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ABSTRACT

Based on concern for the equality of learning opportunities in laboratory work, this study aims to explore the meanings of learning opportunities from a theoretical literature review, and to investigate the distributions of learning opportunities from practical laboratory instruction. Considering both the nature of science activities and the psychological characteristics of students in Taiwan, the study discussed the meaning of learning opportunities from the perspectives of behavioral and cognitive engagement. The subjects of the study were junior high school laboratory students in Taiwan. The study methods included both quantitative and qualitative approaches, which were expected to obtain a thorough understanding of the issue of learning opportunities. During the interactions of students in the junior high school laboratory, students of higher status in class tended to hold better and more opportunities to learn, and were able to take advantage of learning resources in a more active way. On the other hand, students of lower status in class tended to take learning opportunities in a more passive way in processing higher level thinking and even tended to avoid learning resources. (Contains 11 references.) (Author/MVL)

Did they learn and interact equally? – A study of learning opportunities in a small group from the perspectives of behavioral and cognitive engagement

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Did they learn and interact equally? – A study of learning opportunities in a small group from the perspectives of behavioral and cognitive engagement

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Abstract

Based on the concern for the equality of learning opportunities in laboratory work, this study aims to explore the meanings of learning opportunities from a theoretical literature review, and to investigate the distributions of learning opportunities from the practical laboratory instruction. Considering both the nature of science activities and the psychological characteristics of the students in Taiwan, the study discussed meanings of learning opportunities from the perspectives of behavioral and cognitive engagement. The subjects of the study are junior high school laboratory works in Taiwan. The study methods include both quantitative and qualitative approaches, which are expected to obtain a thorough understanding of the issue of learning opportunities. During the interactions of students in the junior high school laboratory works, students of higher status in class tend to hold better and more opportunities to learn, and are able to take advantage of learning resources in a more active way. On the other hand, students of lower status in class tend to take learning opportunities in a more passive way in processing the higher level thinking, and even tend to avoid learning resources.

Introduction

From science philosophy, one of the features of science investigation is interaction between scientists. In the process of interaction, there would be some unexpected results happened, their advantages often beyond what single scientist did. The same situation will happen in the processes of students' science learning. Many teaching strategies try to enforce students' learning or understanding of science via group discussion and peers interaction. But, did every student benefit from the interaction processes? Did they share learning resources fairly? Small group work is a cornerstone of practice in inquiry-oriented science classrooms and not all small group structures in science classrooms provide opportunities for studying students' collaborative knowledge building, so, it is important to understand what limits and promotes students' learning in peer groups (Horgan, 1999).

Peer interaction

Classroom is where students' learning happened, it is also the main topic of educational researcher focuses. In 60s and 70s, the researchers paid more attention to investigate behaviors of teachers in classroom, and teaching skills that could improve students to engage in learning task with concentration and interest. Recently, more studies turn their focuses on students' interactions (Webb, 1989). From psychology of education, peer interactions provide students an environment to help and discuss with others. Peer groups also promote students to experience other one's idea and to challenge their own existed conception. And students will negotiate and solve problems by using more comprehensible language.

Many science education researchers placed great expectation on the learning style of peer interaction. Related study findings are proposed by several decades of researches on the social construction of science learning (Driver, Asoko, Leach, Mortimer & Scott, 1994； Kelly & Chen, 1999) , and on cooperative learning, inquiry-oriented group work (Roth, 1996；Richmond & Striley, 1996).

Equality of interaction

Many theories and studies indicate the importance of peer interaction in science learning, but is the process really successful like what we expected? Little attention has been given to the point, it needs a further clarification. Some research indicated that specific social roles and leadership styles developed within groups that greatly influenced the ease with which students developed scientific understanding (Richmond

& Striley, 1996）. Quantitative analyses of participation during groupwork and performance on unit tests show that high-status students had significantly higher rates of on-task talk and implementation (Bianchini, 1997）.

When students learned in a science laboratory, their ability, popularity, and sex are all the factors in affecting the acquirement of learning opportunities, distribution of education resources, and maintaining of social justice. I would like to focus attention on the clarification of learning opportunity definition, and explore the distributions of learning opportunities and implications in science laboratory.

Indicator of learning opportunities

To investigate distributions of learning opportunities, Newmann (1992) proposed that levels of engagement must be estimated or inferred from indirect indicators in terms of behavioral responses, cognitive processes, and interest. In the situation of this study, only two dimensions of task engagement were considered: (1)behavioral engagement ; (2)cognitive engagement.

Behavioral engagement indicator

We can identify student's behavioral engagement from expectation states theory (Berger, Wagner, and Zelditch, 1985, p.6-9), it proposed four items to identify behaviors that different status students showed up in interaction process. These items include: action opportunity, performance output, reward action, and influences. These items mean that: (1) action opportunities: chances to contribute to the solution of the group's problem; (2) performance output: attempts to solve the group's problem; (3) reward actions: communicated evaluations of such problem-solving attempts; and (4) influence: the changes of opinion after exposure to disagreement. This study focuses on laboratory work, so modifies definitions of these items to fit laboratory context. Table 1 summarizes these definitions and related action example.

Table1

Behavioral engagement indicator

Indicator	Definition	Action example
1. action opportunity	• chances to contribute to the solution of the group's problem	• to direct others doing something • to initiate some work by himself.
2. performance output	• attempts to solve the group's problem	• be directed by other's command. • to repeat what other's command. • to submit what other's command.
3. reward action	• communicated evaluations of such problem-solving attempts	• to controvert other's command. • to correct other's action.
4. influence	• the changes of opinion after exposure to disagreement	• to terminate dispute, controversy, or disagree.

Cognitive engagement indicator

To identify cognitive engagement, we can refer to Welzel's(1998) heuristic that allows us to describe cognitive engagement by means of ten levels of complexity. But in Taiwan's laboratory classes, there are only three cognitive levels to be considered. In addition to these cognitive complexity, there are also some nonsense dialogues and actions happened in interaction process, defined as "order maintain" here. Table 2 summarizes these definitions and related action examples.

Table2

Cognitive engagement indicator

Indicator	Definition	Action example
Order maintain	• to maintain order and accidental situation	• instrument snatching, squabble, asking about experiment procedure, or order maintaining
Level 1 cognition	• to set up and operate instrument	• following experimental steps to manipulate instrument
Level 2 cognition	• to record data, to observe phenomenon, etc.	• to record or write down experimental data.
Level 3 cognition	• to resolve dispute and to make judgement	• to change experimental steps, make judgement or forecast experimental phenomenon

Two-Dimension coding system of learning opportunities

By combining behavioral engagement indicators and cognitive engagement indicators together, a two-dimension coding system of learning opportunity is showed as Table 3.

Table3

Two-Dimension coding system of learning opportunity

Coding system	Action opportunities	Performance output	Reward action	Influence
Order maintain	0.1	0.2	0.3	0.4
Level 1 cognition	1.1	1.2	1.3	1.4
Level 2 cognition	2.1	2.2	2.3	2.4
Level 3 cognition	3.1	3.2	3.3	3.4

Setting and method

Classroom setting and data collection

In the studying setting, students all were allowed to manipulate experimental instrument and discuss with others. In laboratory class, there are 5-6 students in one group and six groups in one classroom. During 14-week period of observing and recording, students studied different topics and study data were taken from 8 classes. One group (six students) agreed to undergo more intensive observation, it came to be chosen as target group. These 6 target students were aged 14 to 15 and with mixed-ability.

To answer our question, video sequences relevant to the question of interest were transcribed including all observable activities. The findings of the study were based on direct observation and we did not interrupt the setting in observing procedure.

Method

Based on status characteristics theory(Wagner & Berger, 1993), the inequality in a classroom can be caused by the difference between sex, academic ability, popularity. And Bianchini (1997) also described that the status in a group is a combination of perceived academic ability and perceived popularity.

In this study, students had to fill out the 'classroom structure inventory'. This questionnaire had four simple items in it: 'whose science ability is better in your class?', 'whose science ability is worse in your class?', 'whose popularity is better in your class?', 'whose popularity is worse in your class?'. Students participated in this study had to nominate tree classmates in every item. To count everyone's nominating in these two dimensions (ability and popularity), and then transform to z-score. After that, using positive nominating z-score to subtract negative nominating z-score. Rating top 25% as 'high status (H)' students, middle 50% as 'middle status (M)'students, and 25% from the bottom as 'low status (L)' students. In the target group, there are two 'H's, two 'M's, and two 'L's.

Result

Distribution of learning opportunities

After taking 8 classes' data, distributions of learning opportunities were showed as Table 4. Inviting four related researchers to make 'interjudge reliability' test, internal consistency reliability estimates were computed as 0.812**. Besides, in the coding results, there were no 'influence' indicators appeared and also only few 'H' students performed in 'level 3 cognition'.

Table 4

Distributions of learning opportunities

	H1			H2			M1			M2			L1			L2		
indicator	**B1**	**B2**	**B3**	**B1**	**B2**	**B3**	**B1**	**B2**	**B3**	**B1**	**B2**	**B3**	**B1**	**B2**	**B3**	**B1**	**B2**	**B3**
C0	8	2	2	13	1	15	16	11	8	6	10	12	40	28	28	9	6	5
	12			29			35			28			96			20		
C1	108	14	10	142	41	41	93	38	26	61	16	8	74	31	22	15	29	4
	132			224			157			85			127			48		
C2	79	7	2	35	32	5	44	15	3	9	5		5	9	2	2		
	88			72			62			14			16			2		
C3	4		1			1												
	5			1														

B1: action opportunity B2: performance output B3: reward action

C0: order maintain C1: level1 cognition C2: level2 cognition C3: level 3 cognition

To go a step further, the researcher combined six students' distributions with 'H', 'M', and 'L' three classes distributions (Table 5).

Table5

Learning opportunity distributions of combined status

	High Status (H)			**Middle Status (M)**			**Low Status (L)**		
Indicator	**B1**	**B2**	**B3**	**B1**	**B2**	**B3**	**B1**	**B2**	**B3**
C0	21	3	17	22	21	20	49	34	33
	41(7%)			63(16.5%)			116(37.5%)		
C1	250	55	51	154	54	34	89	60	26
	356(63.9%)			242(63.5%)			175(56.6%)		
C2	114	39	7	53	20	3	4	9	2
	160(28.8%)			76(19.9%)			18(5.8%)		
C3	4		2						
	6(1.2%)								

* (%) represents the proportion of same status students in different cognitive level

Test of learning opportunities

1. test of goodness of fit

(1) single student

Test of goodness of fit in opportunity distributions of different students was showed as Table 6. We can find that there is significant different participation between different status students in the same cognitive level. It is obviously to say that students' opportunities are not equal in the same level.

Table 6

χ^2-test of learning opportunities

	H1	H2	M1	M2	L1	L2	χ^2	P 值
C0	12	29	35	28	96	20	123.9	.000**
C1	132	224	157	85	127	48	142.19	.000**
C2	88	72	62	14	16	2	152.96	.000**

**p<0.01

(2) combined status

After combining students' status, test of goodness of fit in opportunity distributions of different combination status was showed as Table 7. We can find that there is significant different participation between different statuses in the same cognitive level. Besides, the distributions showed a tendency of 'anti- symmetry' pattern, the pattern means that when the status becomes lower, low level cognitive participation rate will become higher. When the status becomes higher, high level cognitive participation rate will become higher.

Table 7

χ^2-test of different status learning opportunities

	H	M	L	χ^2	P 值
C0	41(18.6%)	63(28.6%)	116(52.7%)	40.54	.000**
C1	356(46.1%)	242(31.3%)	175(22.6%)	65.00	.000**
C2	160(62.9%)	76(29.9%)	18(7.1%)	120.40	.000**

(%) represents the proportion of same status students in different cognitive level **p<0.01

2.test of homogeneity of proportions

(1)single student

From test of homogeneity of proportions in learning opportunities of single student, we got χ^2=194.57 (p=.000**). It showed that there is significant different participation between different status students in the different cognitive level. When cognitive level becomes higher, the different gap tends to become bigger.

(2) combining status

From test of homogeneity of proportions in learning opportunities of combination status, we got χ^2=156.11(p=.000**). It showed that there is significant different participation between different status students in different cognitive level.

Discussion

Participation in order maintain (C0)

From my observation, I found that in 'order maintain' indicator, when status becomes lower, participation rate would become higher. This is because that laboratory setting is a frequently interactive environment. And every student in this kind of situation all have to find something to do even if he were not engaging in learning task. For high status students, they have many chances to show their talents in an interactive setting, but lower status students did not. If lower status students met some difficulties or obstacles in learning task, they night pay more attention to 'order maintain', which was only thing that they can do.

Although 'order maintain' is a necessary element to keep a group working, education resources would be wasted too much if it takes too much time to maintain order or deal with some trivial matters. If a learning group is too loose, the group will expend a great deal of time and care in doing some unrelated learning tasks and create few learning opportunities.

Participation in Level 1 cognition (C1)

From students' performances in level 1 cognition, it showed that when status becomes higher, learning opportunities they got become more. From students' performances in different items, there were not many differences between different status students in 'performance output' item. But in the 'action opportunity' item, higher status students tended to participate more than other status students did. It is possibly 'action opportunity' item emphasizes that learners got contributive chances to solve problems in a task 'actively'. And in the 'performance output' item, it showed that learners do something just 'passively' according to other's command without any argument. Besides, the meaning of 'reward action' is close to what 'action opportunity' means. It also emphasizes 'active' reward and has the same tendency as 'action opportunity'. Higher status students always have more freedom to dominate learning resources. On the contrary, and lower status students have few freedom.

Participation in Level 2 and Level 3 cognition (C2 and C3)

From Table 5, we can see the difference between higher status performance and lower status performance in C2 is far more different than in C1. 'Action opportunity' item is the key point in that kind of difference. This result showed that low status students had has been fading out of the learning task little by little in this cognitive level, and lower status students not only have little active 'action opportunity' but also have little passive 'performance output'. The gap between high and low status students in C2 is bigger than in C1. If we take a closer look at students' performances in C3, only higher status students showed some.

Implication

During the interactions of students in school laboratory works, we can find that students of higher status in class tend to hold better and more opportunities to learn, and are able to take advantage of learning resources in a more active way. On the other hand, students of lower status in class tend to take learning opportunities in a more passive way in processing the higher level thinking, and even tend to avoid learning resources. From these results, one may say that the invisible status structures existing in students will affect the distributions of learning opportunities indirectly.

Several decades of research on cooperative versus competitive learning structures have confirmed that cooperative learning has positive effects on students' achievement, problem solving and motivation to learn (Hogan, 1999). Cooperative learning method and some other investigating group instructions are really good teaching strategies to provide students opportunities for interacting with their peers and teachers. This study provides another perspective to evaluate the effect of group-work learning. It should be noticed that if we ignore the effect of status between students, we would not find out the inequality problems in learning opportunity. If some excellent students dominate most learning resources, lower status students will just gather together and talk about something nonsense. Can we say that this kind of instruction is successful?

The status between students is very obvious, and it is also stable and firm. We must try to alter this tough status by using a variety of instruction method, which will improve the effects of group-work instruction.

Reference

Berger, J., Wagner, D. G., Zeldtch, M. Jr. (1985). Expectation States Theory: Review and Assessment. In J. Berger & M. Zelditch Jr. (Eds.). *Status, Rewards, and Influence : How Expectations Organize Behavior*(pp.1-72). CA: Jossey-Bass.

Bianchini, J. A. (1997). Where knowledge construction, equity, and context intersect: Student learning of science in small groups. *Journal of Research in Science Teaching*, 34(10), 1039-1065.

Driver, R., Asoko, H., Leach, J., Mortimer, E. & Scott, P. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher*, 23(7), 5-12.

Hogan, K. (1999). Sociocognitive roles in science group discourse. *International Journal of Science Education*, 21(8), 855-882.

Kelly, G. J. & Chen, C. (1999). The sound of music: Constructing science as sociocultural practices through oral and written discourse. *Journal of Research in Science Teaching*, 36(8), 883-915.

Newmann, F. M. (Ed.). (1992). *Student engagement and achievement in American secondary schools*. New York: Teachers College Press.

Richmond, G. & Striley, J. (1996). Making meaning in classroom: Social processes in small group discourse and scientific knowledge building. *Journal of Research in Science Teaching*, 33(8), 839-858.

Roth, W. -M. (1996). Teacher questioning in an open-inquiry learning environment: Interactions of context, content, and student responses. *Journal of Research in Science Teaching*, 33, 709-736.

Wagner, D. G. & Berger, J. (1993). Status characteristics theory: the growth of a program. In J. Berger, & M. Zelditch, Jr. (Eds.). *Theoretical research programs : studies in the growth of theory.* CA: Stanford University Press.

Webb, N. M. (1989). Peer interaction and learning in small groups. *International journal of educational research*, 13(1), 21-39.

Welzel, M. (1998) The emergence of complex cognition during a unit on static electricity. *International Journal of Science Education*, 20(9), 1107-1118.

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