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The Character of Biology Teaching Practices: Pedagogical Hiatuses and the Implications for Continued Professional Development

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Abstract

This study was conducted to characterise the Biology teaching practices in a teacher education institution so as to inform us the existing practices which could then be compared with the aspired practices, uncovering the pedagogical hiatuses. This study employed a form of implementation study using classroom observation. A total of three lessons drawn from a Biology course within the Bachelor of Education (Biology Major) by a lecturer in one Teacher Education Institution were observed over a one-semester period. A psychometrically-supported Observation Checklist comprising 50 items or indicators that spread across six principles was utilised in the observation whereby observers checked in terms of presence or absence of each indicator during the classroom observations. In terms of coverage of aspired teaching practices which met the quartile rule (i.e., practices which were observed more than one-fourth or 25% in the overall observations), the findings indicated that lecturers fully ensured constructive instructional alignment (100%), fostered intellectual excitement (66.7%), provided quality spaces, technology and resources (57.1%), nurtured good values, attitudes and behaviours (45.5%), nurtured a climate of inquiry and critical reflection (42.9%). Nevertheless, the characterised teaching practices indicated that the lecturer did not offer adequate diverse learning environment (20.0%). This study provides the characterisation of evidenced-based practices, uncovering the pedagogical hiatuses which could be subsequently addressed by various means such as the providence of continuous in-service courses. Empowering lecturers pedagogically will produce quality teachers which in turn, produce quality students.

Keywords: Teaching practices; Teacher education; Classroom observation; Observation checklist; Pedagogical hiatuses.

1. Introduction

Malaysia has given much emphasis to the development of human capitals in the quest to achieve the status of a developed nation (Curriculum Development Division, 2016). A developed nation, according to Surbhi (2015), refers to the sovereign state, whose economy has highly progressed with an effective rate of industrialisation and individual income, and possesses great technological infrastructure, as compared to other nations. Accordingly, many science-based policies and initiatives have been instituted and implemented in Malaysia, especially when the projection from the National Council for Scientific Research and Development indicates that Malaysia needs approximately 493,830 scientists and engineers by 2020 (Azian, 2015). For example, Malaysia instituted the 60:40 policy in 1967 and implemented the policy in 1970 whereby it was envisaged that 60% students would uptake the science and technical-based subjects, while the remainder would follow through the arts and humanities subjects. Nevertheless, the statistics as of 2014 indicate that Malaysia has yet to attain the projected target of 60% students taking science and technical-based subjects. In fact, only approximately 45% secondary students are currently in the science stream, which include vocational and technical programs.

While Malaysia has zealously targeted the production of more scientists and engineers through its 60:40 policy, the percentage of upper secondary students who chose not to uptake the science stream despite being qualified to be admitted into science stream on the basis of their Form 3 National Standardised Examination (NSE) has increased to 15% (Azian, 2015). Such a depressing enrolment in science stream becomes a more serious problem when the achievement of Malaysia in the *Trends in Mathematics and Science Study* (TIMSS) 2011 shows a sharp decline from the 21st position in science in 2007 to that of 32nd position in 2011 among 63 participating countries (Martin *et al.*, 2012). On a positive note, the ranking of Malaysia did improve in the TIMSS 2015 whereby its ranking climbed to 24th position in science, attaining a mean score of 471, albeit falling short of the TIMSS Scale Centrepoint of 500 (Martin *et al.*, 2016).

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Accordingly, Malaysia has explicitly stated in the Malaysia Education Blueprint 2013-2025 (Ministry of Education, 2012) that she aspires to be at the "top third of the countries in international assessments such as … TIMSS in [the next] 15 years" (Executive Summary, p.9). Therefore, in the quest to achieve such an aspiration, the Malaysian Ministry of Education has identified the factors which contributed to the depressing performance in TIMSS. One of these contributing factors is the inconsistent quality of teaching and learning (Azian, 2015).

Research has indicated that a quality teacher preparation leads to quality teaching in schools by student teachers who followed through the quality teacher education program (i.e., (Hollins, 2011; Paronjodi *et al.*, 2017). In other words, if and only if the teacher preparation was improved, then better and effective teaching would be ubiquitous. Such a notion is further given credence by Goh and Wong (2015) who categorically stated that every student teacher "must" (p. 44) be given the right teacher education preparation so that he/she is able to meet the high teaching standards demanded of him/her. The effectiveness of teachers is thus considered to be the fundamental to school improvement (Roberts-Hull *et al.*, 2015).

Many teacher education programs or pre-service teacher preparation programs, as evaluated by Roberts-Hull *et al.* (2015), have been criticized for "a lack of evidence-based content; inadequate training in subject knowledge; an insufficient focus on data collection and analysis skills for clinical teaching practice; and limited integration of theory and practice" (p. 6). Furthermore, poor pre-service teacher preparation programs have also been characterised by, amongst others, weak pedagogy (Feiman-Nemser, 2001; Zeichner, 2006), teaching practices that were not up-to-date, not based on research, or not properly understood by those who were teaching the pre-service teachers (Teacher Education Ministerial Advisory Group TEMAG, 2014), lack of the necessary procedural understanding of the mathematical or scientific concepts required of the teachers to teach, which in turn, creates anxiety when teaching these subjects (Thanheiser *et al.*, 2014), and ill-equipping beginning teachers with the skills and ability of continually analysing and developing their own practices (Griffin *et al.*, 2013; Hattie, 2009).

On the basis of the preceding discussion, this study was conducted to characterise the Biology teaching practices in a teacher education institution so as to inform us the existing practices which could then be compared with the aspired practices. By uncovering the pedagogical hiatuses, implications on the continued professional development could then be proffered (Montgomery, 2002). Therefore, this study intended to provide illumination to the this research question: *What are the characters of the Biology teaching practices in a Teacher Education Institution as gauged from classroom observations using an observation checklist?*

2. Literature Review: Characterisation of Teaching Practices via Observation

Observation is one of the many legitimate methods in characterising the teaching practices in teacher education institutions. Lasagabaster and Sierra (2011), regard classroom observation as a key component of teacher professional development because "any quest for improving … teachers' training and … teaching quality must revolve around the teaching and learning processes taking place in the classroom" (p. 450). Meanwhile, Richards and Farrel (2011) contend that, while observation plays a central role in one's teaching practices, the purpose and nature of observation, however, differs according to who is involved in the observation process. Given that teaching is a multifaceted and dynamic activity, and that many things occur simultaneously during a lesson, Richards and Farrel (2011) argue that "it is not possible to observe all of them" (p. 90).

Nevertheless, it is a proven fact (Aubusson *et al.*, 2007; Borich, 2008; Gebhard and Oprandy, 1999; Washer, 2006) that many novice and experienced teachers and lecturers dislike and even fear being observed, as they find classroom observation stressful, time-consuming, and intimidating. While formal observation and feedback are integral to improving teaching performance and practice (Jonson, 2008), many teachers and lecturers express their anxiety and worry when it comes to classroom observation, particularly the top-down procedure of classroom observation (Li, 2009) of which the implementation is designed by experts, many of whom are far removed from the classroom realities. Morris (2003), aptly states that "at best it (i.e., observation) is an active, purposeful task that stimulates deep learning and the development of professional 'know-how'. At worst it is a passive process that leads to either heightened anxiety or total 'shut down' in the learner" (p. 1).

Therefore, observation needs to be handled sensitively as the time invested in the process of observing teaching and being observed can help improve teaching experiences, share best practices, build academic links and foster innovation (Washer, 2006). Observation can be a powerful learning tool Wajnryb (1992); O'Leary (2015) for teachers as well as researchers, particularly in the preliminary model development stages. There are many forms of observation in qualitative research and the choice a researcher takes is dependent on "the involvement of the researcher" Gay and Airasian (2000).

However, Babbie (2002) argues that the role for and involvement of the researcher depend on the situation, and hence "there are no clear guidelines for making this choice" (p. 285). In the quest to make a decision on the form of observation to adopt, the quote by Bogdan and Biklen (1998) gives some enlightenment:

Becoming a researcher means internalising 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?' (p. 82).

Observation generally invokes in our minds a qualitative description of certain behaviour which we would like to characterise (Ong and Ruthven, 2010). However, observation in the form of checklist is equally valid in evaluative research to determine the extent to which certain behaviours or teaching practices are observed throughout a lesson (Jarzabkowski and Bone, 1998; Pouezevara *et al.*, 2016). For example, Pouezevara *et al.* (2016) reported on "the percentage of classroom observations in which teachers were observed conducting or engaging in practices related to

providing feedback to pupils, monitoring their work during class, praising or complimenting them, providing equal opportunities to boys and girls to speak in class and engaging pupils throughout the classroom" (p. 9). Here, the teachers' use of effective instructional practices was assessed, and a score assigned to their implementation of the lesson, hence the lesson implementation scores.

Accordingly, observation checklist can be used to facilitate useful observation in a variety of ways. In this research, observation checklist was used to explore the extent to which the psychometrically-supported Guiding Principles for Teaching and Learning have been exemplified. Equally, the observation checklist could also be used to identify certain good teaching practices which, although being observed, were not listed in the checklist, thus providing additional good-practice items to the checklist.

This paper reports a section of a wider study that aims to develop a teacher education model in the Malaysian context. Specifically, it focuses on the character of the biology teaching practices in a Teacher Education Institution, gauged from classrooms observations using the teaching and learning observation checklist.

3. Methodology

3.1. Research Design

This study employed the implementation study using classroom observation (Ong, 2004; Ong and Ruthven, 2010). Based on the intent of the research question, the use of overt non-participant observation procedure was appropriate because it would be more objective to focus our attention on the teaching practices enacted. The observation checklist consists of items which are categorised into six principles or themes as documented in the Teaching and Learning Guiding Principles developed, validated and reported elsewhere e.g., (Mazlini *et al.*, 2015; Noraini, 2014).

In using the checklist, the two observers who are the research team members observed the lessons by checking (✓) in terms of presence or absence of each of the 50 indicators during the classroom observation. To further cross-check the observations, the lesson taught in each classroom observation was videotaped by a research assistant. Should there be any disagreement in a checked observation, the observers would discuss and view the relevant video recordings for empirical evidences in doubtful situations, until a mutual agreement was reached. Such a mutual agreement is important so as to ensure the validity of the checked observations (O'Leary, 2014).

3.2. Sampling

A total of 3 lessons drawn from a Biology course of the Bachelor of Education (Biology major) taught by a lecturer in one Teacher Education Institution were observed within a semester period. Table 1 shows the breakdown of observations by topics.

Table-1. Observation for Each Topic for a Biology Course

Observation	Date / Time	Topic Taught
1	March 25 (0800-1000)	Animalia Kingdom
2	April 01 (0800-1000)	Plantae (Plant Biodiversity)
3	April 22 (0800-1000)	The concept of Meiosis

3.3. Instrumentation

Sultan Idris Education University has been entrusted via a Niche Research Grant Scheme from the Malaysian Ministry of Education to develop a Malaysian Teacher Education Model in the quest to prepare quality teachers for the future. In the early stages of the model development, Guiding Principles for Teaching and Learning were identified by means of document analysis of existing theories and pertinent policies, and interviews with key informants (who are generally policy makers) and experts (who are generally teacher education experts). A Teaching & Learning Instrument was then developed around the Guiding Principles for Teaching and Learning, piloted, and validated through the use of an exploratory factor analysis, supporting the existence of six dimensions/principles (Mazlini *et al.*, 2015) while retaining 50 out of the initial 67 items across the six dimension/principles (Noraini, 2014) for the observation checklist on aspired teaching practices in the preparation of quality future teachers.

Although the Guiding Principles embody the aspired and ideal teaching practices in teacher education institutions, the actual implemented of science-based teaching practices, nevertheless, have yet to be ascertained and characterised. Such characterisation of Biology teaching practices is thus very crucial because it informs us the existing practices which could then be compared with the aspired practices, uncovering the pedagogical hiatuses which could then be subsequently remediated through appropriate in-service professional development.

An Observation Checklist comprising 50 items that are spread across six principles or dimensions was utilised in this research. These six dimensions were psychometrically supported by means of an exploratory factor analysis (Mazlini *et al.*, 2015) with their Cronbach's alpha reliability values for the six dimensions ranging between 0.87 and 0.93 (Noraini, 2014). Table 2 shows the six principles and their pertinent items in the 50-item Observation Checklist.

Table-2. Principles and their Corresponding Items in the 50-Item Observation Checklist

Number	Principle	Items
1	Fostering intellectual excitement	1 – 12
2	Providing quality learning spaces, technology and resources	13 – 19
3	Ensuring constructive instructional alignment	20 – 27
4	Offering diverse learning environment	28 – 32
5	Nurturing a climate of inquiry and critical reflection	33 – 39
6	Nurturing good values, attitudes and behaviours	40 – 50

3.4. Data Collection and Analysis Procedures

In the Bachelor of Education (Biology Major) program, two lecturers assigned to teach the first semester students were identified by means of recommendation by the management of the Faculty of Science and Mathematics. While consent to be observed from these identified lecturers were sought, only one lecturer consented to be observed. Once the consent had been received, the lecturer was asked to send her teaching schedule. An overall observation schedule was drawn up upon consultation with and approval from the participating lecturer.

The lecturer was observed thrice. In each observation, two research team members were assigned as observers while a research assistant was assigned to videotape the teaching. Each observation lasted for the entire lecture session which was a two-hour lecture. At the end of the session, the two observers reconvened and agreed on the observation, specifically to each of the 50 items in the Observation Checklist. The final Observation Checklist consisting of mutually agreed-upon checked observations was collected by the research assistant.

In total, three Observation Checklists were received. The data from the Observation Checklists were keyed into SPSS (Statistical Package for the Social Sciences). The data were then analysed descriptively in terms of frequency and percentage by each item within each theme. Such an analysis by means of aggregation of observations is valid and has been employed in Pouezevara *et al.* (2016) who maintained that "… observations do not represent unique teachers, but are an aggregate of observations of the same cohort of teachers, which may include multiple observations of the same teacher" (p. 8).

4. Findings

In analysing the data from the classroom observation checklist, the prevalence for each indicator (or item or practice) within a theme was quantified and summarised so that a story could be relayed in terms of how wide-spread each of the practices is. While there are many ways to define a mastery level such as the use of two-thirds rule which Ong *et al.* (2013) argue that "it helps to prevent making a decision that a person has "mastered" a certain skill with small majority of correct responses over a large minority of incorrect responses" (p. 988), there was, nevertheless, no hard and fast rule to determine the prevalence of a teaching practice.

As such, by taking into considering practices observed over a semester taught by a Biology lecturer, it was therefore valid to argue that should a practice be observed more than 25% in the total observations, it should be regarded as "prevalent" in the overall observation. Accordingly, a "quartile rule" was conceptualised to assist in the analysis of the observation checklist data.

The analysis of the observation checklist data indicates six themes that serve to characterise the teaching and learning observed, namely

- Fostering intellectual excitement
- Providing quality learning spaces, resources and technologies
- Ensuring constructive instructional alignment
- Offering diverse learning environment
- Nurturing a climate of inquiry and critical reflection
- Nurturing good values, attitudes and behaviours

Theme-1. Fostering intellectual excitement

Based on 3 classroom observations as shown in Table 3, the observed teaching and learning practices indicate that the Biology lecturer did allow students to complete a problem solving activity (#1, f = 1), assign students into small discussion groups (#2, f = 1), provide for small group presentations (#3, frequency, f = 1), and subsequently did afford students to present their work in class (#6, f = 1). Additionally, it was observed that the Biology lecturer did use real-life situations as examples (#9, f = 1) in her teaching and that she did provide students the opportunity to discuss real-life situations related to the topics at hand (#10, f = 1). Equally, it was observed that lecturers did foster intellectual excitement in terms of having students to compare theories and concepts which are relevant to the lesson at hand (#11, f = 1) and provide students with the opportunity to ask higher order thinking questions (#12, f = 1).

Nevertheless, there were no observed practices which foster critical evaluation such as critically evaluating the work or ideas of their peers (#7, f = 0), challenge the ideas proffered by their lecturers or by their peers (#8, f = 0), and debate on an issue (#4, f =0). The use of role play and/or simulations (#5, f = 0) was also not visible in the observed teaching and learning practices.

Table-3. Teaching Practices as Checked against Indicators for Fostering Intellectual Excitement

Item	Indicator	f	%	
1	Problem solving	1	33.3	*
2	Small group discussion	1	33.3	*
3	Group presentation	1	33.3	*
4	Debate	0	0	
5	Role-play or Simulation	0	0	
6	Individual class presentation	1	33.3	*
7	Evaluate peers' work/idea	0	0	
8	Challenge peers' or lecturer's idea	0	0	
9	Use real-life situation as examples	1	33.3	*
10	Use real-life situation as context for student analysis or discussion	1	33.3	*
11	Student compare theories/concepts	1	33.3	*
12	Ask HOT questions	1	33.3	*
* Percentages which met the quartile rule				

Theme-2. Providing quality learning spaces, resources and technologies

Based on 3 classroom observations as shown in Table 4, it was heartening to observe a judicious use of technological equipment provided in the classroom to enhance the teaching and learning process (#13, f = 1) and that the lessons were conducted in a comfortable and conducive manner (#14, f = 1). Although the lecturer was seen encouraging students to use the technological equipment provided for learning purposes during the lesson (#16, f= 1) in the form of assigning tasks that include the use of web based tools (#17, f = 1), there was no observation whatsoever which indicates lecturer informing students where to get the books and/or course materials needed for the lesson (#15, f = 0), making use of web-based resources as part of the materials (#18, f = 0), and assisting students in developing the skills to capitalise on the learning resources (#19, f = 0).

Table-4. Teaching Practices as Checked Against Indicators for Providing Quality Learning Spaces, Resources and Technologies

Item	Indicator	f	%	
13.	Use technological equipment provided	1	33.3	*
14.	Conduct lesson in a comfortable learning space.	1	33.3	*
15.	Inform students where to get the needed books or course materials	0	0	
16.	Encourage students to use the provided technological equipment	1	33.3	*
17.	Assign tasks that include the use of web based tools.	1	33.3	*
18.	Make use of web based resources as part of the materials.	0	0	
19.	Assist students in developing the skills to use learning resources	0	0	
* Percentages which met the quartile rule				

Theme-3. Ensuring constructive instructional alignment

Based on 3 classroom observations as shown in Table 5, the Biology lecturer was seen ensuring constructive instructional alignment and such observation was supported by a positive checked across the items in this theme. In particular, the Biology lecturer related new content or concept at hand to previously learned content or concept (#20, f = 1), carried out activities which were not only appropriate to the topic/content of the lesson (#21, f = 1) but also appropriate to the achievement of the learning outcomes (#22, f = 1), and assigned tasks which require the students to practise what they have learned in the class (#27, f = 1) by providing appropriate assessment tasks or activities to assess students' learning (#23, f = 1) whereby the assessment methods in the lessons were of different varieties (#24, f = 1). Equally, the lecturer was seen making links to real-life situation where she did assign tasks which require students to apply what they have learned to real-life situations (#26, f = 1), and she did ask students to relate the theories or concepts that they have learnt to real-life situations (#25, f = 1).

Table-5. Teaching Practices as Checked Against Indicators for Ensuring Constructivist Alignment

Item	Indicator	f	%	
20	Relate new content to previously-learned content	1	33.3	*
21	Carry out appropriate content-related activities	1	33.3	*
22	Carry out appropriate activities to achieve learning outcomes	1	33.3	*
23	Provide appropriate assessment tasks/activities	1	33.3	*
24	Use a variety of assessment methods	1	33.3	*
25	Ask students to relate theories/concepts to real-life situations	1	33.3	*
26	Assign tasks that apply what was learned to real-life situations	1	33.3	*
27	Assign tasks that require the practice of what was learned	1	33.3	*

*Percentages which met the quartile rule

Theme-4. Offering diverse learning environment

Based on 3 classroom observations as shown in Table 6, the overall picture indicates that the Biology lecturer was not thoughtfully seen in offering an international and culturally learning environment to their students. Apart

from giving tasks or assignments that encourage students to draw from their own experiences (#30, f = 1), the Biology lecturer was neither seen in forming heterogeneous groups in terms of ethnicity (#28, f = 0), using examples which are relevant to different cultures when explaining a topic in class (#29, f = 0), encouraging students to share their views and ideas from their own cultural perspectives (#31, f = 0), nor using books and/or materials produced by authors from different countries on the lessons (#32, f =0).

Table-6. Teaching Practices as Checked Against Indicators for Offering Diverse Learnin Environment

Item	Indicator	f	%	
28.	Form heterogeneous groups in terms of cultural backgrounds	0	0	
29.	Use culturally relevant examples	0	0	
30.	Give tasks or assignments that encourage students to draw from their own experiences.	1	33.3	*
31.	Encourage sharing of different cultural views/ ideas	0	0	
32.	Use books/materials produced by writers from different countries	0	0	
* Percentages which met the quartile rule				

Theme-5. Nurturing a climate of inquiry and critical reflection

Based on 3 classroom observations as shown in Table 7, the overall picture indicates that generally, the Biology lecturer fell short of nurturing a climate of inquiry and critical reflection. While the Biology lecturer was seen giving investigative tasks to the students (#35, f = 1), posing questions which are open and reflective in nature (#38, f = 1) and providing opportunities to students critically evaluate and contribute to the scholarly discourse on practice (#39, f = 1), there was neither an observation of practices which include assignment or question that requires students to reflect on what they have learned and to suggest ways for improvement in the assignments (#33, f = 0) nor provide students the opportunity to do a critical reflection on their own experiences (#34, f = 0). The lecturer was neither seen in encouraging students to ask questions (#37, f = 0) nor was she seen inculcating an attitude in demonstrating a willingness to revise her own views and admit error made (#36, f = 0).

Table-7. Teaching Practices as Checked Against Indicators for Nurturing a Climate of Inquiry and Critical Reflection

Item	Indicator	f	%	
33.	Include assignment that requires students to reflect their learning and to suggest ways for improvement	0	0	
34.	Ask students to do a critical reflection on their own experiences.	0	0	
35.	Give investigative tasks	1	33.3	*
36.	Demonstrate a willingness to revise own views and admit error, and encourage this attitude among students.	0	0	
37.	Encourage students to ask questions.	0	0	
38.	Ask questions which are open and reflective in nature.	1	33.3	*
39.	Provide opportunities for students to critically evaluate and contribute to the scholarly discourse on practice.	1	33.3	*
* Percentages which met the quartile rule				

Theme-6. Nurturing good values, attitudes and behaviours

Based on 3 classroom observations as shown in Table 8, the Biology lecturer was seen nurturing good values, attitudes and behaviours by promoting cooperation among students by getting them to work in pairs or in small group (#40, f = 1), modeling and exemplifying good working habits when conducting the lessons (#41, f = 1) in terms of punctuality, work organisation and preparedness, and showing genuine enthusiasm when teaching the topics in the course (#43, f = 1). Equally, the lecturer was also seen to use positive language encouraging the students to improve (#44, f = 1) and encouraging students to take responsibility for their own learning (#49, f = 1). Nevertheless, it was not observed that the lecturer makes clear to the students the quality level of work expected and valued (#42, f = 0), uses strong deterrent language to make students understand the need to be responsible for all their non-conforming actions (#45, f = 0), encourages students to fall back on their beliefs when they feel discouraged in their studies (#47, f = 0), encourages students to keep up with educational development and best practices around the world (#48, f = 0), and encourages students to learn not just for the sake of getting good grades but more importantly to serve humanities and/or God (#50, f = 0). In terms of academic plagiarism, the Biology lecturer observed had not been seen to remind or even caution students not to plagiarise (#46, f = 0).

Table-8. Teaching Practices as Checked Against Indicators for Nurturing Good Values, Attitudes and Behaviours

Item	Indicator	f	%	
40.	Ask students to cooperate through pair or small group work.	1	33.3	*
41.	Model good working habits (e.g. punctual / well prepared)	1	33.3	*
42.	Make clear to students the quality expected in their work.	0	0	
43.	Show genuine enthusiasm when teaching.	1	33.3	*
44.	Use positive language to encourage student improvement	1	33.3	*
45.	Use strong deterrent language for students' non-conforming actions.	0	0	
46.	Remind students not to plagiarise.	0	0	
47.	Encourage students to fall back on their beliefs when discouraged	0	0	
48.	Encourage students to keep abreast with educational development and best practices around the world.	0	0	
49.	Encourage students to take responsibility for their own learning	1	33.3	*
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	

* Percentages which met the quartile rule

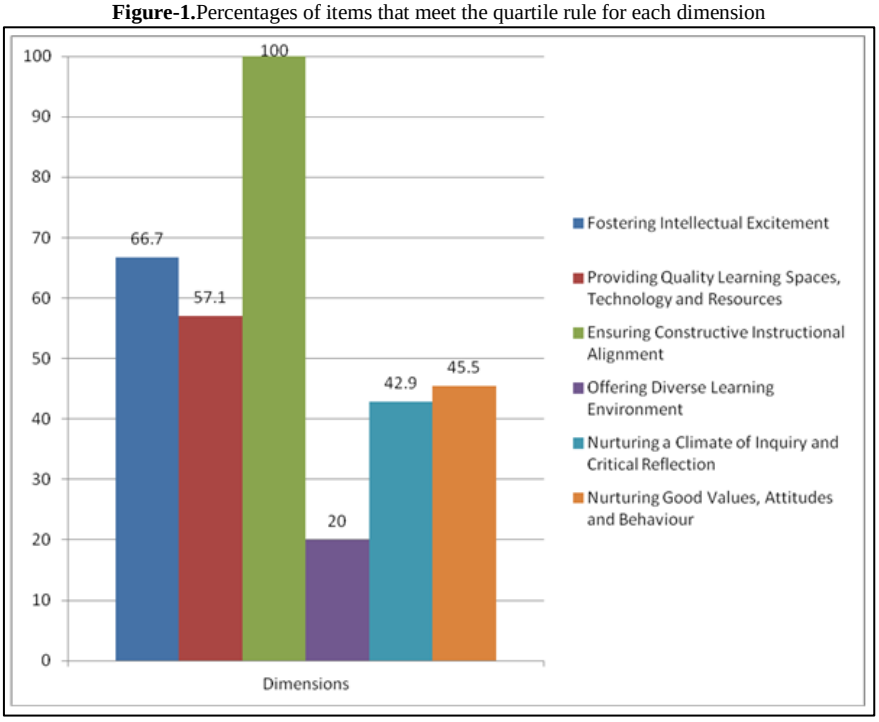
4.1. Summary of Findings

The prevalence of practices across the six dimensions indicates a mixed outcome within and across dimensions. For example, within the dimension of nurturing a climate of inquiry and critical reflection, three items registered a heartening percentage above the quartile cut-off point of 25%, while the remaining items, nevertheless, did not meet the quartile rule. Meanwhile, analysis across dimensions indicates that all indicators within the dimension of ensuring constructivist alignment were prevalent and met the quartile rule whereas all the indicators, except one, within the dimension of offering diverse learning environment failed to meet the quartile rule. Given this mixed outcome, it is therefore difficult to make an objective conclusion to the prevalence of practices in terms of each dimension. In order to provide a more concretised conclusion, the number of items (or, indicators) within each dimension was noted and the percentage calculated. Table 9 summarises the percentages for each dimension in terms of the number of items within the dimension that meets the quartile rule. These percentages are graphically depicted in Diagram 1.

Table-9. Percentages across Dimensions in terms of Indicators Meeting the Quartile Rule

Number	Principle	Items	#Items>25%	Percentage
1	Fostering intellectual excitement	1 – 12	8 (out of 12)	66.7%
2	Providing quality learning spaces, technology and resources	13 – 19	4 (out of 7)	57.1%
3	Ensuring constructive instructional alignment	20 – 27	8 (out of 8)	100%
4	Offering diverse learning environment	28 – 32	1 (out of 5)	20.0%
5	Nurturing a climate of inquiry and critical reflection	33 – 39	3 (out of 7)	42.9%
6	Nurturing good values, attitudes and behaviours	40 – 50	5 (out of 11)	45.5%

Figure-1. Percentages of items that meet the quartile rule for each dimension



Based on the summary given in Table 9, it is clear that, in terms of coverage of aspired teaching practices which met the quartile rule, the Biology lecturer ensured constructive instructional alignment (100%), fostered intellectual excitement (66.7%), provided quality spaces, technology and resources (57.1%), nurtured good values, attitudes and behaviours (45.5%), and nurtured a climate of inquiry and critical reflection (42.9%). Nevertheless, the characterised teaching practices indicated that the Biology lecturer barely offer diverse learning environment (20%).

5. Discussion and Implications

In recapitulation, this study was conducted to characterise the Biology teaching practices in a teacher education institution so as to inform us the existing practices which could then be compared with the aspired practices as depicted in Tables 3-8. Accordingly, the pedagogical hiatuses (or, shortcomings, shortfalls, or gaps) are uncovered as shown in Table 10. By pedagogical shortfall, we take it to mean that these aspired practices were not observed throughout the series of classroom observation by the observers.

Table-10. Pedagogical Hiatuses Identified from the Classroom Observations

Item	**Indicators for Theme 1: Fostering Intellectual Excitement**
4	Debate
5	Role-play or Simulation
7	Evaluate peers' work/idea
8	Challenge peers' or lecturer's idea
Item	Indicators for Theme 2:Providing Quality Learning Spaces, Resources and Technologies
15.	Inform students where to get the needed books or course materials
18.	Make use of web based resources as part of the materials.
19.	Assist students in developing the skills to use learning resources
Item	Indicators for Theme 4: Offering Diverse Learning Environment
28.	Form heterogeneous groups in terms of cultural backgrounds
29.	Use culturally relevant examples
31.	Encourage sharing of different cultural views/ ideas
32.	Use books/materials produced by writers from different countries
Item	Indicators for Theme 5: Nurturing a Climate of Inquiry and Critical Reflection
33.	Include assignment that requires students to reflect their learning and to suggest ways for improvement
34.	Ask students to do a critical reflection on their own experiences.
36.	Demonstrate a willingness to revise own views and admit error, and encourage this attitude among students.
37.	Encourage students to ask questions.
Item	Indicators for Theme 6: Nurturing Good Values, Attitudes and Behaviours
42.	Make clear to students the quality expected in their work.
45.	Use strong deterrent language for students' non-conforming actions.
46.	Remind students not to plagiarise.
47.	Encourage students to fall back on their beliefs when discouraged
48.	Encourage students to keep abreast with educational development and best practices around the world.
50.	Encourage students to learn not just for the sake of getting good grades but more importantly to serve humanities and/or God.

The pedagogical hiatuses, based on the inference whereby the indicators as listed in Table 10 were not observed, indicate that the lecturer whose classes were observed may not have the pedagogical knowledge and pedagogical content knowledge. Understanding the pedagogical hiatuses within one's current knowledge base is crucial as it helps to "determine whether and to what extent re-skilling is required" (Sonmark *et al.*, 2017).

Pedagogical knowledge is defined as "the specialised knowledge of teachers in creating and facilitating effective teaching and learning environments for all students, independent of subject matter" (Sonmark *et al.*, 2017). In the case of the Biology lecturer, while she is a content expert in Animalia Kingdom, Plantae and Meiosis by virtue of her doctorate in Biology, she may have limited pedagogical knowledge especially on the use of simulation, role-play, and cooperative learning whereby heterogeneous groups are formed, given that it is not mandatory for university content lecturers to possess a professional teaching qualification.

Accordingly, a continued professional development is needed by the Biology lecturer in familiarising herself with the pedagogical knowledge on what simulation, role play and cooperative learning are. For example, she needs to know 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" (Centre for Science Education, 1992). She needs to be able to discern between simulations from that of a role play. Role play has been described as "person-centred" whereby scientific issues and concepts are explored by asking students to imagine they are in someone else's shoes, whereas simulations are "job-centred" as the emphasis is on carrying out a certain task and students behave according to the task at hand, with no teacher intervention (Centre for Science Education, 1992).

Equally, the lecturer needs to know the "know-how" of using the simulation strategy: the stages of simulation. For example, Centre for Science Education (1992) stipulates a 5-stage approach for the use of simulation: Preparation, Briefing, Action, Debriefing, and Follow-up. The preparation stage entails checking worksheets and resources, and working out the positions of items as well as people in the room. In briefing state, the lecturer explains the structure and rules to students, discusses the background information, and hands out materials. In the action phase, the lecturer steps back, records and assesses, when the class itself is in control. In the debriefing stage, the lecturer discusses the simulation activity, stressing the important points and correcting misconceptions. She also creates an overview of the simulation. Finally, in the follow up stage, lecturer sets task for students to complete diagrams, write reports, and prepare presentations, besides identifying links with future work (Centre for Science Education, 1992).

Although the Biology lecturer, at this juncture, has addressed the content knowledge (i.e., the knowledge of the subject matter – in this case, Biology, and its organising structures) and the pedagogical knowledge, there is one more aspect which needs to be looked into, namely the pedagogical content knowledge (Shulman, 1986;1987) which is the knowledge of content and pedagogy. With an adequate pedagogical content knowledge, the Biology lecture is able to deliver the topic, say Meiosis, in an effective way using the appropriate pedagogy.

On the basis of the discussion in the preceding paragraphs, the findings of this study certainly do have some implications for teacher education. These implications could broadly be categorised into two categories, namely (i) the content coverage on pedagogy (or models of teaching) in teacher education, and (ii) the pedagogical coverage of pedagogy.

For instance, cased on the pedagogical hiatuses in terms of "offering diverse learning environment" which was rated at 20%, content coverage on pedagogy should give due attention on the indicators within this theme during the continued professional development sessions. For example, while the lecturers, in general, are familiarised to the use of group work and cooperative learning (Gillies, 2016), they, however, may not be competent in the use of heterogeneous grouping in terms of cognitive ability, ethnicity and cultural background.

With regard to the pedagogical coverage of pedagogy, the famous idiom, "practise what you preach" should be used as a lamp to our pedagogical feet and a light to our pedagogical path in teacher education. As such, if a teacher educator wishes to teach, say the simulation of the process of meiosis (Centre for Science Education, 1992) or the structural approach to cooperative learning (Kagan, 1989), he/she should model to his/her student teachers the way in which the process of meiosis is simulated, or how each of the structures in the structural approach is enacted. By practising what one preaches, only then will the "sermon" be effective, in line with the maxim by Roberts-Hull *et al.* (2015) which states that "effective teacher preparation programs should model the practices they expect from their student teachers" (p. 6).

6. Conclusions

This study which characterises the teaching practices of a Biology lecturer in a teacher education institution reveals one major hiatus, namely "offering diverse learning environment" in which the rating observed was less than the quartile rule. While other themes were observed more than the quartile rule, there were still a number of indicators within each theme which were observed less than the quartile rule, and hence attention needs to be given in addressing those pedagogical hiatuses. Two implications for teacher education are proffered, particularly in term of content coverage on pedagogy in teacher education, and the pedagogical coverage of pedagogy. These hiatuses can be successfully addressed through the providence of pertinent in-service courses which must be conducted in line with the practise-what-you-preach idiom and the maxim of "modelling the practices that one expects" of his/her pre-service teachers.

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