International Journal of Evaluation and Research in Education (IJERE)
Vol. 12, No. 2, June 2023, pp. 979~990
ISSN: 2252-8822, DOI: 10.11591/ijere.v12i2.23042

Uncovering pedagogical gaps in a chemistry classroom: Implications for teaching and learning

Eng Tek Ong[1], Charanjit Kaur Swaran Singh[2], Rosdy Wahid[3], Muhamad Ikhwan Mat Saad[4]
[1]Department of Education, Faculty of Social Sciences and Liberal Arts, UCSI University, Kuala Lumpur, Malaysia
[2]Department of English Language and Literature, Faculty of Languages and Communication, Universiti Pendidikan Sultan Idris, Tanjong Malim, Malaysia
[3]Deputy Director General's Office, Ministry of Education, Putrajaya, Malaysia
[4]Department of Biology, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, Tanjong Malim, Malaysia

Article Info

Article history:

Received May 4, 2022
Revised Dec 27, 2022
Accepted Jan 16, 2023

Keywords:

Chemistry education
Classroom observation
Pedagogical gaps
Teaching practices
Teacher education

ABSTRACT

This study was carried out to uncover the pedagogical gaps by characterizing the teaching practices of chemistry within a teacher education institution and subsequently, identifying the prevalent, non-prevalent and unobserved teaching practices. Accordingly, this implementation study employed the classroom observation method. The one-semester implementation of 11 chemistry lessons of a university lecturer was observed using a psychometrically-validated observation checklist comprises 50 items or indicators that measure six principles (dimensions). The use of the observation checklist entails checking whether each indicator is observed or otherwise during classroom observations. With a frequency of more than 25% to be considered prevalent, the findings indicate that the lecturer prevalently "maintained a scaffolding of instructional alignment" (62.5%), "offered quality learning environments, resources, and technology" (57.1%), and "promoted positive beliefs, attitudes, and behavioral patterns" (54.5%). However, it was a non-prevalent practice in "encouraging intellectual curiosity" (8.3%), and "promoting an atmosphere of critical thinking and inquiry" (14.3%). The practice of "offering a varied learning atmosphere" was, regrettably, non-existent (0%). The pedagogical gaps uncovered are discussed in terms of the needed customized staff development on teaching and learning in teacher education, particularly the content coverage of pedagogy (or teaching models), and the pedagogical coverage of pedagogy.

Corresponding Author:

Charanjit Kaur Swaran Singh
English Language and Literature Department, Faculty of Languages and Communication,
Universiti Pendidikan Sultan Idris
35950 Tanjong Malim, Perak, Malaysia
Email: charanjit@fbk.upsi.edu.my

1. INTRODUCTION

Malaysian government is dedicated to reforming its education system over the next 1.5 decades in order to prepare Malaysian students in a well-rounded sense so that they are fully equipped with the 21st century skills needed to compete with the finest in the world [1]. As a result, under the National Philosophy of Education, the education system given must be capable of developing six important traits in Malaysian students (knowledgeable; able to think critically and creatively; imbued with leadership skills; capable of communicating with the rest of the world; inculcated with high moral values, ethics and spirituality; and impregnated with a sense of nationhood), so that they might ultimately be successful. Meanwhile, the aspired key attributes to succeed and compete at a global level are knowledge, thinking skills, leadership skills, bilingual proficiency, ethics and spirituality, and national identity [1].

In the quest to transform its education system, various initiatives were undertaken by the Malaysian Government to identify the difficulties and shortcomings in the educational system and come up with solutions. Based on these findings, the Malaysian Ministry of Education developed the Malaysia Education Blueprint [1], which outlines the ambitions, strategies, and initiatives for improving the National Education System. One of the aspirations for the Malaysian Education System is that of "quality" which has been operationally defined as attaining, "… the top third of countries in terms of performance in international assessments, as measured by outcomes in Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA), within (the next) 15 years" [1].

The 8th grade average scale scores in science achievement for Malaysia in 1999, 2003, 2007, 2011, 2015, 2019 against the TIMSS Centre Point of 500 were 492, 501, 471, 426, 471, and 460 correspondingly [2]. Accordingly, Malaysia's results in the TIMSS have consistently been significantly lower than the TIMSS 8th grade scale center-point of 500, with the exception of 2003. A very sharp decline in science achievement was observed in 2011 whereby Malaysia was ranked 32nd position in 2011 among 63 participating countries from the previous 21st position in 2007 [3]. Looking at the bright side, despite coming up short on the 500 scale-center-point of TIMSS, there has been an improvement with the nation's position in the year 2015, where Malaysia rose to the 24th place in the subject of science, attaining an average score of 471 [2].

As a result, as indicated in the officially documented and widely disseminated Malaysia Education Blueprint 2013-2025, attaining a ranking within the upper quarter of nations in TIMSS is Malaysia's aspiration [1]. Specific elements have been highlighted by Malaysia's Ministry of Education that might have contributed to the poor ranking in TIMSS achievements. Quality inconsistencies in the ways teachers teach have been recognized as one of the main causes of poor performance [4].

According to research, high-quality teacher education program results will be mirrored in pre-service teachers in schools beyond the program whose teaching will also be high quality [5], [6]. To put it in another way, effective teaching will become commonplace in schools and colleges if and only if the teacher preparation program improves. The assertion by [7]–[9] that each pre-service teacher ought to be provided with the necessary education to prepare him/her to reach the anticipated high teaching standards, supports this viewpoint. Effective instructors or lecturers are also critical to school improvement [10].

Several pre-service teacher education programs were evaluated by [10], who found them lacking in the evidence-based curriculum; insufficient subject-matter training; a lack of emphasis on data gathering and analytical abilities for clinical teaching-based classroom practices; and poor theory-practice integration. In addition, substandard preparation in teacher education programs has been labelled as: i) Performing below the international average in pedagogical content knowledge [11], [12]; ii) Novice teachers using out-of-date, non-researched, or poorly understood teaching practices [13]; iii) Educators experience anxiety and dread when presenting these subjects due to limited procedural knowledge of the scientific or mathematical notions that teachers are required to teach [14]; and iv) Novice teachers are inadequately prepared to continuously evaluate and polish their strategies [15], [16].

Based on the preceding discussion on the problems observed such as the poor theory-practice integration [10] and the use of ineffective, outdated pedagogical approaches [13] which resulted from substandard pre-service teacher education programs, there is a need to uncover the current pedagogical gaps in pre-service teacher preparation. Accordingly, the proposed solution to this problem was to conduct an implementation study to uncover the current pedagogical gaps in the pre-service teacher education by observing and characterizing the actual teaching practices which were then compared to the aspired practices, and that the teaching of chemistry was chosen on the basis of the availability of a willing-to-be-observed chemistry lecturer in the teacher preparation program. The consequences of continuous professional growth could then be extended by identifying the instructional shortcomings [17] or pedagogical gaps. As a result, this study was meant to provide illumination on the following research question: What are the prevalent, non-prevalent, and non-existent Chemistry teaching practices observed in a teacher education institution?

2. REVIEW ON THE TEACHING PRACTICES OBSERVED

Teaching practices or behaviors in a distinct environment within a classroom have been previously characterized mainly by employing the observation method [18]. Classroom observation is considered a significant aspect of teacher education programs because "any journey set on the aim of improvement of (pre- as well as in-service) teachers' training and quality of teaching, should be centered on learning and teaching that is undergone within the classroom" [19]. Further, Ryder [20] argued that while observation is important in teaching, the aim and type of observation varies depending on the individual conducting the process. Considering the fact that teaching is a multidimensional activity in which several dynamic situations happen at the same time throughout, Ryder [20] asserted that "monitoring each one of these is impossible."

The time that is spent in teaching and learning observations can make the experience of teaching better, identify exemplary strategies, and encourage innovation which shows the various benefits a teacher could gain professionally [21]. For the design of preparatory teacher education model, especially in the early stages of each development phase, observation should be considered as an effective mechanism to be applied for learning [21]–[23], and hence, should be handled sensitively. Despite the benefits to their careers, many new and seasoned instructors and lecturers do not prefer and even fear being watched or observed in the classroom since it is unpleasant, time-consuming, and unnerving [21], [24]–[28]. Asgari *et al.* [29] asserted that while observation is potentially a dynamic ongoing and intentional endeavor that supports deep learning and improves professional skills, it observation is a passive process in the "worst-case scenario" that leads to students having increased amounts of anxiousness or reacting by shutting down entirely.

There are direct and indirect techniques of observation in qualitative research [30]. Direct observation happens when events are presently unfolding, and depending on whether the observer is active or passive, direct observation can be participatory or non-participatory. Indirect observation, on the other hand, is a distant process that relies on other people's observations or recordings of past events in the form of documentation, videos, and so on. The researcher's choice of observational technique, according to Mills and Gay [30], is determined by the researcher's participation.

Babbie [31] asserted that "there are no clear rules for making this choice," because the researcher's function and involvement are dependent on the situation. The following quote may help determine which type of observation to use: "*Becoming a researcher means internalizing the research goal while collecting data in the field. ... You conduct research ... always from the purpose of promoting your research goals. You carry with you an imaginary sign that you hang over each subject and on every wall and tree. The sign says, 'my primary purpose in being here is to collect data. How does what I am doing relate to that goal?*" [32].

A qualitative depiction of a specific type of behavior that we may wish to describe [33], or may involve using a checklist to decide the degree to which certain practices or showing conducts of behavior are evident during the span of a lesson [34] when they investigated "classroom observation where instructors were noticed leading or taking part in conduct that is identified as giving input to students, observing their work during class, commending or praising them, giving equivalent freedoms to male or female students to voice up in class and interacting with them throughout the session." Using classroom observation, [34] determined the lesson implementation scores by assessing and assigning a score on each of the teacher's use of effective instructional practices, and then aggregating all of the scores as the evaluation for the quality of teaching. Similarly, an observation checklist can be used to characterize the existing teaching practices. In particular, this study characterized chemistry teaching practices enacted by employing a classroom observation method which uses an observation checklist.

3. RESEARCH METHOD

3.1. Research design

This research employed the classroom observation method that uses a checklist to conduct an implementation study [33], [35]. The non-participatory observation strategy was chosen since it was more impartial to hone our focus on the chemistry teaching strategies that were being implemented. The teaching and learning regulatory principles were earlier designed, authenticated, outlined and reported in [36], [37]. The observation checklist named as the "Teaching and Learning Guiding Principles" has items that are divided into six practices or key points.

The two observers used the checklist to observe the lessons by checking (/) for the 50 indicators, observing whether or not these indicators are present or otherwise. A research assistant also videotaped each classroom observation. This was done to double-check the findings. If there was an incongruity or disagreement in any item in the observation checklist, the two observers have to come to a consensus through discussion and cross-checking with the video recording of the particular class session. Accordingly, the validity of the checked observations is consequently ensured by such mutual agreement [22].

3.2. Sampling

During one semester, 11 class sessions from a chemistry course (coded as SKU3013 chemistry 1) of a Bachelor of Education (chemistry major) offered by a lecturer in one Teacher Education Institution were observed. There were 27 students (3 males and 24 females) who registered for the course. The chemistry lecturer alongside 27 students signed the consent form, allowing the lessons to be observed and recorded for research purposes and future publications. The observed lessons were conducted on Mondays from 8 am to 10 am in one of the lecture rooms at the faculty. Table 1 displays the distribution of observations by topic.

Table 1. Observation schedule by date and topic

Observation	Date/Time	Topic taught
1st	14th September	Matter and Measurement
2nd	21st September	Quantum Theory and Atomic Structure (1)
3rd	28th September	Quantum Theory and Atomic Structure (2)
4th	5th October	Periodic Relationships Among the Elements
5th	12th October	Stoichiometry (1)
6th	19th October	Stoichiometry (2)
7th	26th October	Chemical Reactions
8th	2nd November	Gaseous and the Kinetic-Molecular Theory (1)
9th	16th November	Gaseous and the Kinetic-Molecular Theory (2)
10th	23rd November	Chemical Bonding (1)
11th	30th November	Chemical Bonding (2)

3.3. Instrumentation

The Malaysian Ministry of Education has awarded the Niche Research Grant Scheme (NRGS) to Sultan Idris Education University to create a Malaysian Teacher Education Model that will produce competent teachers in the future. The "guiding principles for teaching and learning" were developed at the start of the NRGS via document review of present policy positions, as well as expert interviews with policymakers and experts in teacher education. "A Teaching & Learning Checklist" was produced, piloted, and validated using exploratory factor analysis based on the "guiding principles for teaching and learning", confirming the six-factor checklist [36] with 67 initial items reduced to 50. The "Guiding Principles for Teaching and Learning" show the intended or aspired teaching practices in teacher preparation program, but the actual or direct implementation of science-based teaching practices still has to be determined via classroom observations. This type of characterization of chemistry teaching practices is critical because it tells us about the current or actual practices, which can then be compared to desired or aspired practices, revealing pedagogical gaps that may then be addressed by proper pre- and in-service teacher education.

The "Teaching & Learning Checklist" which is also known as "Observation Checklist" has Cronbach's alpha reliability values within the 0.87 to 0.93 range [37] and its six traits, factors or principles supported psychometrically [36]. The six principles are shown in Table 2. The table presents the principles together with the relevant items from the 50-item observation checklist.

Table 2. The 50-item observation checklist: Principles and corresponding items

Number	Principle	Items
1	Encouraging intellectual curiosity	1–12
2	Offering quality learning environments, resources, and technology	13–19
3	Maintaining a scaffolding of instructional alignment	20–27
4	Providing a varied learning atmosphere	28–32
5	Promoting an atmosphere of critical thinking and inquiry	33–39
6	Promoting positive beliefs, attitudes, and behavioral patterns	40–50

3.4. Data collection and analysis procedures

Two lecturers were selected via a recommendation from the relevant Faculty's administration to teach the Bachelor of Education (chemistry major) program students in the first semester. While the approval of these designated professors to be monitored was requested, only one lecturer agreed to be observed. The lecturer was requested to submit her lecturing timetable once permission was granted. Following discussions with and permission from the participating lecturer, an overall observation timetable was created (refer to Table 1).

The lecturer was observed 11 times. There were two research team members observed each lecture while a research assistant was appointed to videotape the session. Every observation took up the whole two-hour teaching period. The two observers then reassembled upon completion of the observations, and concurred on the observation, particularly for every one of the 50 items on the Observation Checklist. The research assistant then compiled the final Observation Checklist which comprised the verified observations that had been mutually agreed upon.

Eventually, 11 completed Observation Checklists were gathered. The information provided by the Observation Checklists was input into the "statistical package for the social sciences" program or SPSS, and descriptive statistics for each item within each topic were computed. Previous study [34] utilized an analysis based on observation aggregation, which is a valid method.

4. RESULTS

The frequency of each indicator (or item or practice) within a theme was assessed and reported when the information from the classroom observation checklists was reviewed, enabling a narrative to be told about how frequent each of the practices was. To assess the prevalence of any particular teaching practice, there had been no definitive guideline. For example, a mastery level using two-third rule by [38] who assert that the two-third rule "helps to prevent deciding that a person has 'mastered' a certain skill with a small majority of correct responses over a large minority of incorrect responses." However, in the teaching practices which encourage teachers to use more ways to teach in order to reach the students, hence two-third rule is rather stringent in this sense.

Consequently, it was an affirmation that a practice should be deemed "prevalent" in the overall observation if it was seen more than 25% of the time throughout a session enacted by the chemistry lecturer. A "quartile rule" was thus developed to cater for the interpretation of the observation checklist data in this study. There were six themes emerged from the observation checklist data which provide six characteristics of the observed teaching and learning: i) Encouraging intellectual curiosity; ii) Offering quality learning environments, resources, and technology; iii) Maintaining a scaffolding of instructional alignment; iv) Providing a varied learning atmosphere; v) Promoting an atmosphere of critical thinking and inquiry; and vi) Promoting positive beliefs, attitudes, and behavioral patterns

4.1. Theme 1: Encouraging intellectual curiosity

The observed teaching and learning practices suggest the widespread use of problem-solving activity (#1, f=10, 90.9%) based on 11 classroom observations as presented in Table 3. Although the chemistry lecturer did assign students to small discussion groups (#2, f=2, 18.2%), allow for presentations in small-groups (#3, f=1, 9.1%), allow learners to showcase task products/outcomes in class (#6, f=1, 9.1%), these practices were not prevalent. Meanwhile, no behaviors that promote critical assessment were noticed, such as critically assessing their peers' work or ideas (#7, f =0), questioning their lecturers' or peers' views (#8, f=0), or discussing an issue (#4, f=0). There was an unapparent use of role-playing and/or simulations during the observation of the lecture activities (#5, f=0). Similarly, the chemistry lecturer did not seem to utilize real-life events as examples in her lecture (#9, f=0), nor did she give students with the chance to debate real-life problems relevant to the subjects at hand (#10, f=0). There were no observations of the lecturer allowing students to compare subject-related ideas and concepts amongst themselves (#11, f=0) and asking higher-order thinking questions (#12, f=0).

Table 3. Frequency count for items in encouraging intellectual curiosity

Item	Indicator	f	Percentage (%)
1	Problem-solving	10	90.9*
2	Small group discussion	2	18.2
3	Group presentation	1	9.1
4	Debate	0	0.0
5	Role-play or simulation	0	0.0
6	Individual class presentation	1	9.1
7	Evaluate peers' work/idea	0	0.0
8	Challenge peers' or lecturer's idea	0	0.0
9	Use real-life situations as examples	0	0.0
10	Use the real-life situation as context for student analysis or discussion	0	0.0
11	Students compare theories/concepts	0	0.0
12	Ask HOTS questions	0	0.0

*Percentages which met the quartile rule of >25%

4.2. Theme 2: Offering quality learning environments, resources, and technology

It was encouraging to see that the classroom's technical equipment was used frequently and judiciously to improve the teaching and learning process (#13, f=10, 90.9%), and that the lectures were always conducted in a conducive and comfortable setting (#14, f=10, 90.9%) based on the 11 classroom observations as seen in Table 4. Additionally, the lecturer was observed using web-based resources (#18, f=5, 45.5%) and telling students where they could obtain the books, references, and/or course materials they required (#15, f=3, 27.3%). During the class, while the lecturer was observed inviting or encouraging students to utilize the electronic tools supplied for educational reasons (#16, f=1, 9.1%) and assigning or delegating tasks that included the use of internet-based technologies (#17, f=1, 9.1%), these observations were sporadic and their frequencies did not meet the quartile rule of more than 25%. Throughout the 11 classroom observations, it was not observed that the lecturer assisted students in developing the skills needed in accessing learning resources (#19, f=0).

Table 4. Frequency count for items in offering quality learning environments, resources, and technology

Item	Indicator	F	Percentage (%)
13	Use technological equipment provided	10	90.9*
14	Conduct a lesson in a comfortable learning space	10	90.9*
15	Inform students where to get the needed books or course materials	3	27.3*
16	Encourage students to use the provided technological equipment	1	9.1
17	Assign tasks that include the use of web-based tools	1	9.1
18	Make use of web-based resources as part of the materials	5	45.5*
19	Assist students in developing the skills to use learning resources	0	0.0

*Percentages which met the quartile rule of >25%

4.3. Theme 3: Maintaining a scaffolding of instructional alignment

Based on the 11 classroom observations, the chemistry lecturer was seen ensuring or maintaining a scaffolding of instructional alignment which is constructivist in nature, albeit in five out of eight items in this theme as shown in Table 5. The chemistry lecturer did relate new content or concept to be learned to content or concept that was previously taught (#20, f=8, 72.7%). Additionally, she did carry out activities that were appropriate to the lesson content (#21, f=10, 90.9%) and that conformed to the learning outcomes (#22, f=9, 81.8%). Appropriate assessment tasks or activities were provided as assessment of students' learning (#23, f=9, 81.8%) and the tasks assigned were akin to the practice of what had been taught (#27, f=6, 54.5%). However, throughout the 11 observed lessons, the chemistry lecturer was not seen to use a variety of assessment methods (#24, f=0). Furthermore, she neither ask her students to relate the theories or concepts taught to the students' real-life situation (#25, f=0) nor assign tasks that warrant the application of what was learned in real-life situations (#26, f=0).

Table 5. Frequency count for items in maintaining a scaffolding of instructional alignment

Item	Indicator	F	Percentage (%)
20	Relate new content to previously learned content	8	72.7*
21	Carry out appropriate content-related activities	10	90.9*
22	Carry out appropriate activities to achieve learning outcomes	9	81.8*
23	Provide appropriate assessment tasks/activities	9	81.8*
24	Use a variety of assessment methods	0	0.0
25	Ask students to relate theories/concepts to real-life situations	0	0.0
26	Assign tasks that apply what was learned to real-life situations	0	0.0
27	Assign tasks that require the practice of what was learned	6	54.5*

*Percentages which met the quartile rule of >25%

4.4. Theme 4: Providing a varied learning atmosphere

On the basis of the 11 classroom observations as in Table 6, the broader situation suggests that it was not a prevalent practice of the Chemistry lecturer in providing an international and culturally relevant learning environment for her students. While she did occasionally form ethnically diverse groups (#28, f=2, 18.2%) and used culturally-relevant examples in her explanation of a topic or a concept during the lessons (#29, f=1, 9.1%), these practices were not prevalent or widespread, failing to meet the quartile rule of more than 25% across all the 11 teaching episodes observed in the classroom. Meanwhile, three of the remaining indicators were not at all observed. These unobserved indicators are: giving students assignments or tasks that embolden them to capitalize their personal experiences (#30, f=0), encouraging students to voice their culturally relevant ideas or views and ideas (#31, f=0), and using books, references and/or materials created by multiple authors of various nationalities (#32, f=0).

Table 6. Frequency count for items in providing a varied learning atmosphere

Item	Indicator	f	Percentage (%)
28	Form heterogeneous groups in terms of cultural backgrounds	2	18.2
29	Use culturally relevant examples	1	9.1
30	Give tasks or assignments that encourage students to draw from their own experiences.	0	0.0
31	Encourage the sharing of different cultural views/ideas	0	0.0
32	Use books/materials produced by writers from different countries	0	0.0

4.5. Theme 5: Promoting an atmosphere of critical thinking and inquiry

Drawing upon 11 classroom observations as seen in Table 7, the broader situation reveals that the chemistry lecturer generally failed to create an environment of critical thinking and inquiry. The only item which met the quartile rule is that the chemistry lecturer was seen encouraging students to ask questions

(#37, f=8, 72.7%). Although she was observed to employ the practices of assigning students with tasks or works that necessitate them to reflect and convey what they had gained or learned (#33, f=2, 18.2%), ingraining a mindset of being inclined to reassess their viewpoints and admit fault (#36, f=1, 9.1%), and posing open and reflective questions (#38, f=1, 9.1%), these practices were not prevalent. Meanwhile, practices such as enabling students to critically reflect through their observations (#34, f=0), giving investigative assignments to students (#35, f=0), and allowing students to actively assess and participate in the academic debate or scholarly discourse (#39, f=0) were not at all being observed.

Table 7. Frequency count for items in promoting an atmosphere of critical thinking and inquiry

Item	Indicator	F	%
33	Include assignment that requires students to reflect their learning and to suggest ways for improvement	2	18.2
34	Ask students to do a critical reflection on their own experiences	0	0.0
35	Give investigative tasks	0	0.0
36	Demonstrate a willingness to revise own views and admit error, and encourage this attitude among students	1	9.1
37	Encourage students to ask questions.	8	72.7*
38	Ask questions that are open and reflective in nature	1	9.1
39	Provide opportunities for students to critically evaluate and contribute to the scholarly discourse on practice	0	0.0

*Percentages which met the quartile rule of >25%

4.6. Theme 6: Promoting positive beliefs, attitudes, and behavioral patterns

On the basis of the 11 classroom observations as seen in Table 8, the chemistry lecturer was often seen modelling and demonstrating excellent working behaviors while giving lectures (#41, f=9, 81.8%), showing genuine enthusiasm when teaching the course topics (#43, f=9, 81.8%), encouraging students to become better by using positive words (#44, f=7, 63.6%), and encouraging student collaboration by requiring them to work in groups of two or small-numbers (#45, f=7, 63.6%). Making it obvious to students what standard of work performance is anticipated and appreciated (#42, f=3, 27.3%) and employing firm deterrent words to help learners grasp the need of taking responsibility for any non-conforming behaviors. There are two indicators in this theme that slightly meet the quartile rule for prevalence where their percentages are more than 25%.

In terms of academic plagiarism, the chemistry lecturer was only seen once (#46, f=1, 9.1%) in advising or cautioning students not to plagiarize. The lecturer was seen twice urging pupils to be responsible for their education (#49, f=2, 18.2%) in terms of responsible self-learning. Meanwhile, there were no observation of practices in encouraging students to rely on one’s beliefs especially in times of dispirited (#47, f=0), encouraging students to stay educationally current with the exemplary practices around the world (#48, f=0), and encouraging students to study not solely of getting higher scores but to serve humanity as well as God (#50, f=0).

Table 8. Frequency count for items in promoting positive beliefs, attitudes, and behavioral patterns

Item	Indicator	f	%
40	Ask students to cooperate through pair or small group work	6	54.5*
41	Model good working habits (e.g., punctual/well prepared)	9	81.8*
42	Make clear to students the quality expected in their work	3	27.3*
43	Show genuine enthusiasm when teaching	9	81.8*
44	Use positive language to encourage student improvement	7	63.6*
45	Use strong deterrent language for students’ non-conforming actions	3	27.3*
46	Remind students not to plagiarize	1	9.1
47	Encourage students to fall back on their beliefs when discouraged	0	0.0
48	Encourage students to keep abreast with educational development and best practices around the world	0	0.0
49	Encourage students to take responsibility for their learning	2	18.2
50	Encourage students to learn not just for the sake of getting good grades but more importantly to serve humanities and/or God	0	0.0

*Percentages which met the quartile rule of >25%

4.7. Summary of findings

Based on Tables 3-8, it is difficult to make a comparison across the six dimensions as to whether each dimension meets the quartile rule. Furthermore, the number of items in each dimension is unequal and that the number of items (or indicators) that fulfilled quartile rule also varies. Therefore, it is difficult to draw a compelling conclusion about the comparative prevalence of classroom practices in terms of each of the six dimensions. To provide a clear and fair comparative prevalence of classroom practices across the dimensions, the number of items (or indicators) within each dimension that met the quartile rule was recorded and its percentage computed as presented in Table 9.

Based on Table 9, it is apparent that the prevalent practices (i.e., practices which met the quartile rule of more than 25%) of the chemistry lecturer were "maintaining a scaffolding of instructional alignment" (62.5%), "offering quality learning environments, resources and technology" (57.1%), and "promoting positive beliefs, attitudes, and behavioral patterns" (54.5%). Meanwhile, the non-prevalent practices (i.e., practices which although being observed, they did not meet the quartile rule) of the chemistry lecturer were "promoting an atmosphere of critical thinking and inquiry" (14.3%), and "encouraging intellectual curiosity" (8.3%). The non-existent teaching practice was observed in the dimension of "offering a varied learning atmosphere" (0.0%).

Table 9. Comparative prevalence of teaching practices across six dimensions

Dimension	Principle	Items	#Items>25%	Percentage (%)
1	Encouraging intellectual curiosity	1–12	1 (out of 12)	8.3
2	Offering quality learning environments, resources, and technology	13–19	4 (out of 7)	57.1
3	Maintaining a scaffolding of instructional alignment	20–27	5 (out of 8)	62.5
4	Offering a varied learning atmosphere	28–32	0 (out of 5)	0.0
5	Promoting an atmosphere of critical thinking and inquiry	33–39	1 (out of 7)	14.3
6	Promoting positive beliefs, attitudes, and behavioral patterns	40–50	6 (out of 11)	54.5

5. DISCUSSION

In recapitulation, the purpose of this research was to characterize the Chemistry teaching exemplified by a chemistry lecturer in a teacher education institution in order to identify the prevalent, non-prevalent, and non-existent practices. As shown in Tables 3-8, these practices that were characterized from 11 classroom observations were noted in terms of the observed frequency for each item within the desired or aspired practices. As a result, pedagogical gaps are revealed as shown in Table 10. The pedagogical gaps in this context relate to the desired practices that were non-existent (with frequency=0) throughout the 11 classroom observations.

Table 10. Pedagogical gaps or non-existent teaching practices

Indicator	Item	
Indicators for Theme 1: Encouraging intellectual curiosity	4	Using a debate
	5	Using a role-play or simulation
	7	Evaluating peers' work/idea
	8	Challenging peers' or lecturer's idea
	9	Using a real-life situation as an example
	10	Using a real-life situation as a context for student analysis or discussion
	11	Comparing theories/concepts
	12	Asking HOT questions
Indicators for Theme 2: Offering quality learning environments, resources, and technology	19	Assisting students to develop skills in using learning resources
Indicator for Theme 3: Maintaining a scaffolding of instructional alignment	24	Using a variety of assessment methods
	25	Asking students to relate a theory/concept to a real-life situation
	26	Assigning a task that applies what has been learned to a real-life situation
Indicators for Theme 4: Offering a varied learning atmosphere	30	Giving a task, work, or an assignment that encourages students to draw from their own experiences.
	31	Encouraging students to voice or share from their cultural view/perspective.
	32	Using books, references, or materials produced by multiple writers from different countries.
Indicators for Theme 5: Promoting an atmosphere of critical thinking and inquiry	34	Asking students to do a critical reflection based on personal experiences.
	35	Giving investigative tasks.
	39	Providing opportunities for students to critically evaluate and contribute to the scholarly discourse on practice.
Indicators for Theme 6: Promoting positive beliefs, attitudes, and behavioral patterns	47	Encouraging students to fall back on their beliefs when down, dispirited or discouraged.
	48	Encouraging students to keep abreast with educational development and best practices around the world.
	50	Encouraging students to learn to get good grades and more importantly, to serve humanities and/or God.

This study is novel in terms of the method employed to uncover the pedagogical gaps in this study. Furthermore, the method employed was objective with a very low inference because the observed data were gathered in a non-judgmental way based on what was enacted by the chemistry lecturer and that the observations were truly rooted in the actual practices in the classroom and not in observers' assumptions or inferences. The method employed also innovatively presented the quartile rule that was established upfront to demarcate prevalent, non-prevalent and non-existent teaching practices. Hence, this may be added to the reservoir of classroom observation methods [22]. In bringing the discussion further, the pedagogical competency of the chemistry lecturer whose classroom practices were observed could be categorized in one of the four quadrants using the conscious-competence model [39] as summarized in Figure 1.

Conscious Incompetence (2nd Stage): He/she knows that he/she doesn't know	Conscious Competence (3rd Stage): He/she knows that he/she knows
Unconscious Incompetence (1st Stage): He/she doesn't know that he/she doesn't know	Unconscious Competence (4th Stage): He/she doesn't know that he/she know

Figure 1. Summary of the conscious-competence model

The conscious-competence model as shown in Figure 1, views pedagogical learning in two dimensions, namely consciousness dimension and competence dimension. In each dimension, there are two distinct categories. For example, conscious and unconscious, or competence and incompetence. Accordingly, there are stages of progression: unconscious incompetence (1st Stage), conscious incompetence (2nd Stage), conscious competence (3rd Stage), and unconscious competence (4th Stage). Pedagogical gaps in which the indicators stated in Table 10 were not seen or non-existent may place the lecturer in Stages 1 and 2, but indicators that were prevalent and non-prevalent (Tables 3-8) may place the lecturer in Stages 3 and 4. Recognizing the educational gaps in one's existing knowledge base is important since it helps decide if and how much re-skilling is needed [40].

The chemistry lecturer may have inadequate pedagogical knowledge, particularly when it comes to the utilization of debate, role-playing, simulation, real-life situations as examples, as well as the context for the teaching and learning. Therefore, the lecturer needs to concretize the first principle of quality teaching and learning, namely in encouraging intellectual curiosity. By the way, pedagogical knowledge is defined as a "teacher's specialized skills in creating and enhancing successful teaching and learning experiences for students, independent of subject matter" [40].

Having identified the pedagogical gaps, a more specific continued professional development that has been customized to the needs of the chemistry lecturer is crucially required to familiarize with the pedagogical knowledge on the-what, and the-why of using debate, simulation, role play and context-based teaching. For instance, lecturer must be aware of the fact that "simulation activities involve students working as realistically as possible within a reproduced situation. Information is supplied which allows students to operate within the simulation" [41]. In addition, the person must be able to distinguish between simulations and role-plays. A study described role play as "person-centered," in which students are asked to imagine themselves in someone else's shoes in order to explore scientific issues and concepts, whilst simulations are described as "job-centered," in which the main focus is on completing a specific assignment and learners' function according to the desired outcome, with no teacher interference [41].

The lecturer or teacher must also understand how to use the simulation technique, including the stages of the simulation. These stages are: preparation, briefing, action, debriefing, and follow-up [41]. The teacher prepares worksheets and resources, as well as the positions of goods and individuals in the room, during the preparation stage. The teacher explains the basic framework to the students, gives additional context, and distributes materials at the briefing stage. When the class is in command of the action phase, the teacher steps away, records, and evaluates. During the debriefing phase, the teacher goes through the simulation exercise again, emphasizing important points and clarifying any misunderstandings. The teacher also provides a visual representation of the simulation. Ultimately, in the follow-up stage, the teacher directs students the duty of completing diagrams, writing reports, and preparing presentations, as well as establishing connections to future projects [41].

Besides, based on the pedagogical gaps, the lecturer needs also to know and be able to demonstrate a variety of assessment methods. Black and Wiliam [42] strongly advocate for the use of a range of formative assessment strategies which will help students learn better. Such advocacy is supported by [43] who propounds the use of research-informed formative assessment practices and contends that the use of such a classroom-based approach to assessment for learning is effective in promoting learning. Because of numerous class observations, game-show assessments with traffic lights and thumbs up and thumbs down prevail, the advocacy of [42], [43] is especially important. While whole-class learning assessments are beneficial, they only give a limited amount of information about students' comprehension. What should a teacher do when 10 out of 30 students show the red light as opposed to others who show the green light? Furthermore, since the whole-class learning check occurs after the activity, the feedback is frequently too late to be useful, and the window of opportunity has passed.

Although there is no qualm that the chemistry lecturer has shown to have a good grasp of the content knowledge, the pedagogical content knowledge is lacking [44], [45]. An adequate pedagogical content knowledge is of utmost importance, particularly in delivering a chemistry topic or facts or concepts effectively using appropriate pedagogy. The discussion in the preceding paragraphs indicates that generally, while the chemistry lecturer has a good grasp of the content knowledge, there are gaps in the pedagogical knowledge as well as pedagogical content knowledge. Accordingly, two implications for continued professional development in terms of teaching and learning at teacher education should be taken into account: the content coverage on pedagogy and the pedagogical coverage of pedagogy (or how the pedagogy is delivered or enacted in the training session). In the former, the content coverage should include the pedagogical gaps outlined in Table 10. Given the pedagogical gaps in terms of "encouraging intellectual curiosity," the content coverage on pedagogy should pay special attention to indicators within this theme, such as the use of debate, role-play, simulation [41], argument-driven inquiry in chemistry [46], project-based and problem-based learning, questioning techniques, and higher-order thinking skills.

The famous phrase "practice what you preach" should be utilized as a candle to our pedagogical feet and a light to our pedagogical route in teacher education in the latter case regarding the pedagogical coverage of pedagogy [47]. As a response, if a teacher educator wishes to educate his or her student teachers on how to simulate molten sodium chloride electrolysis [41], he or she should model how molten sodium chloride conducts electricity during electrolysis. The "successful teacher preparation programs should model the behaviors they demand from their student teachers," is in line with this pedagogical covering of pedagogy [10]. In other words, the teacher educator must model or replicate the pedagogy, technique, or model of teaching that he or she wishes to convey to his or her pre-service teachers so that they may experience and reflect on the learning activities that they will use in their classrooms.

6. CONCLUSION

This research identifies three main shortcomings in a chemistry lecturer's teaching methods in a teacher education institution setting, namely "offering a varied learning environment" (0%), "encouraging intellectual curiosity" (8.3%), and "promoting an atmosphere of critical thinking and inquiry" (14.3%) – all of which have the observational rating of equal or below the quartile rule (25%). Meanwhile, three other themes namely "promoting positive beliefs, attitudes, and behavioral patterns" (54.5%), "offering quality learning environments, resources, and technology" (57.1%), and "maintaining a scaffolding of instructional alignment" (62.5%) achieved or met the quartile rule. Although these three themes met the quartile rule, a few indicators were observed in a frequency below the quartile rule within each of these themes. As a result, when addressing those pedagogical inadequacies during teacher professional development, these observed-less-than-quartile-rule indicators must be given the attention they deserve. Consequently, in teaching professional development, both the content and pedagogical coverage of pedagogy must be considered. Through effective modelling of the models or methods, the related models or methods to these pedagogical deficiencies must be meaningfully addressed.

ACKNOWLEDGEMENTS

The generosity of the Malaysian Ministry of Higher Education in granting the Niche Research Grant Scheme (NRGS/KPT 2014-0001-107-82-2) is greatly acknowledged with appreciation. The willingness of the chemistry lecturer to be observed throughout a semester is equally cherished with gratitude.

REFERENCES

[1] Ministry of Education Malaysia, *Malaysia Education Blueprint 2013-2025 (Preschool to Post-secondary Education)*. Putrajaya: Ministry of Education Malaysia, 2012.

[2] I. V. S. Mullis, M. O. Martin, P. Goy, D. L. Kelly, and B. Fishbein, *TIMSS 2019 International Results in Mathematics and Science.* Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College, 2020.

[3] M. O. Martin, I. V. S. Mullis, P. Foy, and G. M. Stanco, The *TIMSS 2011 International Results in Science.* Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College, 2012.

[4] T. S. A. Azian, "STEM Education: Policies and prospects towards achieving the International standard and meeting national development needs," The keynote address was given at *International Science, Technology, Engineering and Mathematics High-Level Policy Forum on Evidenced-Based Science Education in Developing Countries*, Kuala Lumpur, 2015.

[5] C. Green, M. Eady, and P. Andersen, "Preparing quality teachers," *Teaching & Learning Inquiry*, vol. 6, no. 1, pp. 104–125, Mar. 2018, doi: 10.20343/teachlearninqu.6.1.10.

[6] G. K. Paronjodi, A. J. Jusoh, and M. H. Abdullah, "A comparative study of beginning teacher induction in Malaysia and Victoria (Australia): A review of the literature," *Journal of Research, Policy & Practice of Teachers & Teacher Education*, vol. 7, no. 1, pp. 36–48, Jun. 2017, doi: 10.37134/jrpptte.vol7.no1.5.2017.

[7] P. S. C. Goh and K.-T. Wong, "Discerning beginning teachers' conceptions of competence through a phenomenographic investigation," *Journal of Research, Policy & Practice of Teachers & Teacher Education*, vol. 4, pp. 40–47, 2014.

[8] C. K. S. Singh, R. Gopal, N. A. Mostafa, R. K. A. Singh, E. T. Ong, and T. S. M. Singh, "ESL teachers' strategies to foster higher-order thinking skills to teach writing," *Malaysian Journal of Learning and Instruction*, vol. 17, no. Number 2, pp. 195–226, Jul. 2020, doi: 10.32890/mjli2020.17.2.7.

[9] C. K. Swaran Singh, E. T. Ong, T. S. Masa Singh, M. Maniam, and T. M. Tunku Mohtar, "Exploring ESL learners' reading test taking strategies," *Studies in English Language and Education*, vol. 8, no. 1, pp. 227–242, 2021, doi: 10.24815/siele.v8i1.18130.

[10] K. Roberts-Hull, B. Jensen, and S. Cooper, *A new approach: Teacher education reform*. Melbourne, Australia: Learning First, 2015.

[11] H. T. L. Ha, A. T. K. Pham, H. T. Nguyen, and H. T. T. Duong, "Training Pedagogical Skills: Evaluation of Lecturers and Teacher Training Students at Educational Universities in Vietnam," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 17, no. 12, p. em2054, Dec. 2021, doi: 10.29333/ejmste/11418.

[12] K. E. Leong, C. M. Chew, and S. S. Abdul Rahim, "Understanding Malaysian pre-service teachers mathematical content knowledge and pedagogical content knowledge," *EURASIA Journal of Mathematics, Science and Technology Education*, vol. 11, no. 2, Apr. 2015, doi: 10.12973/eurasia.2015.1346a.

[13] Teacher Education Ministerial Advisory Group, *Action Now: Classroom Ready Teachers*. Teacher Education Ministerial Advisory Group Final Report, 2015.

[14] E. Thanheiser *et al.*, "Prospective Elementary Mathematics Teacher Content Knowledge: What Do We Know, What Do We Not Know, and Where Do We Go?" *The Mathematics Enthusiast*, vol. 11, no. 2, pp. 433–448, 2014, doi: 10.54870/1551-3440.1308.

[15] P. Griffin, E. Care, M. Francis, D. Hutchinson, A. Arratia-Martinez, and C. McCabe, *Assessment and Learning Partnerships: The influences of teaching practices on student achievement*. Melbourne: Assessment Research Centre, 2013.

[16] F. Senom, A. R. Zakaria, and S. S. Ahmad Shah, "Novice Teachers' Challenges and Survival: Where do Malaysian ESL Teachers Stand?" *American Journal of Educational Research*, vol. 1, no. 4, pp. 119–125, 2013, doi: 10.12691/education-1-4-2.

[17] S. Halim, R. Wahid, and T. Halim, "Classroom observation- a powerful tool for continuous professional development (CPD)," *International Journal on Language, Research and Education Studies*, vol. 2, no. 2, pp. 162–168, May 2018, doi: 10.30575/2017/IJLRES-2018050801.

[18] M. Hammersley and P. Atkinson, *Ethnography Principles in Practice*, 4th ed. London: Routledge, 2019.

[19] T. L. Hutner and V. Sampson, "New ways of teaching and observing science class," *Phi Delta Kappan*, vol. 96, no. 8, pp. 52–56, May 2015, doi: 10.1177/0031721715583964.

[20] J. Ryder, "Practice Teaching: A Reflective Approach," *ELT Journal*, vol. 67, no. 3, pp. 361–363, 2013, doi: 10.1093/elt/cct027.

[21] J. N. Mikeska, S. Holtzman, D. F. McCaffrey, S. Liu, and T. Shattuck, "Using classroom observations to evaluate science teaching: Implications of lesson sampling for measuring science teaching effectiveness across lesson types," *Science Education*, vol. 103, no. 1, pp. 123–144, Jan. 2019, doi: 10.1002/sce.21482.

[22] M. O'Leary, *Classroom Observation: A Guide to the Effective Observation of Teaching and Learning*, 2nd Edition. UK: Routledge, 2020.

[23] E. C. Wragg, *An Introduction to Classroom Observation*, 2nd ed. London: Routledge, 2012.

[24] M. Antinluoma, L. Ilomäki, and A. Toom, "Practices of Professional Learning Communities," *Frontiers in Education*, vol. 6, Apr. 2021, doi: 10.3389/feduc.2021.617613.

[25] G. D. Borich, *Observation skills for effective teaching: Research-based practice*, 7th ed. Abingdon, OX: Taylor & Francis, 2016.

[26] W. Lan and R. Lam, "Exploring an EFL teacher's beliefs and practices in teaching topical debates in mainland China," *Iranian Journal of Language Teaching Research*, vol. 8, no. 1, pp. 25–44, 2020.

[27] K. Jonson, *Being an Effective Mentor: How to Help Beginning Teachers Succeed*. Thousand Oaks: Corwin Press, 2014.

[28] P. J. E. Alegado and H. Y. Soe, "the Significance of Mentoring on Teachers' Beliefs and Teachers' Pedagogical Practices: A Comparative Analysis Among 47 Countries Based on 2018 Teaching and Learning International Survey (Talis)," *Bulgarian Journal of Science and Education Policy*, vol. 14, no. 2, pp. 232–259, 2020.

[29] M. Asgari, A. M. Miles, M. S. Lisboa, and M. A. Sarvary, "COPUS, PORTAAL, or DART? Classroom Observation Tool Comparison from the Instructor User's Perspective," *Frontiers in Education*, vol. 6, Nov. 2021, doi: 10.3389/feduc.2021.740344.

[30] G. E. Mills and L. R. Gay, *Educational Research: Competencies for Analysis and Applications, Loose-Leaf Version*, 11th Ed. London: Pearson, 2014.

[31] E. R. Babbie, *The Basics of Social Research*, 7th ed. Boston, MA, USA: Cengage Learning, 2017.

[32] R. Bogdan and S, K. Biklen, *Qualitative Research for Education: An Introduction to Theories and Methods*, 5th ed. University of California: Pearson A & B, 2007.

[33] E. T. Ong and K. Ruthven, "The distinctiveness and effectiveness of science teaching in the Malaysian 'smart school,'" *Research in Science and Technological Education*, vol. 28, no. 1, pp. 25–41, 2010, doi: 10.1080/02635140903513557.

[34] United Nations Educational, Scientific and Cultural Organization (UNESCO), *Education for People and Planet: Creating Sustainable Futures for All*. Paris: United Nations Educational, Scientific and Cultural Organization, 2016.

[35] E. T. Ong, "The character of 'Smart Science Teaching' in Malaysian schools and its effects on student attitudes, process skills, and achievement," Doctoral Dissertation, University of Cambridge, 2004.

[36] M. Adnan, A. Masuwai, N. M. Tajudin, and N. A. Rahman, "An Exploratory Factor Analysis on Generating Teaching and Learning Guiding Principles from Malaysian Teacher Educators' Perspectives," *Creative Education*, vol. 06, no. 12, pp. 1245–1255, 2015, doi: 10.4236/ce.2015.612123.

[37] I. Noraini, *Teaching and Learning Guiding Principles: Informing the design of a Malaysia Teacher Education Model for preparing quality teachers for the future*. Tanjung Malim: Universiti Pendidikan Sultan Idris, 2014.

[38] E. T. Ong, Y. T. Wong, M. Y. Sopia, B. Sadiah, and Y. Asmayati, "Acquisition of Basic and Integrated Science process skills amongst form 2 students in Sarawak," *Pertanika Journal of Social Science and Humanities*, vol. 21, no. 3, pp. 1065–1081, 2013.

[39] M. Fuller, E. Kamans, M. van Vuuren, M. Wolfensberger, and M. D. T. de Jong, "Conceptualizing Empathy Competence: A Professional Communication Perspective," *Journal of Business and Technical Communication*, vol. 35, no. 3, pp. 333–368, Jul. 2021, doi: 10.1177/10506519211001125.

[40] K. Sonmark, N. Révai, F. Gottschalk, K. Deligiannidi, and T. Burns, "Understanding teachers' pedagogical knowledge: report on an international pilot study," *OECD Education Working Papers*, No. 159, OECD Publishing, Paris, 2017.

[41] B. Harrison, *Active Teaching and Learning Approaches in Science*. HarperCollins Publishers, 1992.

[42] P. Black and D. Wiliam, "Classroom assessment and pedagogy," *Assessment in Education: Principles, Policy & Practice*, vol. 25, no. 6, pp. 551–575, Nov. 2018, doi: 10.1080/0969594X.2018.1441807.

[43] Curriculum Development Division, *The guide to the implementation of Science, Technology, Engineering and Mathematics (STEM) in teaching and learning*. Putrajaya: Ministry of Education Malaysia, 2016.

[44] C. L. Shing, R. M. Saat, and S. H. Loke, "The knowledge of Teaching- Pedagogical Content Knowledge (PCK)," *The Malaysian Online Journal of Educational Sciences*, vol. 3, no. 3, pp. 40–55, 2015.

[45] J. Gess-Newsome, J. A. Taylor, J. Carlson, A. L. Gardner, C. D. Wilson, and M. A. M. Stuhlsatz, "Teacher pedagogical content knowledge, practice, and student achievement," *International Journal of Science Education*, vol. 41, no. 7, pp. 944–963, May 2019, doi: 10.1080/09500693.2016.1265158.

[46] S. Kaçar and A. G. Balim, "Investigating the Effects of Argument-Driven Inquiry Method in Science Course on Secondary School Students' Levels of Conceptual Understanding," *Journal of Turkish Science Education*, vol. 18, no. 4, pp. 816–845, 2021, doi: 10.36681/tused.2021.105.

[47] E. T. Ong, C. K. Swaran Singh, N. Abd Rahman, and L. F. Md Ibharim, "The Character of Biology Teaching Practices: Pedagogical Hiatuses and the Implications for Continued Professional Development," *The Journal of Social Sciences Research*, vol. 5, no. 2, pp. 389–399, 2019, doi: 10.32861/jssr.52.389.399.

BIOGRAPHIES OF AUTHORS

Eng Tek Ong is a Professor at the Department of Education, Faculty of Social Sciences and Liberal Arts, UCSI University, Kuala Lumpur, Malaysia. Prior to joining UCSI University, he was a Professor in Science Education at Sultan Idris Education University (UPSI). He holds a Ph.D. in Science Education from Cambridge University, UK, an M.Ed. in Curriculum & Instruction from University of Houston, Texas, and a B.Sc.Ed.(Hons) in Mathematics and Chemistry from University Science Malaysia. His research interests and publications include teacher education, science process skills, inquiry learning, cooperative learning, indigenous people, ESD, STEM education, HOTS, and HIV-AIDS preventive education across levels and disciplines. He can be contacted at email: OngET@ucsiuniversity.edu.my.

Charanjit Kaur Swaran Singh is an Associate Professor at Department of English Language & Literature, Faculty of Languages & Communication, Universiti Pendidikan Sultan Idris, Perak, Malaysia. Her research interests are in the field of Language assessment, Teacher education, English education and English for Specific Purposes. She is regularly invited by numerous organizations to give talk and conduct workshops in her area of specialization (i.e., Language assessment, teaching and learning strategies and Higher-order thinking skills). However, she is currently focusing much of her time to promote the Development of an Assessment Literacy Framework for In-Service. She can be contacted at email: charanjit@fbk.upsi.edu.my.

Rosdy Wahid is currently attached at the Deputy Director General's Office as a special officer in the Development of Teachers' Professional Sector, Ministry of Education Malaysia. He received the Ph.D. in Education (Pedagogy) from the Sultan Idris Education University (UPSI), while his M.Ed. in TESL and B.Ed. in TESL were from the National University of Malaysia (UKM). He has the experience of teaching in national primary and secondary schools for 8 years before assuming the role of an Assistant Director at the Curriculum Development Division and also at the Matriculation Division, Ministry of Education Malaysia for 8 and 3 years respectively. He can be contacted at email: rosdy.wahid@moe.gov.my.

Muhamad Ikhwan Mat Saad is a senior lecturer at the Department of Biology, Faculty of Science and Mathematics, Sultan Idris Education University (UPSI), Malaysia. Prior to joining UPSI, he was the Chief Assistant Director at the Education Policy Planning and Research Division (EPRD), Malaysian Ministry of Education. He holds a PhD in Measurement in Education and M.Ed. in Biology Education from UPSI. He obtained a B.Sc.Ed.(Hons) in Biology Education from University Malaysia Sarawak. His research interests and publications include areas such as teaching and learning, teacher education, science and biology education, STEM education, self-regulated learning, reasoning skills, Measurement in education, program evaluation, Adventure Based Learning and Education Policy. He can be contacted at: Ikhwan.saad@fsmt.upsi.edu.my.