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A WIHIC EXPLORATION OF SECONDARY SCHOOL SCIENCE CLASSROOMS – A CASE STUDY FROM TRINIDAD & TOBAGO

Abstract: In this work the WIHIC (What is Happening In this Classroom) instrument was used to assess the types of interactions, from students' perspectives, that occur in two science classrooms in Trinidad & Tobago. It was the first attempt to use the WIHIC instrument in the research context. An exploratory case study research design in the quantitative paradigm was employed in the assessment. The findings reveal that classroom interactions were dominated by student-centered interactions that mapped onto the student cohesiveness and cooperation scales of the WIHIC instrument. A high level of interaction in the investigation and involvement scales was also determined. What was surprising however, was the low level of teacher supportive interactions and interactions which demonstrated teacher impartiality as reported from students' perspective.

Keywords: Classroom interactions, student perceptions, WIHIC instrument.

Introduction

Anecdotal accounts obtained through informal interactions with secondary school science students have revealed that there is a range of activities which occur in secondary school science classrooms in Trinidad and Tobago (Maharaj-Sharma, 2013). Students often engage in compare and contrast discussions with their peers across classrooms in the same school and across schools in the country, to gauge the meaningfulness and worth of their classroom experiences. Such discussions have the tendency to implicitly communicate to stakeholders, such as parents and administrators, images of the science classrooms which increasingly suggest that students across the country and even across classes in the same school, are not equal beneficiaries of a sound science classroom experience. While it may not be possible to provide all students with the same science experience, the expectation at a policy level is that all students will receive a common set of experiences to ensure that they leave their secondary school training with equivalent competencies, socialization skills and readiness for the labour market. This expectation has prompted researchers and policymakers in Trinidad and Tobago to consider assessing the soundness, validity, and efficiency of instructional practices in science classrooms.

At the global level, educational policies and education reform initiatives are guided by the value derived from instructional practices which aim to result in improved learning outcomes for students. The No Child Left Behind (NCLB) initiative, for example, mandated teachers to

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adopt specific evidence-based instructional practices in order to improve student achievement (Klein, 2015). This, and other similar reform efforts suggest that a detailed examination of teachers' classroom practices and how these practices are linked to other student characteristics, are key for understanding the extent to which these initiatives are effective (Ball and Rowan, 2004; Blank, Porter and Smithson, 2001; Mayer, 1999).

In science classrooms, implementation of desired high-quality science instruction can be challenging given the range of considerations that must be met. These include adequate infrastructure, uninterrupted supply of scientific resources inclusive of apparatus, models and reagents, and of course professional pedagogically trained teachers. Even while acknowledging the challenge, very little is empirically known about the nature of the instructional practices and the resulting classroom interactions which occur in science classrooms (Green and Joo, 2017). Some studies have attempted to bridge this gap and have used available instruments such as WIHIC, VOST and STEBI to describe the science classroom transaction between students and teachers (Fraser, 1998). These have explored aspects of science classroom instruction in areas such as teacher support, student involvement, levels of hands-on experimentation and cooperation among students (Bleicher, 2004). Despite these and other published works, much is still unknown about the specific nature of the various dimensions of classroom interactions. Even less is known about the link between types of classroom interactions and other student characteristics such as academic achievement, attitudes and behaviour.

In Trinidad and Tobago no such survey has ever been done. Furthermore, in Trinidad and Tobago, there are no stringent and consistent monitoring and evaluation systems to check the levels and nature of classroom interactions, the types of activities teachers facilitate in their classrooms, the kind of support teachers provide for students and the extent to which all students are equal beneficiaries of the classroom transaction. As such, it is impossible to confidently express an opinion on any aspect of classroom interaction and whether these interactions have direct bearing on student outcomes in Trinidad and Tobago. In other words, the research base to support any claims about the value and effectiveness of classroom interactions in Trinidad and Tobago is non-existent. This reality motivated the current work.

This work attempts to explore the nature of classroom interactions which occur during science instruction in Trinidad and Tobago. Being the first of its kind in the research context the science classes of only one school were examined. Several classroom instruction survey instruments were carefully reviewed to determine the best choice of instrument for the research context. The context and the anecdotal accounts which pointed to the need to assess classroom interactions were the primary determining factors used to choose the most appropriate instrument.

Equity of treatment of students as well as task orientation and student cooperation were elements of classroom interactions which were perceived to be weak in the Trinidad and Tobago context and were therefore determined to be worthy of exploration (Maharaj-Sharma, 2013). The VOST and STEBI have been effectively used to assess several aspects of classroom interactions, inclusive of task orientation and equity, but the assessment made through those did not specifically target students' perceptions. While the importance of independent views and perspectives of teachers cannot be underestimated, the inherent subjectivity of students arising from their articulated perspectives was deemed to be more suitable for the current work. Exploration through the eyes of students is an important

element of giving students a voice in the classroom – a construct that is often underestimated in advocative research. Since rigorous exploration of the nature of science classroom interactions was being sought in this work, students were believed to be best placed to offer data of this nature. With those delimitations, the WIHIC instrument, a science-based instrument and one which is crafted from the perspective of students and in first person language, was determined to be the most suitable for the intended purposes. The final version of WIHIC consisting of seven scales and 56 items was used in this work (Aldridge, Fraser and Huang, 1999). Against that background therefore, the following research questions guided to approach adopted in this work:

1. What are students' perceptions of the nature of the interactions which occur in their science classrooms?
2. What are the most and least prevalent types of interactions in the science classrooms, based on the categories in the WIHIC instrument?

This work is significant as it is the first attempt to document the use of the WIHIC instrument to assess the nature of classroom interactions in the research context. This work will therefore not only lay the foundation for subsequent work with the WIHIC instrument but will in fact prompt teachers and educators in Trinidad and Tobago to initiate further research in this area of the nature of classroom interactions. The findings will also add to the existing body of literature on the use of the WIHIC instrument and will emphasize the unique realities associated with developing status jurisdictions.

Literature Framework

The WIHIC Instrument

The original version of the WIHIC instrument designed in 1996 contained nine scales and 90 items (Fraser, McRobbie and Fisher, 1996). Some years later, Aldridge, Fraser and Huang (1999), used collective sets of statistical analyses and interview data from a cross section of students, localities and subject disciplines, in an exercise which led to a refinement of the original instrument. In the revision process, some scales were condensed, some items were reworded, and some items omitted, thus reducing the instrument to a seven scale, 54 items tool. This revised instrument was subsequently field-tested in Australia and Taiwan with students across 50 classrooms in each context (Aldridge and Fraser, 2000). An Arabic translation of the WIHIC instrument was also field tested across several classrooms in Turkey (Macleod and Fraser, 2010). These tests led to the inclusion of two additional items and the final version of the WIHIC instrument emerged with seven scales and 56 items. Furthermore, the tests which led to the development of the final version of the WIHIC instrument ensured that factorial validity and internal consistency reliability of the instrument were achieved in all instances. This seven-scale, 56 items WIHIC will be used in this work. The seven scales in this final version of the WIHIC instrument are: *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equality*. The format used in this work consisted of the prescribed 56 items across the seven scales with a response scale ranging from strongly agree to strongly disagree for each item. This format was most suitable for the exploration of classroom interactions being sought by the research questions in this work.

Research using the WIHIC

The finalized version of the WIHIC instrument, as well as its various adaptations have been used across all educational levels, from early childhood classrooms to tertiary lecture halls, and in a variety of classrooms including language arts, mathematics and science classrooms

(Allen and Fraser, 2007; Dorman, 2003; Martin-Dunlop and Fraser, 2007; Chionh and Fraser, 2009; Wolf and Fraser, 2008; Khoo and Fraser, 2008; Zandvliet and Fraser, 2005). It has also been well-used in several research and geographical contexts to arrive at empirical data about the nature of classroom interactions in many places (Singh and McNeil, 2014).

Most published work emanating from the use of the WIHIC instrument sought to empirically capture the multifaceted nature of classroom interactions with the aim of locating these interactions within a formal framework. Some studies relied heavily on teachers' perceptions while others sought to extract students' interpretations of the nature of their classroom interactions. Only few studies used a combination of teacher and student input to arrive at a determination of the nature of classroom interaction (Tshewang, Chandra and Yeh, 2017). In the current work, students' interpretations will be solicited in attempting to ascertain the nature of classroom interactions which occur in the participating science classrooms.

An adaptation of the WIHIC questionnaire used by Yang (2015) reported findings from a survey of how rural junior secondary school students in the western part of China perceive their mathematics classroom learning environments. The study captured data from 749 Grade 7, 842 Grade 8 and 864 Grade 9 students from 12 coeducational schools and 52 classrooms in three provinces in China. Data were analyzed through factor analysis, descriptive statistics, two-way ANOVA, simple correlation analysis and multiple regression analysis. It was found that while rural junior secondary students generally did not have an overall favorable perception of their mathematics classroom environment, they had positive views about student cohesiveness and cooperation among students in most of the classrooms in the survey. In fact, it was revealed that *teacher support* and *equality* were the scales that received the overall lowest ratings.

Interestingly however, in earlier work the WIHIC instrument was successfully validated by Brok, Brekelmans and Wubbels (2006) when it was used to examine what factors influenced the perceptions of 665 students in 26 middle-school science classes in 11 Central Californian schools. In that work, among the factors that emerged as most influential in describing favorable classroom environments were *teacher support*, *investigation*, and *equality*. It was also noted in Brok, Brekelmans and Wubbels (2006) that *task orientation* and *involvement* were high in just about 50% of the science classrooms surveyed while *equality* received the lowest overall rating.

In a comprehensive study of 2,310 Grade 10 geography and mathematics students from 75 classes in 38 schools in Singapore, Chionh and Fraser (2009), reported strong factorial validity and reliability for the WIHIC when it was used to survey classroom environment for both subjects. They showed that there were direct associations between student outcomes and the classroom learning environment. Even though interesting differences between the environments of the geography classrooms and the mathematics classrooms were revealed in that work, high overall ratings were obtained for the learning environments of classrooms of both subjects. Students rated *task orientation*, *teacher support* and *student cohesiveness* very high in the geography classrooms while *teacher support* and *involvement* were the most highly rated scales in the mathematics classrooms. *Investigation* was rated the lowest in the classrooms of both subjects.

Methodology

The WIHIC instrument was the primary data collection instrument used in this work. The scales in the WIHIC instrument, a description of what each scale assesses and a sample item for each scale are presented in Appendix I. The actual version of the WIHIC instrument used in this work is presented in Appendix II.

Research Design

This study adopted an exploratory case study research design in the quantitative paradigm (Creswell, 2014). The case in this instance was a single school. Two science classes from this school participated in the research. It is the first study using the validated WIHIC instrument in the research context. As such the case study design was deemed most suitable. This school was selected because a science teacher from this school read about the WIHIC instrument and wanted to use it to make a general assessment of the types of interactions occurring in her classroom. This teacher approached the researcher with her intentions seeking guidance and collaboration to undertake the research.

Very little formal documentation of what interactions occur in the classrooms (and in this case in science classrooms) in Trinidad & Tobago is available and so, the aim in this work was to gain insights and hence to arrive at a generalized quantitative assessment of the nature of the classroom interactions in a typical science classroom in Trinidad & Tobago. Furthermore, the intent was to make a preliminary determination of what teacher activities and what student activities and experiences constitute the learning transaction which influences the nature of the classroom interactions. It is in that regard therefore, that the approach adopted is described as exploratory (Stebbins, 2001).

Participants

A total of 60 students from two form 3 (3rd year secondary school level) classes (30 students per class) in a sub-urban district school in Trinidad participated in this work. The group was purposively selected based on an expressed interest by the group's teacher to the researcher, to formally assess the nature of the interactions in her science classrooms using the WIHIC instrument. This teacher indicated to the researcher that her self-reflection over the period of one year had her concerned about her classroom practice and that she was desirous of understanding more fully the nature and types of classroom interactions that define her classroom practice. Her long-term intention is to use new understandings derived to explore ways to improve her science teaching.

The participating group of students was a gender-mixed one comprising 34 females and 26 males. Their age ranged between 13 - 15 years and the group was of mixed academic ability. These students pursue several subjects at the Form 3 level inclusive of mathematics, language arts, science, and social studies. Each subject is taught by a subject specialist. The WIHIC instrument was used to collect data from interactions occurring in the science classes only, because the science teacher was the one who expressed a desire to undertake this study.

The nature of the study was explained to all students and they were advised that the data emerging from the study will be used only for the purposes of the current work. They were assured that their anonymity would be guaranteed and that they had the right to withdraw from the study at any time if they wanted to.

Treatment

Prior to the classroom intervention, the WIHIC instrument was sent to the participating teacher for careful study and critique to ensure that the items in each of the seven scales were suitable for the research context in terms of students' reliability to what each item targeted. Minor adaptations in the wording of two items were made to scale down the vocabulary to match students' vocabulary levels. The instrument was piloted with a group of 25 students who did not constitute the research group, but who had similar demographics to the research group. The intention was to ensure that students understood what each item was asking. Students' responses from this 'pilot' group were reviewed and subsequent random interview with half of the group revealed that there was no ambiguity with their interpretation of the items on the WIHIC instrument used in this work.

The study spanned two weeks during which time the class teacher delivered a total of 8 science lessons to both sub-groups. Students were given the WIHIC instrument to complete at the end of each class. They were instructed to complete the questionnaire individually and based on their experiences during the immediately concluded class. Completed questionnaires were collected at the end of each teaching session. No names or other identifying marks were included on the questionnaires and students were advised **not** to write their names on their questionnaire. This was to ensure anonymity of the responses received. A total of 480 completed questionnaires were received from students over the 2-week period. No student withdrew from the study and none of the completed questionnaires were deemed unacceptable for the research purposes.

Data Analysis

The WIHIC instrument consisted of 56 items across seven (7) scales. Each item was rated on a Likert-type scale which was quantified to reflect students' responses in respect of their degree of agreement or disagreement with the statements presented. Each statement had an assigned score ranging from 1 to 5, with 1 representing strongest disagreement and 5 representing strongest agreement with the statement, so that the closer the mean score was to 5, for a particular statement, the higher was students' agreement with the statement. Some questions were worded in negative form and for those the score was reversed for analysis. This was done to prevent students from developing a stereotyped response set where a pattern developed, such as agreeing (or disagreeing) with all the statements (Babbie, 1998).

A total of 480 completed WIHIC questionnaires were collected from the students. Given that the primary concern in this work was to introduce the WIHIC instrument in the research setting, the data gathered in this inaugural work was analyzed only by descriptive statistical analyses. Determination of only descriptive parameters of mean (\bar{x}), standard deviation (SD) and coefficient of variance (CV) from the collective responses to items in each of the seven scales in the instrument was made. These were subsequently used to discuss students' perceptions of the nature, extent and type interactions in their science classrooms. No inferential statistical analyses or qualitative assessments of students' perceptions were done in this work. The expectation is that analyses of the latter types will be employed in future work which will pursue deeper explorations of the preliminary findings and insights generated from this work.

Findings

In assessing what is happening in the science classrooms in this work, all 60 students from both classes completed the WIHIC instrument at the end of each lesson. The intent was to explore the nature of classroom interactions as well as the types of activities which facilitate these interactions from the perspective of the students. Ghafarpour and Moinzadeh (2020) have spoken about the use of the WIHIC instrument to characterize classroom activities from the teacher's perspective as well, but in view of the seminal nature of the current work, students' perspectives were deemed more instructive at this time. Furthermore, this work was initiated by the class teacher, who felt that the student's perspective, instead of her own, would provide a more truthful interpretation of the nature and types of classroom interactions.

Students' responses generated from the completed WIHIC instrument were analyzed with the intent of classifying the nature of the interactions occurring in the two science classrooms targeted in this work. Descriptive analyses of their responses revealed that, from the perspective of the students, the interactions among the students in these two science classes were highly *cooperative and cohesive*. The mean score obtained from the collective responses to items in both the *student cohesiveness and the cooperation* scales was greater than 4.00, with the *student cohesiveness* scale scoring a mean of 4.72 – the highest mean score obtained among all seven scales in the WIHIC. What this means is that most students in this work strongly agreed that their classroom interactions were characterized by high levels of *student cohesiveness*. The Standard Deviation (SD) and the coefficient of variance (CV) for *student cohesiveness* were 0.3 and 0.05 respectively while for *cooperation* the corresponding values were 0.02 and 0.05. The low SD values suggest that individual student's perception about the nature of their classroom interactions differed only slightly and the CV values (also notably very low) quantifies this slight difference to be 6% and 5% respectively for the *student cohesiveness and cooperation scales*. While these revelations are new and insightful for the research context it is interesting to note that they are somewhat aligned with those reported by Yang (2015).

In contrast, and based on students' responses, it seems that the classroom interactions were not the kind in which teacher support or teacher input was high. In fact, the *teacher support* scale received the second lowest overall mean (mean = 1.98; SD = 0.3) but the second highest coefficient of variance (CV = 0.15) which suggests that even though there was a 15% variation in students' perceptions in this scale, there was overall agreement that their classroom interactions were not characterized by *teacher supportive* interactions.

Also receiving a low mean score (the lowest mean among all 7 scales), despite scoring a relatively high coefficient of variance, was the *equality* scale (mean = 1.72; SD= 0.3; CV = 0.17). Items in the *equality* scale described in a general sense, teacher-student interactions in which students were asked to rank their feelings of being treated the same as their peers in terms of teacher praise, encouragement and opportunity to participate in class discussions. It appeared, from the students' responses to items in this scale, and reflected in the overall mean and standard deviation for this scale, that in these science classes the majority of students felt that the teacher-student interactions did not equally facilitate all students in the group. Responses to certain specific items in the *equality* scale suggest that only a few students benefitted from the attentiveness of the class teacher. This feeling of inequity of

treatment from the teacher which seem to have been experienced by a majority of the students may be linked to responses provided in the *teacher support* scale and may account for the similarly low mean (and similarly high coefficient of variance) obtained for that scale as well. In particular, items in the *teacher support* scale which described interactions such as the teacher “helping students ... with work” and the teacher “taking an interest in” and “talking with” the students were each ranked “strongly disagree” by more than 60% of the respondents. A comparable percentage of students (64%) ranked items in the *equality* scale which described interactions such as “teacher provided encouragement” and “teacher gave praise” as “strongly disagreeable”. Again, these findings align to some extent with those reported by Yang (2015) and also with those reported by Brok, Brekelmans and Wubbels (2006) but they contrast the findings of Chionh and Fraser (2009), particularly in the *teacher support* scale. It would be interesting to explore the reasons for the difference in the latter case, perhaps with focus on possible differences in contextual and cultural circumstances.

Interactions which students perceived as the kind which promoted engagement; hands-on or otherwise; as well as those interactions students perceived as organizational were similarly ranked. This was concluded based on the similar mean values obtained for the scales of *involvement*, *investigation*, and *task orientation*. Not only were the mean scores close in value, but they were relatively high (> 3.15 in all cases) which suggest that students perceived their classroom interactions to be engaging, participatory and generally well-organized (in terms of getting assigned tasks completed in a timely manner). Coefficient of variances for these scales were all relatively high when compared to that for *student cohesiveness and cooperation*, but they were within a very narrow range of values (0.09 – 0.13). It seems therefore that while the students gave a collective high ranking to their student-student classroom interactions, as determined from their responses to items in these three scales, not all students ranked these scales in the same way. In fact, there was a 9 – 13% variation in students’ scoring of items in these scales.

The equal and relatively high mean value ($x = 3.18$) obtained for the *investigation* ($SD = 0.4$) and *involvement* ($SD = 0.3$) scales, may be associated with agreeable/highly agreeable responses given to the experimental, practical, and hands-on activities described by items in these two scales. It is quite possible that students may have interpreted the items which described activities of this kind to be ones that will provide opportunity for them to engage in active science tasks and activities and this interpretation may therefore account for the high mean values obtained for both scales. This associative inference between interactions described in items in the *investigation* and the *involvement* scales is supported by the strongly agree rating given by more than 50% of the students to several items which span both scales and which described interactions which provided opportunity for students to share ideas and to learn by doing experiments. In particular, the following items were unanimously rated as highly agreeable types of interactions in the classrooms:

- I did experiments to test my ideas in this science class (*investigation*)
- I did experiments to answer questions coming from discussion (*investigation*)
- I did experiments to answer questions that puzzled me (*investigation*)
- I talked about ideas in this science class (*involvement*)
- I talk about my ideas with other students in this class (*involvement*)

Table 1 presents a snapshot of students’ ranking of their perceptions of the nature of the classroom interactions across each of the seven (7) scales of the WIHIC instrument. The mean scores (x), standard deviations, SD , and respective Coefficient of Variances (CV) values are

shown. The two scales with the highest ratings are highlighted in **bold** type and the two scales with the lowest ratings are *italicized*.

Table 1: Perceptions of classroom activities (n=60)

Scale	Mean (x)	SD	CV
Student Cohesiveness	4.76	0.3	0.06
<i>Teacher Support</i>	1.98	0.3	0.15
Involvement	3.18	0.3	0.09
Investigation	3.18	0.4	0.13
Task Orientation	3.22	0.4	0.12
Cooperation	4.22	0.2	0.05
<i>Equality</i>	1.72	0.3	0.17*

Closer examination of students' responses to specific items across the various scales of the WIHIC instrument indicate that students seem to have very little difficulties working together to get assigned tasks completed on time and that they work responsibly and amicably. Activities and interactions which surveyed students' efforts in the division of labor and an obligation to overall group success were also ranked very high. This was concluded from the highly agreeable responses provided for items such as "I worked well with other students" and "I did as much as I set out to do in this science class."

On the other hand, specific item responses revealed that students did not view their teacher's role in the teaching and learning transaction to be supportive and impartial. Interactions that would normally show teacher's knowledge of students, in terms of their challenges and learning needs, were seemingly almost absent in these classrooms. This summation was arrived at based on the fact that more than 80% of the students responded either 'disagree' or 'strongly disagree' to the item 'the teacher knew my problems in this class' in the *teacher support* scale. In addition, in respect of students' perceptions of teacher impartiality, 84% of the students responded, 'strongly disagree' to the item "I was treated the same as other students in this science class."

In summarizing therefore, in respect of research question 1, which sought to assess students' perceptions of the nature of the interactions which occur in their science classrooms, the following can be said:

- Interactions are generally cohesive and cooperative among students in these two science classes
- There is a high degree of collegiality, friendliness, and collaboration among students
- Students are supportive of each other and helpful towards each other
- Teacher supportive interactions are minimal and unequally directed

In respect of research question 2 – What are the most and least prevalent types of interactions in the science classrooms, based on the categories in the WIHIC instrument, the following can be said:

- Interactions which rest in the domain of the students are most prevalent
 - Student cohesiveness and cooperative types of interactions as described by the WIHIC instrument dominated the classrooms surveyed in this work.

- Participatory and engaging types of interactions as described by the investigation and involvement scales in the WIHIC instrument were the second most prevalent types of interactions in the classrooms surveyed in this work.
- Interactions which rest in the domain of the teacher are least prevalent
 - Teacher supportive types of interactions were very low in the classes surveyed but the least prevalent type of interactions was those which promoted equitable treatment of students by the class teacher.
- *Corporation* (among students) and *student cohesiveness* seem to be associative in respect of agreeability while *teacher support* and *equality* (of treatment of students) seem to be associative in respect of disagreeability.

Concluding Remarks

In this work the WIHIC instrument was used to gain insights into the nature and types of interactions that occurred in two science classrooms in Trinidad & Tobago. It is a small-scale study, and it is first of its kind in the research context. The intent in the first instance was to introduce the WIHIC instrument in the research context and secondly to initiate empirical research by way of assessing the nature of classroom interactions in Trinidad & Tobago using the instrument. While the findings arising from this small-scale assessment cannot be generalized, they are interesting as they seem to suggest that the nature of classroom interactions is determined largely by student activities and actions. Interactions which demonstrated teacher support and impartiality are least prevalent.

These findings are instructive and point to the role of the teacher and that of students. Questions about how responsive teachers are and what efforts teachers make, beyond providing tasks for students, arise. Best practice literature suggests that teachers are more than just transmitters of knowledge and facilitators. In fact, Maharaj-Sharma (2013), discussed the multifaceted role of the teacher and suggested that a primary role is creating a comfortable and interactive learning environment which promotes student collaboration in a teacher supportive environment. Very important too is the need for all students to feel equally valued and appreciated by the teacher as far possible. These findings highlight the existence of an obvious gap in teacher support that may not be unique to the science classes surveyed in this work – a presumption that is worthy of further investigation.

The learnings emanating from this work point to the need for greater teacher awareness in the facilitation of classroom interactions during the teaching and learning transaction. Perhaps it will be useful for teachers who find themselves in contexts with high levels of positive student interactions (such as the types described in this work) to utilize these to promote rich and meaningful classroom discourse rather than ignore the inherent potential of such types of interactions. In case of the specific teacher in this work, and perhaps for other teachers as well, the findings are very instructive. They suggest that even if students are prepared and can take autonomy for their learning, the role of teacher remains critical. Students need their teachers to show explicit support for their efforts and teachers who are prepared to interact with them openly, fairly, and non-discriminatory. This work alerts teachers to the importance of self-reflection and its implications on their everyday practice.

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Appendix I

Scale	Description	Sample item
Student cohesiveness	Extent to which students know and are friendly to each other	I am friendly with other students in my science class
Teacher support	Extent to which the teacher helps, befriends, trusts and is interested in students	My science teacher goes out of her way to help me in class
Involvement	Extent to which students have attentive interest, participate in discussions, and explain their solutions	I talk about ideas in my science class
Investigation	Extent to which skills and processes of inquiry are used in class	I do experiments to test my ideas in my science class
Task orientation	Extent to which it is important to complete activities planned and to stay on the subject matter	Getting a certain amount of work done in class is important to me
Cooperation	Extent to which students cooperate rather than compete with one another on learning tasks	I cooperate with other students when doing science class activities
Equality	Extent to which students are treated equally by the teacher	I can talk the same amount as other students in my science class

Appendix II

Scale	Item	SA	A	N	D	SD
Student Cohesiveness	1. I am friends with other students in this science class.					
	2. I know other students in this science class.					
	3. I am friendly to other students in this science class.					
	4. My classmates are my friends in this science class.					
	5. I worked well with my peers					
	6. I helped my peers who were having trouble with their work.					
	7. I felt liked by my classmates in this science class.					
	8. I did not get help from my peers in this science class.					
Teacher Support	9. My teacher took an interest in me in this science class.					
	10. My teacher helped me in this science class.					
	11. My teacher knew my feelings in this science class.					
	12. My teacher helped me when I had trouble with the work in this science class.					
	13. My teacher did not talk with me in this science class.					
	14. My teacher knew my problems in this science class.					
	15. My teacher moved about the class to talk with me in this science class					
	16. My teacher's questions helped me to learn in this science class.					
Investigation	17. I did experiments to test my ideas in this science class.					
	18. I was asked to think about the evidence for statements made in class					
	19. I did experiments to answer questions coming from discussions.					
	20. I explained experimental procedures, diagrams and graphs to my classmates					
	21. I did experiments to answer questions that puzzled me.					
	22. I did experiments to answer the teacher's questions.					
	23. I found answers to questions by doing experiments.					
	24. I solved problems by doing my own experiments.					
Involvement	25. I talked about ideas in this science class.					
	26. I did not give my opinions during discussions in this science class.					
	27. My teacher asked me questions in this science class					
	28. My ideas were used during discussions in this science class.					
	29. I did not ask the teacher questions in this science class.					
	30. I talked about my ideas with my peers in this science class.					
	31. My classmates talked to me about solving problems in this science class.					
	32. I was asked to talk about how I solve problems in this class.					
Task Orientation	33. Getting a certain amount of work done in class is important to me					
	34. I did as much as I set out to do in this science class.					
	35. I knew what I was supposed to learn in this science class.					
	36. I was not ready to start this science class on time					
	37. I knew what I was trying to do in this science class.					
	38. I paid attention during this science class					
	39. I did not understand the work in this science class.					
	40. I knew how much I had to do in this science class					
Cooperation	41. I got along with my peers when doing assignment work.					
	42. I shared my books with my classmates in this science class.					

	43. When I worked in groups, there was teamwork in this science class.						
	44. I did not work well with my classmates in this science class.						
	45. I learned from my peers in this science class.						
	46. I worked with other classmates when doing homework for this class.						
	47. I got along with my classmates when we worked on class activities.						
	48. My classmates worked with me to achieve our class goals.						
Equality	49. The teacher answered my questions just as much as the questions of my peers						
	50. I got the same amount of help from the teacher as did my classmates.						
	51. I talked the same amount as my classmates in this science class.						
	52. I was not treated the same as my classmates in this science class						
	53. I got the same amount of encouragement from the teacher as my classmates						
	54. I talked in class discussions just as much as my peers in this science class.						
	55. My work got as much praise as other students' work in this science class						
	56. I got to answer questions just as much as other students in this science class						