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Constructivist Feedback Practices: A Comparative Study of Chemistry Teaching in Cambodian General Public and New Generation Schools

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Considering chemistry teaching from a constructivist perspective, students learn abstract and complex concepts through the mutual construction between teacher and student dialogue, including teacher feedback. The teachers' feedback to students during the question-answer exchange greatly influences students' knowledge construction. New Generation Schools (NGS) was initiated in Cambodia in 2016 by mandating constructivist learning in education reform. In that process, this comparative study measured the different changes in the performance of Chemistry teachers' feedback between General Public Schools (GPS) and NGS. Six chemistry teachers from GPS and three from NGS volunteered to audio-tap and videotape their lessons. Verbal transcriptions of teachers' questions and statements were analyzed interpretively using the framework by Chin (2006) as an analytical lens. The commonality was that both groups provided neutral feedback on students' correct answers. Thus, NGS teachers challenged students to provide the reason for those correct answers. The difference was that GPS teachers typically used directed feedback, whereas NGS teachers facilitated feedback by responding to students' insufficient answers. Various forms of feedback in this study could serve as a practical framework, supplementing Chin's model and being utilized in professional development courses in Cambodia or elsewhere. The implication was that teachers armed with this practical feedback framework could confidently enhance their feedback strategies within the constructivist learning approach.

Keywords: teaches' feedback, constructivist learning approach, IRE/F pattern, chemistry, Cambodia

INTRODUCTION

The essence of the constructivist learning approach in science learning is that the children explore science concepts together through conversation with each other and with the teacher to self-construct the meaning of knowledge (Osborne, 1985). This

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approach posits that the teacher's role is to help their students construct new understandings for themselves actively. The teachers engage students in an interaction called classroom discourse through three exchange moves (Dori et al., 1999). The first move is the teachers' initiation of the questions (I move) to elicit or diagnose ideas from students on the concept to be taught. Then the second move is students' responses to teachers' questions, called (R moves). This move refers to the students' turn who express their ideas either conceptions or misconceptions responding to teachers' questions. The third move is followed by teachers' feedback, known as (the E/F move). It turns to the teacher's responsibility to evaluate students' responses or prompt more students' responses such as justification, logical explanation, or further investigation. The third step of the classroom sequence (teachers' feedback) is a crucial point for opening the inquiry learning flow and promoting students' cognitive process (Bloom et al., 1956; Tsui et al., 2004), which is aligned with what constructivist learning is.

Within education reform, Cambodian education has introduced a constructivist teaching approach, for almost two decades. The reform started by focusing on teacher quality. One action plan among others of teacher policy action plans was implemented in 2018 by transforming from the teacher training formula 12+2 (12 years of education plus two years of training at teacher education centers) to 12+4 for pre-service teachers training. This formula transaction aims to equip and deepen pre-service teachers' understanding and practice with more constructivist teaching approaches and subject matter knowledge courses by shifting from the 28% Pedagogical content knowledge course in the 12+2 program to 65% in the 12+4 program. However, the first trial of the 12+4 program started with only two teacher education colleges among 23 teacher education centers in the whole country (MoEYS, 2024).

Cambodia has also taken a step toward quality of teaching and management at school-level under the influence of the international school-based management (SBM) movement, which includes both the charter school movement in the United States as well as innovative schools in Southeast Asia by creating "New Generation Schools" (NGS) in 2016; and it has reached 11 NGSs up to present time (2024). According to the study by Donaher & Wu, (2020), they mentioned that NGS creates a system of teacher professionalism through the government framework, operational autonomy, high professional standards for principals and teachers, a rationalized resource allocation framework, and strict accountability requirements with a required annual accreditation process to develop students' critical thinking skills and cognitive competencies in STEM (Science, Technology, Engineering, and Mathematics). The keys to operating NGS are private tutoring and student purchases of teacher goods are mandatory abolished (e.g., study papers, cake, etc.). The staff is intrinsically motivated and dedicated to serving students well. For example, NGS teachers should be willing to incorporate Information and Communication Technology (ICT) and constructivist pedagogy into their classrooms as compulsory.

However, teachers' practice at General Public Schools following the constructivist approach remains limited. It has been elaborated by the studies of Benveniste et al. (2008) and Bunlay et al. (2010) claimed that most activities teachers provided in the class were to ask students to copy the instructions from the blackboard or textbooks.

Students spent roughly one-third of the total time receiving instruction—or 21 percent of the total class time—in copying activities. Based on Tandon and Fukao (2015) highlighted that primary school teachers' questions, used for one-hour lessons, are mainly conducted with management classroom questions rather than academic questions for teaching the concept. The teaching activities were limited, with the opportunities for students to interact questioningly, engage in creative thinking, or explore concepts.

From that process, we do not know much about the different changes between GPS and NGS in terms of their teaching practices at the classroom level. The explanation of how teachers deliver questions for teaching science is quite unclear, and there were only studies that highlighted context, design, planning, and learning outcome, except for the performance of practical teaching in a classroom context (Donaher & Wu, 2020). To some extent, the number of empirical findings has scattered on mathematical teachers' pedagogical content knowledge, either knowledge or practice, Sin (2021), Van et al. (2018) and Song (2015), and the other study emphasized teachers' working conditions, competencies of instructional strategies, and social challenges (MoEYS, 2015; McNamara & Hayden, 2022). The investigation into teachers' questioning discourse practice, especially regarding teacher feedback in GPS and NGS science classes, remains under-explored.

From that viewpoint, such measures need to be taken to see how Cambodian teachers' practice has been implemented at the classroom level from the context of General Public Schools and New Generation Schools. Therefore, this study aims to compare the performance of teachers' feedback for teaching chemistry at the lower secondary level in Cambodia between GPS and NGS. In response to the objective above, the central question in this research is, "How do teachers deliver feedback at GPS and NGS for teaching chemistry at the lower secondary level in Cambodia?"

Literature Review

Feedback is conceptualized as "information provided by the teacher regarding an aspect of students' performance or understanding" (Hattie & Timperley, 2007). The main purpose of feedback is to bridge the gap between students' understanding and skills with learning objectives. It is a consequence of students' performance, and its impact on learning and achievement can be positive or negative depending on how it responds to students' answers (Hattie, 2009a; Brown et al., 2016). Based on Scott (1998), it was mentioned that teachers' feedback might function differently, depending on whether it pays attention to students' support of knowledge building or focuses on knowledge transmission from teacher to student. In authoritative or triadic dialogue as known as the Initiation-Response-Evaluation (IRE) sequence, the teacher initiates discourse in the classroom, sets the topic for a lesson, controls the direction, and decides which response will be the acceptable answer (Dillion, 1988). Teachers' feedback in the IRE sequence is directed to the learning process. The teachers invite students to answer questions, and students' responses remain brief and teacher-framed. They mainly focus on evaluating the correctness of the concept and prefer to conduct a series of questions to reach one specific point of view as an expected answer or move directly to the next instruction.

The IRE sequence is the most obvious in teacher-led classroom discourse, and most teachers' questions are instructional, factual, and review questions (Lemke, 1990).

However, if the discourse is oriented toward constructivist learning approaches, the teachers' feedback surely facilitates the learning process. The teachers invite students to respond, consider their responses, and possibly engage in turn-taking interactions with students to create a dialogue on the concept (Scoot, 1998). Facilitated feedback does not focus directly on the task, process, and self-regulation aspects of learning; thus, directly involving the learner in the knowledge-building process (Mortimer & Scott, 2003).

Educators mostly agree that teachers' feedback has a great influence on students' construction of knowledge focusing on developing students' critical thinking and allowing students to construct conceptual knowledge independently rather than learning the facts of scientific ideas (Hunkins, 1966; Black, 2004).

A growing line of classroom discourse research comes from teacher talks and teacher-student interaction, which plays a crucial role in students' meaning-making of a concept (Cazden, 2001; Long, 1980). Over the last decades, research on classroom discourse, primarily emphasizing teachers' questioning behaviors and types of questions (Stevens, 1912), effective questioning strategies and testing the effectiveness of questioning strategies interventions for training teachers (Wilen, 1991), developing systemic observation instruments for use in investigating teachers' questions (see review by (Gall, 1970), and explored the relationship between the type of questions teachers ask and students' learning achievement (Winne, 1979). However, investigating the specific move of classroom discourse, which elaborates on how teachers react to students' responses, seems fragmented. Carlsen (1991) argued that the research on teachers' questioning attempted to characterize and count the number of teachers' questions without a plausible explanation of each question flow is meaningless, and if the students' responses are neglected to investigate. The essential role of classroom discourse lies in the fact that teacher questions do not occur alone; they are associated with how teachers react to students' responses, primarily when the learning is focused on a constructivist learning environment. The study by Edwards & Westgate (1994) emphasized that the feedback (F) move is an essential teaching move in which the teachers evaluate students' responses and provide supportive feedback that provokes deeper thinking beyond confirming the correctness of the concept. Providing classroom feedback has been found to potentially impact students' learning, with an overall effect size of d = 0.79 (based on 12 meta-analyses, 196 studies, and 6972 effect sizes) (Hattie, 2009b). The current chemistry syllabus focuses on constructivist approaches to teaching chemistry where learners are expected to participate actively in the construction and acquisition of knowledge. The F move is crucial for teaching chemistry due to the complexity and abstraction of chemistry concepts. The chemical concepts are viewed in three levels: 1) macroscopic view, 2) microscopic view, and 3) symbolic view. To enable students to explain the relationship among these three views, visualize and explain the microscopic part (particle behavior), and understand the symbolic view, the teacher requires intellectual efforts and skills to think about conceptual understanding activities (Rahayu & Kita, 2010). This process required formulating questions for particular topics and considering the students' responses. These moves engaged

students in more cognitive roles, such as proposing hypotheses, initiating investigations, and generating findings that enhance learning achievement.

METHOD

To investigate constructivist feedback practices in between the performance of Chemistry Teachers in Cambodian General Public and New Generation Schools, this study adopted qualitative research (Creswell, 2012) by analysing inductively communication episodes between teachers and students, focusing on teachers' questions and responses to build a naturalistic account of teachers' feedback patterns for teaching Chemistry at lower secondary school level.

Only general public schools and new generation schools were involved in this study due to the purpose of comparison between the performance of teachers in those schools. Several general public lower secondary schools were randomly selected based on the school that has many experienced teachers, with more than ten years of teaching chemistry. There were six General Public Lower Secondary School (GPS) teachers (coded as T1, T2, T3, T4, T5, and T6) volunteered to participate in this observation study and agreed to provide one video for each.

The author selected an NGS school in a city that has a higher student passing rate in national examinations grade 12. There were three (NGS) teachers (coded as T7, T8, and T9) who volunteered to participate and provided two for each in this study.

Each teacher's demographic information is shown in Table 1 below.

Table 1
Demographic information of the sample in this study

Demographic information	General Public Lower Secondary Schools						New Generation School		
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Video codes	V1	V2	V3	V4	V5	V6	V7-V8	V9-V10	V11-V12
Gender	F	F	F	F	M	M	M	M	F
Age (years)	>46	>46	36-46	>46	>46	>46	<25		
Year in teaching experience (years)	>10						<3		
Teacher training program	12+2*	7+3*	12+2	12+2	7+3	7+3	12+4*		
Number of students/classes	33	33	40	41	40	47	35	36	35

**7+3: implemented from 1982-1988 The program is for issuing a certificate of lower secondary school teacher (7 years of general education+3 years of the teacher training program)*
**12+2: implemented from 1997 up to the present. It is for issuing a lower secondary school teacher (12 years of general education+2 years of the teacher training program)*
** 12+4: implemented from 2018 up to the present for becoming lower secondary school teachers (12 years of general education + 4 years of the teacher training program)*
**Class activities refer to the involvement of students with teachers' questions, such as sharing answers, giving presentations, explaining their ideas*
**N/A: Not applicable*

The author and colleagues received a consent form from each school and each teacher to conduct an observation class. The observation and video recording lessons were conducted according to the schedule provided by each school. The teaching lessons were recorded using a camcorder. The teaching lessons that were recorded were "physical change of matters," "Solution," "Matter," "Periodic table," and "Carbon." The authors used a camcorder put at the back of the classroom and facing the teacher and students back. This helps capture teachers' activities and students' voices seated at the back of the classroom. The authors used another video camera to record whenever the teacher circulated among groups to talk to individual students. The video camera recorded all the teachers' and students' activities during the lesson. Each lesson's video lasted from 40 to 45 minutes.

All the lessons were repeated with careful listening by the author, which is an important first step for transcription. This familiarity with data and attention to what is there rather than what is expected can facilitate realizations or ideas that emerge during analysis. Transcribing takes at least 3 hours per 40-45 minutes of classroom talk and the author transcribed it verbatim into Khmer and translated it into English. Three Cambodian science teacher trainers checked and finalized the translation. The transcription was organized in a paragraph of conversation between teacher and students. What teachers and students talk included in the transcription.

Before performing feedback analysis, the authors classified all teachers' questions in each class based on Bloom's taxonomy (Anderson, 2001) to check the preference of type and level of questions conducted by teachers. The lower-order questions consisted of remember, understand, and apply levels. The higher-order level included analyzing, evaluating, and creating. The next step is defining the subject for feedback analysis. From the communicative episode between the teacher and students, the subject for analysis cantered on teachers' responses in the third move of the classroom sequence (IRF). The teachers' responses could be questions or statements. The categorization of feedback was analyzed through the existing framework by Chin (2006) as an analytical Lens. The feedback is classified into two domains, directed and facilitated, which result in four feedback types (a-d). Feedback types (a) and (c) are characterized as directed feedback, and types (b) and (d) are classified as facilitated feedback (See more in Table 2). If the feedback occurs differently from the framework of Chin, the purpose of feedback will be analyzed and generated as the new theme through the content analysis. The frequency of occurrence of each feedback was counted to notify the typical feedback conducted by each group of teachers.

Table 2
Type of science teachers' feedback by Chin framework

Type of students' responses	Type of feedback	Feedback types	Description of feedback
Correct answer	(a) Affirmation-direct instruction	Directed	Teachers affirm the correct response with comments such as "okay," "that is good," or "restating students' answers." Alternatively, the teacher provides a series of questions that build on students' previous responses in direct instruction to the next step.
A mix of correct and incorrect answers	(b) Extension by responsive Extension by zooming in and out	Facilitative	Teachers Accept students' responses, followed by a series of related questions that build on previous ones to probe or extend conceptual thinking.
Incorrect answer	(c) Explicit correction-direct instruction	Directed	The teacher points out students' mistakes and provides correct answers with some explanation.
	(d) Constructive challenges,	Facilitative	The teacher challenges students to think through the question "how," and the teacher brings all students' ideas to discuss with the class. The series of questions attempts to make students self-evaluate their thinking, reflect on the incorrect answers, and discover why.

Source: Feedback type by Chin (2006), page 1326

FINDINGS

General Public Lower Secondary Schools:

The proportion of all teachers' questions conducted in each class at GPS was 96% lower-order questions and 4% higher-order questions. The teachers in GPS provided various feedback to students' responses as shown in the description below.

The teachers provided "affirmation-direct instruction" and "direct instruction" feedback when students provided correct responses. Affirmation-direct instruction occurs by acknowledging students' answers before moving to the next instruction as planned. Affirmation of students' answers could be praising, restating, accepting answers, and seeking peer approval. An example of praising feedback, such as "That is good," was highlighted in the excerpt below, extracted from one episode of video 4 on the topic of the mixture and its characteristics.

> *Quote from classroom interaction:*
>
> *T: What is mixture?*
>
> *S: Mixture is the combination of two or more things together which have no*
>
> *Chemical reactions between each other.*
>
> *T: Thank you. Sit down; that is good. Let me continue with the other question.*

Some teachers at GPS provide Direct instruction as feedback when students make correct responses. The teachers do not acknowledge students' responses, whether praising or repeating them. The teacher moves directly to the next instruction by adding

a detailed explanation to the student's answers. For example, in the case of video 4, which taught the topic of the mixture and its characteristics, the teacher asked, "How many types of the mixture?" The students answered, "two types: homogenous and heterogenous mixture." Without providing any affirmation statement, the teacher moved to the next instruction plan by explaining what is homogenous and heterogenous and the criteria for classifying this mixture.

When students provided incorrect answers, the teachers conducted feedback called Explicit correction-direct instruction. This feedback responded to students' answers by evaluating students' answers that were wrong and directly providing the correct answers. For example, the teacher asked students to classify compounds and elements in one episode in video 5 on the mixture and its characteristics. The question was, "Between Zn and H_2O, which is an element, and which is a compound?" The students answered that Zn is a compound, and H_2O is an element. The teacher replied that this was an incorrect answer. Following that response, the teacher elaborated that Zn is an element, and H_2O is a compound because an element is composed of a single atom, such as Zn. In contrast, a compound is composed of many types of atoms, such as the case of H_2O, which comprises an atom of Hydrogen and Oxygen. Similarly, in video 2, the physical change of matter is discussed. When the students fail to answer the teacher's question, "What will it change if we boil water?" The teachers expressed the statement like "eish" and decided to provide the correct answer by saying, "It will become water vapor. Because when we boil water, it evaporates and changes to water vapor. This is called the physical change of water."

When the students provided an incomplete answer, a combination of correct and incorrect, or partially correct answers, the teacher pointed out students' mistakes and kept providing a series of close-ended questions to help students reach the correct answer. This technique has been called explicit correction by the question–direct instruction. An example of this feedback appeared in video 1 on the topic of the mixture and its characteristics was shown in the excerpt below:

Quote from classroom interaction:

T: What is a mixture?

S: A mixture is everything except pure substance.

T: A mixture is everything except pure substance; it was correct but not entirely correct. When you combine chia seeds and water, do you see any change?

S: change

T: Change to what?

S: Oh, no change

T: Then the mixture has no chemical reaction, is it right?

S: Yes

T: Okay, a mixture is a combination of two or more substances without having a chemical reaction between each other.

To a sum extent, In the GPS class, teachers conducted four types of feedback responses to students' answers or ideas. The high frequency of feedback that teachers used was the feedback that responded to the correct answer. The students tend to make correct answer based on the tendency of using lower order questions.

Table 3
A frequency of occurrence of each feedback conducted by GPS teachers

Video Code	Type of feedback and frequency of occurrence (times)			
	Affirmation-Direct instruction	Direct instruction	Explicit correction-direct instruction	Explicit correction by question – direct instruction
1	6	1		2
2	3	3	3	1
3	7	1		1
4	5	3		
5	3	4	1	
6	2	4		
The total frequency of occurrence in each feedback	26	16	4	4
Percentage%	52	32	8	8

New Generation Schools

The proportion of all teachers' questions conducted in each class at GPS was 82% lower-order questions and 18% higher-order questions. The findings of teachers' feedback are described separately based on the type of students' responses. The frequency of each feedback occurrence was calculated in each video lesson, as shown in Table 4.

Two types of feedback were provided by teachers responding to students' correct answers: 1) affirmation-direct instruction and 2) challenging instruction. In affirmation-direct instruction, the teacher cheers and praises the correct answer, restates the answers to the whole class, or seeks confirmation from other peers by providing the same questions before proceeding to the next instruction step.

Examples of cheering and praising words are "Clap hands for our friends" and "Thank you for your answer; it is right," As evidenced in video 11, the teacher asked students who created the periodic table and when it was created. The student answered that the periodic table was created by Dmitri Mendeleev in 1869. The teacher asked all students to clap their hands for this answer and said, "That is correct, thank you. An example of seeking confirmation from other peers is found in video 10, where the teacher asked students to show the location of metal in the periodic table. One student responded to the teacher's question correctly. However, the teacher kept requesting a few other students to answer the same questions to ensure the correctness of the answer among the peers. The other case of responding to students' correct answers was challenging instruction by providing why questions for students to explain their answers to ensure

their conceptual understanding. For example, in the case of video 9, the teacher was teaching about the matter. The teachers showed pictures of a few things, such as buildings, books, and glasses, and asked students what these are called. A student answered, "Matter." Even though the answer was correct, the teacher kept asking the student, "Why do you call it as matter?". After the students responded to the why question, the teacher kept asking them to justify the reason behind their answer until the teacher could make sure students understood the concept.

When the students provided an incorrect answer, the teachers did not point out the mistake directly and correct the answer. They conducted a constructive challenge by requesting students to think through the question "how," and the teacher brought all students' ideas to discuss with the class. The series of questions attempts to make students self-evaluate their thinking, reflect on the incorrect answers and discover why. Doing this allowed the students to evaluate their answers and reflect on their mistakes. For example, in video 11 on the periodic table topic, there was a constructive challenge episode, as shown in the excerpt below:

> *T: asked how elements were arranged in the periodic table*
>
> *S: Elements in the periodic table were arranged based on a mass atom.*
>
> *(The answer was incorrect, and the correct answer was supposed to be that the elements were arranged based on the* ***atomic numbers****, the integers of which are equal to the positive electrical charges of the atomic nuclei expressed in electronic units.)*
>
> *T: Are elements arranged based on the mass of the atom?*
>
> *S: Yes, the mass of an atom*
>
> *T: How about Tealium and Idiom? Look at the mass of atoms. Moreover, how do these elements were arranged?*
>
> *S: Hmmmm, their arrangement is not based on the atom's mass.*
>
> *T: OK, so what could be the core reason for element arrangement? Could anyone share your ideas about this?*
>
> *S: If the problem is Te and I, the other answer could be based on atomic number.*
>
> *T: Why do you say so?*
>
> *S: I see the arrangement of Te and I based on the increasing number of atomic numbers.*
>
> *T: That is right. First, they arranged elements based on atom mass, but there was a problem with Te and I; therefore, the arrangement of elements was based on atomic number. You can check the other element's location in the periodic table. Everyone, can you catch it? Or do you have any questions?*

Noticeably, when the students provided an incomplete answer, such as a combination of correct and incorrect answers or a partial part of correct answers, the teacher did not directly tell the students the correct concept. However, the teacher used feedback, which extended students' thinking and was called extension by responsiveness. The teachers ask a series of questions followed up on students' responses to probe and extend

students' thinking. For example, in the case of video 7, one episode of extension by responsive as shown in except below:

T: Why did we create a periodic table?

S: We can guess its characteristics through the collection of elements

T: Could you tell me more about what kind of characteristics?

S: It is like an atom and mass.

T: How do these characteristics relate to the creation of the periodic table?

S: We collect the elements with similar characteristics in the same column.

T: Then what characteristic do you mean?

S: The physical and chemical characteristics of elements. It is easy to find elements with similar characteristics.

Table 4
The frequency of each feedback session conducted by NGS teachers

Video Code	Type of feedback and frequency of occurrence (times)			
	Affirmation-Direct instruction	Extension by responsive questioning	Constructive challenge	Challenge instruction
7	3			6
8	3			6
9	1			6
10	9	2	1	2
11	9	2	1	
12	1	2		6
The total frequency of occurrence in each feedback	26	6	2	26
Percentage%	43	10	4	43

In NGS class, even though the students provided the majority of correct answers, the teachers not only used affirmation-direction feedback but also challenge instruction to help students have in depth understanding of the concepts.

DISCUSSION

This study was undertaken to understand the various ways of delivering feedback between teachers at GPS and NGS using the Chin feedback framework as an analytical lens (2006). This study's findings have added various forms of directed and facilitated teacher feedback to the existing Chin (2006) framework. "Direct instruction and Explicit correction by the question-direct instruction" are direct feedback aiming to lecture on and verify the concepts. The added facilitated feedback was "challenging instruction," which aims to challenge students' thinking through the question "why" even though they answer correctly. The findings in this study show some characteristics of feedback delivered by teachers.

Feedback as neutral responses

Both groups of teachers implemented neutral feedback to the students when they provided correct responses, 52% by GPS and 43% by NGS teachers. Neutral feedback was neither directed nor facilitated; it encouraged or praised the students' effort, which did not provide information on improving the performance of the task (Kluger & DeNisi, 1996; Yilmaz, 2023). It is rarely effective when students' attention is drawn to the self and may even have negative consequences, such as distracting the learner from the task and encouraging effort avoidance behavior to minimize the risk to the self (Black & Wiliam, 1998).

Feedback indicated classroom discourse patterns.

Apart from praising the answer, the teachers at GPS provided direct instruction for about 32%. Nevertheless, the teachers at NGS probed more students' elaboration by asking questions "why" in their responses, about 43% among all types of feedback. In the case of NGS teachers, it is reflected in teachers' concern about students' responses, which possibly responded without passthrough logical thinking. Even though the students are motivated to express their ideas in class, they still have some limits to expressing their opinions due to the culture of actively expressing ideas (active learning), which has just been introduced to them (Sot et al., 2022). In Cambodia's classroom, sometimes the students try to reach the correct answers by repeating the answers from the textbook without applying the questions to their thinking process (Song, 2015). To ensure conceptual understanding and allow students to extend their conceptual understanding, the teachers at NGS applied the challenge instruction by following up with questions "why" even though they gave correct answers. Providing a follow-up question "why" is derived from the Socratic questioning technique, which tries to extend students' thinking and throw the responsibility of thinking back to the student (Holme, 1992).

The GPS teachers evaluated the students' answers when they gave insufficient responses. Teachers pointed out mistakes or directly corrected them by elaborating on the concept's correctness or asking a series of closed-ended questions to reach the expected answer, about 16% among all types of feedback. The students did not have a chance to confront their prior ideas or insufficient answers with the scientific ones because teachers did not provide follow-up questions or probe more student responses. The flow of evaluating students' responses has been indicated as an IRE sequence in the classroom discourse. Mehan (1979) and Lemke (1990) elaborated on this sequence, stating that "the teacher primarily uses closed questions that are information-seeking, require a predetermined short answer, and are usually pitched at the recall or lower-order cognitive level". The teachers followed students' responses with commands and explicit corrections or direct instructions such as "You must," "You have to," or "This concept is like this," which negatively affects deep learning and students' performance (Wijnia et al., 2001). IRE sequence commonly occurs in traditional classroom-oriented practices, often perceived to have suppressive effects on students' thinking as teachers' feedback tends to be judgmental comments and verifying the concept (Mory, 2003). This implies that GPS teachers are still dominant in traditional classroom-oriented practices. It is important in the learning process when students fail to make correct responses, it is a corner point for teacher to create a chance to help students construct

knowledge. The teachers could not just evaluate the answer, whether it is right or wrong, they need to consider the sequence of responses to students' answers. Creating an environment that allows students to confront their prior knowledge or wrong answers with the scientific concept is crucial for helping students reconstruct the teachers' feedback could be in questions or statement which help students to resolve inconsistent views by establishing relationships between existing knowledge and a new concept (Yip, 2004). This type of feedback offered as possible mechanisms for triggering levels of students' engagement, which involved students in cognitive processes, such as asking for clearer information, and providing and responding to feedback to problem-solve solutions (Dang et al., 2022). In such cases, there was evidence from the NGS teachers who conducted feedback to facilitate the learning process. When students provided incomplete or incorrect answers, the teachers did not evaluate the responses explicitly; instead, they provided follow-up questions probing students' responses. Those facilitated feedback and instruction such as "You can," "Could you elaborate more," "You should," and "What do you think?" which positively affect students' learning and performance. This type of feedback has been found in the Singapore classroom context. The teachers were trained in questioning-based courses for inquiry lessons, and the teachers and students were oriented toward a constructivist learning approach. Chin (2006) described two cases of grade 7 science teachers who could provide facilitated feedback, such as constructive challenge and extension, using responsive questioning when students could not provide correct responses. This case is similar to the context of the New Generation School in Cambodia, where the school provided enough time to conduct constructivist teaching activities in each science class. The school is oriented by a constructivist teaching approach as mandatory. The teachers tried to follow up with their responses with the question, "Why do you think like that? Alternatively, "Why is that so?" to probe their reason and explain the concept more logically. According to the initial and in-service training policy at NGS, all science teachers were trained in questioning-based approaches, such as Bloom's taxonomy and Socratic questioning, before entering the schools, and students are motivated to communicate actively with teachers through the teaching and learning dialogue. The initial training and in-service training in terms of professional development in each school could be a crucial factor in helping teachers obtain the necessary competencies in conducting a constructivist approach, especially in helping students construct knowledge themselves. In 2011, the World Bank's Systems Approach for Better Education Results (SABER) analysis of Cambodia indicated that teacher training programs did not include the sufficient practical professional experience to help teachers transition from learning to teaching (Maclean et al., 2022).

This evidence suggested reconsidering the professional development system, which enhances the practice of classroom discourse, especially in the context of teachers who are still dominant in traditional class-oriented, such as the case of GPS teachers. The characteristics of professional development in NGS could be the lessons learned for better implementation of facilitated feedback at GPS practices. As evidence in the study by Chin (2006) mentioned teachers' concerns about their knowledge of the subject matter, challenging them with students' complex questions if they proceeded with feedback more than evaluated and direct instruction. In addition to the professional

development program, the teachers might have concerns about the curriculum implementation, which made them think about the transmission of knowledge rather than facilitated knowledge construction. The teachers described that providing more follow-up questions required more time and effort in each class session, which led to failure to finish the curriculum course on time.

Based on the discussion mentioned above, traditional classroom teaching, such as the case of GPS teachers, tends to provide feedback directed and neutral feedback (rather than facilitated) to the learning processes. Directed feedback evaluates students' answers by focusing on their state of achievement, whether correct or not. The information for communication in this feedback does not carry information other than the process of verifying the concept, direct instruction, and explicit correction (by statement or eliciting through close-ended questions). Thus, teachers oriented to a constructivist approach, such as NGS teachers, tend to balance neutral and facilitated feedback. Facilitated feedback was not for evaluating students' answers but to help guide students in revising and constructing knowledge (Shute, 2008). Moreover, the students who received facilitated feedback also achieved higher module grades than the students who received only directed feedback. Therefore, probable that the encouragement of facilitated feedback enhanced students' learning achievement (Cobbold, C., & Wright, L., 2021). The nature of feedback consisted of questions or information that engaged students to perform more advanced thinking skills, such as extension through responsive questioning and constructive challenge feedback.

CONCLUSIONS

The commonality of feedback provided by the two groups of teachers was neutral feedback, which was found to be affirmation-direction. Both groups cheered students' efforts and praised their answers when students made correct responses. Praising students' answers typically occurs in the Cambodian school context, either in traditional or constructivist teaching approaches. Thus, there were some different feedback practices between GPS and NGS teachers when students could not provide correct responses. The teachers at GPS are dominant in correcting students' mistakes directly or by a series of closed-ended questions to reach the expected answers. Nevertheless, the teachers at NGS preferred facilitated feedback by using follow-up or related questions on students' responses to probe more responses and extend conceptual understanding. Teacher feedback is essential in the science teaching process for opening the flow for students to develop their thinking skills and construct knowledge (Hargreaves et al., 2000). Teachers need to have a well-understood way of delivering feedback; thus, balancing directed, facilitated, and neutral feedback seems challenging, especially from the perspective of traditional classroom teaching. These results were uniquely featured and contextualized to the particular classes and teachers at the time of the study, and the findings were not generalized across the whole country. The various forms of feedback in the follow-up move of the IRF format of teaching exchange in this study could serve as a practical framework, supplementing Chin's existing model and being utilized in appropriate situations such as in future professional development pre-service or in-service programs in Cambodia or elsewhere. These findings imply that teachers

working to improve their feedback strategies may find multiple opportunities within a constructivist learning environment.

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