). A study by Ketsing *et al.* (2018) found that Thai students also expressed a strong preference to be silent in class, which is considered the typical trait of Asian students. One more study published in 2019 about students' classroom participation also showed that most of Bhutanese students are in passive involvement in the classroom (Ghalley & Rai, 2019). Such these situations may be similar to what happens in Vietnam. This is currently both a concern and a challenge for Vietnamese educators and teachers in manipulating STEM education in formal learning format. The success of a STEM lesson in formal education is closely related to students' involvement in the classroom. A thorough understanding of factors affecting students' verbal participation may allow teachers to help students engage talking or discussing more in the classroom discourse.

Regarding this concern, Taiwanese researchers have developed the Engagement and Participation in Classroom-Science (EPIC-S) questionnaire to assess students' participation preference and their perceptions of the science classroom environment. It has been proved to be a

valid and reliable tool (Chien *et al.* 2018) and has been used in several research studies in Taiwan, Thailand, Korea, and Indonesia (Faisal & Martin, 2018; Kang *et al.*, 2018; Ketsing *et al.*, 2018)

Vietnam is undergoing a nationwide education reform in which STEM education is emphasized as an important factor to prepare students for the 4.0 industrial revolution (The Vietnamese Prime Minister, 2017). STEM education is an approach in which science is taught in integration with other disciplines toward solving real-life problems and improving existing conditions (Bybee, 2010). The problem here is that there is no specific or separate syllabus for STEM education in the new curriculum. As suggested by Bybee (2010), STEM lessons or activities could be integrated into the formal school curriculum instead of importing a large-scale STEM curriculum into schools (Bybee, 2010). In such a situation, the science classroom is one of the most relevant environments for integrating STEM into the formal curriculum (Bien *et al.*, 2019; National Research Council, 2013). However, students' perceptions of participation in the science classroom environment, especially in the context of STEM education in Vietnam, has not been sufficiently studied, and therefore, needs further investigation. Moreover,

the science classroom environments in different countries are also different partially due to cultural features (Chang *et al.*, 2018). Therefore, the research about students' verbal participation in Vietnamese classroom is necessary.

Our study explores possible similarities and differences in perceptions of silent students and verbally participating students. Our research question is "Do verbal students perceive the facets of science classroom environment in the same way as silent students do in science classrooms?"

## **METHOD**

### **Sampling and participants**

The study was conducted on 884 students of 11 lower secondary public schools in Vietnam, who might or might not be familiar to STEM activities in a formal class. They were a diverse group in terms of grade level, gender, area, family background and Grade Point Average (GPA) in science. The questionnaire with information and guidelines for implementation was sent to teachers at the participating schools. The teachers randomly selected several classes in the school to implement the questionnaire. The completed questionnaires were returned to the authors via postal mail. The survey was conducted near the end of the second semester when students had finished

their schoolwork and the final examinations.

### **Measurement**

The Engagement and Participation in Classroom – Science questionnaire (EPIC-S) is a valid and reliable tool to assess students' preference towards classroom participation which was developed by a group of Taiwanese researchers (Chien *et al.*, 2018; Chien *et al.*, 2016). The English full version questionnaire is composed of all items about the participation style and science classroom environment such as students' preferences about seating patterns in the classroom, students' classroom participation, peer relationship including peer support and caring for peers; students-teacher relationship and teacher's openness, students' personality factors including fear of embarrassment, self-effacing and interest (Chien *et al.*, 2016). The EPIC-S questionnaire assessed student involvement, verbal participation and silent participation (Chien *et al.*, 2018; Jen *et al.*, 2017; Chien *et al.*, 2016). Verbal participation includes asking or responding to questions. Silent participation includes attentive listening or taking notes. The English version of the questionnaire consisted of 79 questions, of which 52 items were rated on a four-point Likert

scale from 1 - strongly disagree to 4 - strongly agree.

For our study, the questionnaire was translated into Vietnamese by a group of Vietnamese researchers and was proofread by some secondary teachers to ensure that the language used in the questionnaire were appropriate to the students. Thereafter, it was printed and delivered to secondary teachers to collect the data. The data were analyzed to check for internal consistency and discriminant validity of the scales of the Vietnamese version of EPIC-S, together with an examination of its factor structure. Exploratory Factor Analysis - EFA was employed to explore and examine the structure of variables and items to make sure that it fits Vietnamese students. EFA was performed using IBM SPSS Statistics Version 20.

### **Data analysis**

Analysis of covariance (ANCOVA) was employed to analyze quantitative data, in which students' participation preference was the independent variable and students' mean scores on each component was the dependent variables. We also statistically controlled the influence of students' interest in science on their participation by using students' interest scores as a covariate in ANCOVA, because it has been found that students

who had high interest in science might choose to participate either verbally or non-verbally (Chien *et al.*, 2018). Each component of the science classroom environment is considered a main effect in the analysis.

Each questionnaire item belongs to either verbal participation (VP) or non-verbal participation (NVP) components. For the purpose of this study, we were only interested in students with mean score on NVP component of 3.0 or higher. Students with NVP mean score lower than 3.0 were considered idle in the classroom and their data were excluded from analysis. Among the participating students, those who had a mean score on VP higher than 3.0 were classified as verbal participation and those who had a mean score on VP lower than 3.0 were classified as silent participation (Jen *et al.*, 2017). This classification principle allowed us to distinguish the silent participating students who are non-verbal but participate in class by taking notes or listening from the non-participating students who barely performed any behaviors in class. Due to this selection, the sample size of verbal and silent students was reduced.

## **RESULTS AND DISCUSSION**

### **Validation of the Vietnamese EPIC-S**

The sample size of data subset 1 (n = 468) was adequate for EFA, as

evidenced by the overall KMO value of .85 and the statistically significant result of the Bartlett's Sphericity test ( $p < .001$ ). Items with a cross-loading over .4 were eliminated. Six components were extracted, accounting for 61% of the variance. The final solution of EFA can be found in Table 1. Each component had an adequate number of items ( $> 3$ ), an acceptable Cronbach's  $\alpha$  ( $> .6$ ), and sufficient factor loadings ( $> |.45|$ ). Multi-collinearity among factors was not severe ( $r < |.5|$ ). The instrument is reframed to make it relevant for Vietnamese circumstances. The components of the questionnaire are clarified in Table 2.

#### **Differences between verbal students' and silent students' perceptions of science classroom environment**

Participation-related differences in students' perceptions of science classroom environment were explored using a one-way analysis of covariance (ANCOVA) with the components of classroom environment as dependent variables and participation styles as independent variables. The interest of science average score was used as the covariate. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate.

There were some significant differences between silent students' and verbal students' perceptions of the science classroom environment ( $p < 0.05$ ) as shown in Table 3. The one-way ANCOVA revealed that there were no statistically significant differences between the verbal and silent groups in terms of mean scores for Relationship with Teacher ( $F(1, 298) = .72, p = .397, \text{partial } \eta^2 = .002$ ). Meanwhile, there were statistically significant differences between two groups in terms of mean scores for Peer Support ( $F(1, 298) = 19.95, p < .001, \text{partial } \eta^2 = .063$ ), Fear of Embarrassment ( $F(1, 298) = 6.66, p = .01, \text{partial } \eta^2 = .022$ ), Teacher Openness ( $F(1, 298) = 6.87, p = .009, \text{partial } \eta^2 = .023$ ). In particular, the effect size for the component of Peer Support was relatively large at 0.63, explaining 63 % of variance of the perceptions about the way classmates share ideas and think in science class. The effect sizes for Fear of Embarrassment and Teacher Openness components are not so high, revealing small effects. These results were different from those of a study on Taiwanese students, for whom the verbal and silent groups perceived differently about Fear of Embarrassment, yet perceived similarly about peer support, the importance of

their relationship with their teacher and teacher openness (Jen *et al.*, 2017).

According to the results shown in Table 3, the verbal and silent groups had different perception about Peer Support in the classroom. The mean score for peer support of the verbal group is higher than 3.00 which indicates a perception that classmates are always willing to share their ideas with each other as well as communicate well in the science class. Moreover, the peer support mean score also shows that active students express their thoughts and respect to each other. Meanwhile, silent students think that classmates don't need to do these things, which is shown in the different scores on this peer support component. The results of this study are inconsistent with the findings of previous studies of similar nature. The perception of students about their classmates affects students' engagement in classroom as well as the group performance (Chung *et al.*, 2018; Wentzel *et al.*, 2010). According to Abdullah *et al.*, passive students sometimes think that peers' influence on their learning is mostly negative (Abdullah *et al.*, 2012b). They thought that the activeness of verbal students in talking made them feel left behind, so they chose to be silent in the classroom.

Regarding fear embarrassment, silent students reported a higher mean

score. This implied that silent students tend to be more afraid of receiving negative feedback from their classmates. According to Jen, verbal and silent Taiwanese students had different perception about the fear of embarrassment (Jen *et al.*, 2017). Students of higher feeling at risk embarrassment in front of their classmates tend to avoid speaking up their ideas in class. They maintain the silent behavior because that makes them feel safe. These results agree with other studies which focus on student engagement. In terms of verbal participation, one of the classroom environment factors affecting students' behavior lies in students' traits which are revealed via self-efficacy (Mahyuddin *et al.*, 2006), self-limitations such as fear of offense (Mustapha *et al.*, 2010), fear of being criticized about their answers (Fassinger, 1996).

The relationship with teacher component represents the feeling of students in their interaction with the teacher. The high score indicates the strong feeling of worry that the relationship with the teacher becomes worse if students ask too many questions in class. Such results are pretty similar to what happens with Taiwanese students. In this component, the scores of the two groups in this study were both

reported under 3.0 and there was no statistically significant difference between them. These results imply that most of the students don't feel comfortable to pose questions to teachers in the science classroom. It is noteworthy that these results are consistent with the result of Taiwanese students (Jen *et al.*, 2017). Positive relationship with students also contributes to the conducive environment in which students are encouraged to be more active and enthusiastic (Abdullah *et al.*, 2012a). Both passive and active students admitted that instructors play an important role in the classroom (Abdullah *et al.*, 2012a). One of the important factors that contributes to the active participation of students in the classroom is the traits and skills of the instructor, such as supportiveness, understanding, approachability, and friendliness (Dallimore *et al.*, 2004; Fassinger, 2000; Frisby *et al.*, 2014; Kim *et al.*, 2000; Pimentel & Mcneill, 2013). An instructor's personal traits such as friendliness, knowledge of each student, tendency not to criticize students, good mood, and approachability are favored by most of students. It is relevant for students to feel that the way of teacher encourages them to engage in class is important which is proved by the highest mean

score of Teacher Openness for both verbal and silent groups. The effect size for Teacher Openness is not strong enough to make it a key difference in perception of verbal and silent students. As indicated by a report of OECD (OECD, 2015), the average class size in Asian countries is significantly higher than those in Western countries. Due to the tight school schedule, it is extremely difficult for Asian teachers to frequently answer all the questions from the students.

Due to the coexistence of students of different participation behaviors in a classroom, teachers should strive to hold the team working together (or cooperatively) so that members in a group come from verbal, silent, and non-participating group as well. One of the particular features in a STEM activity is teamwork through which students may enhance their cooperation and communication competencies (Kelley & Knowles, 2016; Zollman, 2012). Cooperation and communication are also two of the primary competencies in the national curriculum in Vietnam which was enacted officially in 2018 (The Vietnamese Ministry of Education and Training, 2018). Moreover, according to the study of Abdullah *et al.*, (Abdullah *et al.*, 2012a) students prefer to be in a group with peers who are similar to them in terms of assertiveness



in the classroom. A procedure to enhance the communication skill in science should be manipulated in teamwork to encourage silent students as well as to exploit the good perception of verbal students. Teachers should find appropriate ways to help students feel comfortable in sharing thoughts with friends such as how to form a well-structured group (Saleh *et al.*, 2007) or

study more or develop by themselves in fostering students in interaction verbally more in group work (Kaendler *et al.*, 2015; Kelly, 2007). Besides, teachers may create a learning environment in which students feel safe and comfortable to express their ideas without worrying of being judged or blamed for their opinions.

Table 1. Description of sample by grade level, area, and gender (N = 884 students)

Grade	The North		The Middle		The South		Total
	M*	FM*	M	FM	M	FM	
6	0	0	0	0	43	56	99
7	5	20	31	15	105	97	273
8	73	81	29	36	64	80	363
9	24	38	30	25	20	12	149
Total	241		166		477		884

\*M – Male

\*FM – Female

Table 2. Factor Structure and descriptive statistics of the Vietnamese EPIC-S.

Component	Items	Cronbach $\alpha$	Factor loadings	$r$ with other components
Fear of Embarrassment	5	0.85	0.55 ~ 0.91	-0.01 ~ -0.46
Interest	5	0.74	0.50 ~ 0.79	-0.17 ~ 0.39
Peer Support	3	0.64	0.72 ~ 0.75	-0.08 ~ 0.29
Relationship with Teacher	3	0.78	0.77 ~ 0.87	-0.46 ~ 0.15
Teacher Openness	3	0.60	0.56 ~ 0.81	-0.13 ~ 0.39

Table 3. Results from one-way ANCOVA – Verbal and Silent groups

	Silent group (n = 161)		Verbal group (n = 140)		F	$\eta^2$
	M	SE	M	SE		
Peer Support (PS)	2.72	.05	3.03	.050	19.95***	.063
Fear of Embarrassment (PT)	2.38	.06	2.15	.066	6.66**	.022
Relationship with Teacher (RT)	2.86	.05	2.74	.043	.72	.002
Teacher Openness	3.07	.04	3.23	.04	6.87**	.023

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

## CONCLUSION

Overall, our finding is of a great value for teachers to plan and apply

proper techniques to build an active science environment. This is especially important in a STEM lesson which

requires the cooperation of students. It is also pertinent for teachers to encourage students' active involvement. Verbal and silent students co-exist in a Vietnamese science classroom, which poses a considerable challenge for teachers. The study has revealed useful insights into the difference in thinking between verbal and silent students in the classroom. We found that Vietnamese students seem to remain silent in classroom for their perception of peer interaction. They do not feel comfortable to share with classmates or do not think sharing with peers is necessary. Besides the fear of embarrassment, teacher openness also contributes to silent behaviors of students in class. Based on these findings, it is necessary for teachers to create an appropriate science classroom environment in which students are encouraged to actively engage in the lesson.

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