Teachers' Beliefs, Practices, and Challenges: Enhancing Inquiry-Based Learning in Bintulu's Secondary Science Classrooms

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***Abstract* – The purpose of this study is to examine secondary science teachers' beliefs about and practices in using the Inquiry-Based Learning (IBL) model in science lessons. It also aims to determine the challenges or difficulties facing science teachers in IBL implementation. The cross-sectional survey design was utilized to answer the research questions. A convenience sample of 50 secondary science teachers from five secondary schools in Bintulu, Sarawak answered a 28-item survey on IBL. Descriptive statistics (i.e., means, standard deviations, frequencies and percentages) and Pearson correlation were used in the data analysis. The results show that science teachers have positive beliefs about using IBL in the classroom (M= 3.34) and reported practicing IBL very often (M= 3.28). However, teachers refrain from freely allowing students to conduct science experiments in the science lab due to safety concerns. The main challenges in IBL implementation were insufficient time, overcrowded classrooms and inadequate teaching materials and resources. The findings of this study will help teachers and school administrations to improve the implementation of IBL in school. The results may also guide the teachers of other subjects where IBL can be applied. This study can be further extended with bigger samples that include urban and rural science teachers. Qualitative research methods— such as document analysis and non-participant classroom observations— are recommended to obtain more in-depth information on IBL implementation in Malaysian schools.**

***Keywords* – Inquiry-based learning, IBSE, Science education, Secondary schools, 21st century learning, Student-centred approach, Teaching methods, Instructional strategies**

I. INTRODUCTION

Education systems nowadays tend to focus more on equipping learners with knowledge and skills that are judged necessary to help them perform effectively in the current era that is rife with new ideas, new inventions, global competitiveness and technological sophistication. Among the emphasized skills are the much-hyped 4Cs (i.e., collaboration, communication, cooperation and critical thinking), as well as lifelong skills and technological competencies. In this era of great change, studies looking into the "right" type of education to be imparted to students are numerous and never ending. In all this fervor, Ramnarain and Hlatswayo (2018) remind us of an important core principle that needs to be remembered in our search for the right education—that it needs to prepare our future generations of youth and children to be more independent students are expected to be problem solvers and critical thinkers who can use the systems concept for understanding and framing problems (Matthee & Turpin, 2019). Developing such abilities has been a clear and a great challenge for present-day teachers. What it means for them is they need to modify and improve their teaching methods to align with current demands to develop critical competencies in students. Their instructional methods must be effective enough to promote a holistic development of students in order that the students can compete globally. In response to these demands, the Ministry of Education (MOE) Malaysia developed the National Education Blueprint with the aims of raising the standard of local education to that of international standard. With the shifts proposed in the blueprint, the preparation of Malaysian students for the needs of the 21st century workplace is necessary and timely (Ministry of Education, 2013).

To have a comprehensively effective teaching and learning process, various learning models have been practiced and tested, and the outcomes were reviewed. (Andrini, 2016; Kang & Keinonen, 2018; Lee & Boo, 2022) commented that using a less precise learning model may lead to students' disinterest and demotivation in classroom activities. Therefore, the efficacy of more instructional models needs to be tested, that is, those that meet the needs of 21st century learners. The Inquiry-Based Learning (IBL) model is lauded as one of the instructional models capable of enhancing students' achievement and scientific attitudes, in addition to changing their learning strategies towards greater independence, creativity and tolerance (Kousloglou et al., 2023; Majeed et al., 2023). The same narrative is mooted in plenty of research into IBL's effectiveness across disciplines (e.g., Gormally et al., 2009; Husni, 2020; Pedaste et al., 2015; Sotiriou, Lazoudis & Bogner, 2020; Venera & Hewa, 2023).

IBL includes student-centred learning activities that enhance learners' analytical and critical thinking by having them solve real-world problems in authentic contexts. IBL is a question-driven strategy of learning that is premised on the belief that humans have a strong desire to find their own knowledge and construct their own understanding of the world (Collins & Stevens, 1983; Collins, 1987; Sanjaya, 2006). In IBL, students relate their previous experience to the new knowledge being taught, and then apply it in relevant situations (Hazari, North & Moreland, 2009; Nuttavut et al., 2020). Given these benefits, IBL should be implemented by teachers in the classroom, but what teachers actually believe about this instructional strategy—how they perceive IBL—is not clearly known. Hence, this study is an attempt to determine secondary school teachers' beliefs about IBL, and the practices and challenges facing them in IBL implementation, particularly in the subject of science.

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II. PROBLEM STATEMENT

The Malaysian National Education Blueprint (2013) states that the performance of Malaysian students in critical subjects like science and mathematics is deteriorating based on their achievements in international student assessments, such as the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA). These assessments are unlike the traditional pencil-and-paper tests that Malaysian students are accustomed to. Rather, they assess higher-order cognitive skills in applying knowledge and principles, and students' ability to reason (Ministry of Education, 2013). In 1999, Malaysia first participated in TIMSS and scored higher than the international average in science and mathematics before her performance dropped drastically in the year 2011, with 35% and 38% of Malaysian students failing to meet the minimum proficiency levels in mathematics and science, respectively. This implies the limited mastery of basic mathematical and scientific concepts and reasoning skills possessed by Malaysian students. The same applies to PISA where Malaysia was placed at the bottom third of 74 participating countries. These results served as a wakeup call for the Ministry of Education to revise the national curriculum and for all education practitioners to re-examine their instructional approaches that have been practiced for decades.

In Malaysia, direct instruction is a prevalent approach among teachers to deliver the content of the syllabus (Kaya et al., 2021; Mohamad Hisyam et al., 2019). Teachers who employ direct instruction are likely those that regard teaching as a process of mere information transfer and prefer a one-way communication in the classroom where students hardly get any chance to interact with one another during the lesson. However, according to Vygotsky (1962), this kind of teaching method is ineffective and the lesson will not be fruitful. The students will only obtain the meaningless repeating of terminology and never get a concrete understanding of the actual concepts.

Literature has shown that using IBL in the classroom improves students' engagement and achievement. In Abdi (2014), IBL produced higher achievement scores compared to the traditional method of learning science. IBL works because it is based on constructivist principles that insist on practical hands-on exploration of learning materials through inquiry, discovery and problem solving (Thompson, 2006). In these strategies and processes, both knowledge and skills are interwoven and work concurrently. In IBL, students construct their own learning by asking questions, addressing problems, formulating hypotheses, developing models, planning and conducting investigations, analyzing and interpreting data, using mathematics and computational thinking, explaining situations, designing solutions, justifying inferences with evidence, and evaluating and communicating information (National Research Council of the National Academies, 2012). In a nutshell, the inquiry method enhances higher-order thinking skills—such as analyzing and evaluating—among students (Conklin, 2012).

Upon completing tertiary education, students will compete for places in the industry and job markets. It is a highly competitive world where only the talented and the skilful will get the best jobs (Cornish, 2004; Musalamani et al., 2021). Hence, the preparations for entry into this competitive world should start early and be planned well ahead. Beginning with elementary and secondary education, teachers must prepare students with the lifelong skills they need later in life, i.e., those that require the ability to think critically, communicate effectively and efficiently, and use technology in appropriate and responsible ways (Silva, 2008). Therefore, the implementation of IBL is essential in order to produce students that can cope with the evolving industry. Due to this, in a recent systematic review, Marimuthoo and Nasri (2019) argued that teachers have a crucial role to play in implementing IBL in their classrooms effectively. They further added that teachers' beliefs about using IBL in lessons is important; and they are influenced by the challenges they face in IBL implementation. Hence, this study examines secondary Science teachers' beliefs about IBL, as well as the practices and challenges facing them in IBL implementation.

III. LITERATURE REVIEW

Theoretical Foundation of IBL

IBL is an educational approach that has its roots in the learning theory of constructivism, which suggests that humans construct knowledge and meaning from direct experiences with the external world, and not from mere information transfer and passive acceptance of established facts (Olusegun, 2015). IBL has several important characteristics that work to develop critical thinking and problem-solving skills in students. Its major strength is that it allows students to form and express concepts through a series of questions and active participation during the lesson. Marimuthoo and Nasri (2019) explained that IBL provides "authentic learning experiences applicable for a wide range of disciplines providing a strong and empowering foundation for the 4C component in 21-st century skills" (p. 18). Using the IBL approach, students become the center of the learning, while the teacher acts as a facilitator in an active process of knowledge construction and meaning making. In IBL, students have the opportunity to contribute to the learning process, construct their own knowledge through experiments and project-based learning, and express their ideas throughout the lesson. Pedaste et al. (2015) explained in their literature review on IBL that inquiry-based learning has become popular in science curricula, project development, research and teaching because of modern developments fueled by technological advancements. They added that IBL has distinct inquiry phases that form the inquiry cycle. This cycle may differ based on the specific model of inquiry being adopted.

However, in Malaysian science classrooms, students are normally exposed to the traditional learning method where the teacher has total control over the students with content being delivered through one-way communication (Ravana & Palpanadan, 2022; Sobral, 2021). The materials typically used are mainly taken from textbooks and workbooks. At the end of the syllabus, students are given numerous sets of questions to be answered as a preparation for their examinations (Mohamad Hisyam et al., 2019). This kind of didactic learning experience will not likely promote students' engagement in science, or boost their interest in the subject, which then leads to the decreasing number of secondary students taking the science stream. Based on the statistics of students' enrolment in 2021, there were 80, 278 students in the science stream, which decreased to 73, 888 in 2022. This data indicates a decrease of 8 percent from 2021 to 2022 (EPRD, 2022). According to a study conducted by Mohd. Ramli & Awang, (2020) the decline in enrolment in the science stream is attributed to students' diminished interest in science subjects, perceiving them as challenging, which may consequently impact examination outcomes. Students who opt out of the science stream in upper secondary levels jeopardize opportunities to pursue tertiary education or higher learning institutions offering STEM fields, thereby attenuating prospects for engaging in STEM-related careers. Hence, IBL is one of the most suitable methods to increase student-centeredness and learning engagement, two factors that work to improve students' achievement and attitude towards science. It is important to add that teachers' beliefs about IBL play an important role in IBL implementation in science classrooms as they are facing various challenges in this respect (Marimuthoo & Nasri, 2019).

Empirical Studies on IBL

IBL is an educational approach that has its roots in the learning theory of constructivism, which suggests that humans construct knowledge and meaning from direct Literature has shown that IBL has been used in various academic disciplines for its positive impacts on students' motivation, engagement and achievement (Buchanan et al., 2017; Husni, 2020). For instance, Damopolii et al. (2020) in an experimental study, tested the effectiveness of IBL in improving high school learners' thinking skills based on the SOLO taxonomy. The evidence led them to conclude that using IBL actually improved learners' thinking skills. Husni (2020) tested the effect of inquiry learning models on high school students' involvement in learning religious studies subjects. The findings showed that students became "more diligent, more enthusiastic, asked more questions, more active in discussion group, and more creative in solving problems and finding new knowledge" (p. 43). Ramnarain and Hlatswayo (2018) investigated the effectiveness of inquiry-based instruction in improving the mathematics and science achievements of fifth graders in a rural elementary school in South Alabama. It was concluded that inquiry-based instruction was effective in increasing students' achievements in mathematics and science for certain student subgroups, particularly black students, female students and students living in poverty. Clearly, IBL offered academic benefits to certain disadvantaged groups.

Using cross-sectional survey data, Ibrahim and Mahmud (2020) studied the relationship between secondary teachers' knowledge and perceived skills in implementing IBL in science teaching. They concluded that teachers' knowledge and skills are related to each other; and they are necessary components in the implementation of inquiry-based science teaching. In their systematic review, Marimuthoo and Nasri (2019) stated that teachers' beliefs about using IBL in science lessons play a major role in its effective implementation. These beliefs are based on the challenges facing teachers in IBL application.

Various studies have been conducted to investigate the circumstances that can be a hindrance for IBL. Saad and BouJaoude (2012) asserted strongly that teachers' beliefs about teaching, learning and classroom management are among the main barriers to inquiry implementation and practices in science classrooms. Haney, Czerniak and Lumpe (1996) reported that teacher beliefs could predict their willingness to use more interactive or "a reform-based pedagogy" including IBL. Wallace and Kang (2004) found that teachers who had positive beliefs about inquiry actually worked on integrating IBL into classroom learning activities, and they produced more successful and effective learning in science, particularly in instilling a sound understanding of science concepts. According to Taylor and Bilbrey (2016), teachers generally are not dismissive of IBL, but instead, consider inquiry-based approaches workable for their teaching contexts.

Finally, the literature has referred to various challenges and factors that affect the implementation of IBL in the teaching and learning process. Ramnarain and Hlatswayo (2018) said, "teachers claim that the implementation of inquiry-based learning is fraught with difficulty and this creates a tension in their willingness to implement it" (p. 1). Among the main factors that make the teaching of inquiry lessons difficult are the lack of laboratory facilities, limited teaching materials, insufficient time to complete the curriculum, and large classes. In conclusion, the empirical literature reveals that researchers have discovered that IBL is one of the effective methods of science teaching, and that there is a strong relationship between teachers' beliefs about and attitudes towards IBL.

IV. METHOD

The purpose of this study is to explore secondary science teachers' beliefs about IBL, their practices of it and the challenges they faced in its implementation. This section describes the procedures involved in data collection and analysis which are organized as follows: research methods, population of the study, sample size and sampling procedure, research instrument, data collection procedure and data analysis.

In this study, the quantitative cross-sectional survey design was utilized. The survey design is among the most common designs used in education research (Creswell, 2014). All of the study's dependent variables related to IBL are quantitative in nature, implying that they vary in degree and amount (Johnson & Christensen, 2000). The quantitative data were collected by distributing the questionnaires to science teachers in secondary schools in Bintulu, Sarawak, Malaysia.

The population is a complete set of observations that a researcher is interested in. This study was conducted with a population of 75 science teachers who were teaching the lower and upper secondary levels in five (5) schools in the Bintulu district, Sarawak, Malaysia. It is important to highlight that the teachers who completed the questionnaire were those teaching the science subject and those using IBL in their classes. In this study, the respondents had taught at least one science class, and were generally familiar with IBL.

The researcher used convenience sampling to select respondents from the five (5) schools in the Bintulu district. The researcher was working in the same district so she was able to contact available teachers who were willing to participate in the study. The researcher managed to get a quick consent from the respondents. The final sample size taken was 50 science teachers from the total population of 75 (66.7%).

In this study, the researcher used the cross-sectional survey method to acquire IBL data from 50 teachers. The survey questionnaire comprised 28 items divided into four (4) sections including the respondents' demographic information (e.g., gender, age, race and teaching experience). The survey was short enough to sustain the attention of the respondents, but it covered the important information needed for this study. Some items from the instrument were adopted in whole, while some others were adapted to suit the local context (Otilia & Lucia, 2013). Six (6) questions of the survey looked at teachers' beliefs, eight (8) questions on IBL-aligned instructional practices, and the remaining eight (8) on the challenges they encountered. The questionnaire was prepared in English and took approximately 10 to 15 minutes for a respondent to complete. All respondents were asked not to write their names on the questionnaire as their responses were completely confidential. Finally, they were required to select one of the four Likert categories given—ranging from Strongly Disagree (1) and Disagree (2) to Agree (3) and Strongly Agree (4). Table I shows some sample items from the questionnaire by construct.

TABLE I: SAMPLE QUESTIONNAIRE ITEMS BY CONSTRUCT

Construct	Sample Item	Total
Demographic	Age, gender, race, teaching experience	6
Teachers' Beliefs	IBL is important for my current teaching practices. IBL develops extensive content knowledge among students.	6
Teachers' Practices	I let my students learn through doing exercises. I give my students easy questions followed by harder questions.	8
Teachers' Challenges	I do not have enough time to prepare IBL lessons. I do not have adequate teaching materials to use for IBL.	8

Content validation is done by experts who have deep knowledge and expertise about the subject matter being researched (Otilia & Lucia, 2013). Three lecturers from the Kulliyyah of Education, IIUM were selected to validate the questionnaire items and to provide useful feedback on the items used to measure beliefs, practices and challenges surrounding IBL. The experts reviewed the research questions and operational definitions of the key terms, and assessed whether each item aligned well with the construct it was supposed to measure. The experts were asked to evaluate the relevance of each item using the following assessment scale: perfect match, moderate match and poor match. This information was used later to refine the instrument. Items that were assessed as poor matches were removed from the questionnaire, and those regarded as perfect matches were kept. Items with a moderate match were refined and reassessed by the content experts. Upon completing this exercise, the questionnaire items were judged to have content validity.

A reliability test was also run to check the internal consistency, stability and repeatability of the items (Mohajan, 2017). The method used in this study was the Cronbach's alpha coefficient as the internal consistency estimate. Table II shows that the reliability indexes of all three constructs were above the recommended value of 0.70 (Pallant, 2013).

TABLE II: RELIABILITY ESTIMATES OF THE IBL CONSTRUCTS

Construct	Number of Items	Cronbach's Alpha
Teachers' Beliefs	6	0.844
Teachers' Practices	8	0.896
Challenges in IBL	8	0.870

The researcher distributed the questionnaires to the science teachers in the staff rooms of the selected schools. The teachers were given a short briefing on the intention of the study and were informed that their participation would be kept anonymous and confidential. They took five minutes to complete the questionnaires. In order to get more teachers to participate in this survey, the researcher also constructed the questionnaire in Google Forms to make it more convenient for the teachers to answer the survey in their free time. The completed questionnaires were collected and made ready for the data analysis.

Descriptive statistics (i.e., frequencies, percentages, means and standard deviations) were used to answer the first three questions: 1) What are teachers' beliefs about using IBL in the science classroom? 2) How do teachers practice IBL in the science classroom? and 3) What are the challenges facing teachers in implementing IBL in the science classroom? Apart from the descriptive analysis, the Pearson correlation analysis was performed to answer the fourth question which is to determine the relationship among teachers' beliefs, practices and challenges in the implementation of inquiry-based learning. The level of significance for decision-making is determined to be at $p = 0.05$, which is the generally accepted level of statistical significance in social science research. The collected data were processed in SPSS (version 27). All the results are presented in tables and subsequently described in the next section.

V. FINDINGS

This section first presents a demographic profile of the secondary science teachers who participated in the survey, followed by the results of data analysis obtained in relation to the four research questions: 1) What are teachers' beliefs about using IBL in the science classroom? 2) How do teachers practice IBL in the science classroom? 3) What are the challenges facing teachers in implementing IBL in the science classroom? and 4) Is there any relationship between teachers' beliefs, practices and challenges in implementing IBL in the science classroom?

The sample consisted of 50 secondary science teachers from three rural Bintulu schools. Table III shows that male respondents made up 20.0% of the sample (n=10), while female respondents, 80.0% (n=40). The respondents were categorized into four different age groups, where a majority were aged between 31 and 40 years (58.0%; n=29). Other respondents were aged between 21 and 30 years (30.0%; n=15), and 41 and 50 (10.0%; n=5), with only one respondent being above 50 years of age (2.0%; n=1). In terms of race, a majority of the respondents were Malay 56.0% (n=28), while Chinese made up 32.0% (n=16) and other ethnic groups, 12.0% (n=6). The teachers had a teaching experience that ranged between 1 and 5 years (30.0%, n=15), 6 and 10 years (34.0%, n=17), and 11 and 15 years (22.0%, n=11). Teachers with the most experience, i.e., over 16 years, constituted just 14.0% (n=7) of the sample. Finally, 72.0% (n = 36) of the respondents were science majors, while the rest specialized in other fields, but were currently assigned to teach science (28.0%; n=14).

TABLE III : RESPONDENTS' DEMOGRAPHICS (n=50)

Construct	Variable	Frequency	%
Gender	Male	10	20.0
	Female	40	80.0
Age	21 – 30 years	15	30.0
	31 – 40 years	29	58.0
	41 – 50 years	5	10.0
	Above 50 years	1	2.0
Race	Malay	28	56.0
	Chinese	16	32.0
	Indian	0	0.00
	Other	6	12.0
Teaching Experience	1 – 5 years	15	30.0
	6 – 10 years	17	34.0
	11 – 15 years	11	22.0
	Over 16 years	7	14.0
Specialization	Science	36	72.0
	Other	14	28.0

This study assessed three important aspects of IBL implementation among the science teachers, namely their beliefs (6 items), practices (8 items), and the difficulties or challenges faced (8 items). Descriptive statistics (i.e., frequencies, percentages, means and standard deviations) were used to analyze the teachers' responses to the twenty-two items addressing the first three research questions. Table IV reveals that the mean score values are M = 3.34 (SD=0.430) for teachers' beliefs, M = 3.28 (SD=0.500) for teachers' practices, and M = 2.66 (SD=0.612) for challenges. The mean values suggest that the teachers have a high level of positive beliefs about IBL and appear to also employ IBL in their classrooms. However, the challenges they experienced varied among the teachers based on the results obtained.

TABLE IV: DESCRIPTIVE ANALYSIS OF THE CONSTRUCTS (n=50)

Construct	Mean	Standard Deviation
Teachers' Beliefs	3.34	0.430
Teachers' Practices	3.28	0.500
Challenges	2.66	0.612

Table V presents the results of the descriptive analysis (i.e., frequencies, means, standard deviations and percentages of agreement) of the teachers' beliefs arranged in a descending order from items with the highest to the lowest mean scores. Item 2 has the highest mean score, M = 3.48 (SD=0.505), that shows all respondents (100.0%) agreeing that IBL encourages students to develop extensive content knowledge. This is followed by Item 1 (i.e., IBL is important for my current teaching practices) (M=3.38, SD=0.530, 98.0%) and Item 5 (i.e., IBL creates active participation among students during my lessons) (M=3.36, SD=0.563, 96.0%). Meanwhile, Item 4 (i.e., IBL is appropriate for overcoming students' motivation problems) (M=3.34, SD=0.557, 96.0%) and Item 6 (i.e., IBL is appropriate for addressing students' learning problems) (M=3.34, SD=0.519, 96.0%) obtained a slightly lower mean. The two items show the same mean values and percentages of agreement (M=3.34, 96.0%). The lowest mean was obtained for Item 3 (i.e., IBL fits both low and high achieving students) (M=3.16, SD=0.738, 84.0%).

TABLE V: DISTRIBUTION OF RESPONSES FOR TEACHERS' BELIEFS (n=50)

No.	Item	1 n %	2 n %	3 n %	4 n %	TA	M	SD
2	IBL develops extensive content knowledge among students.	0 0.0	0 0.0	26 52.0	24 48.0	100.0%	3.48	0.505
1	IBL is important for my current teaching practices.	0 0.0	1 2.0	29 58.0	20 40.0	98.0%	3.38	0.530
5	IBL creates active participation among students during my lessons.	0 0	2 4.0	28 56.0	20 40.0	96.0%	3.36	0.563
4	IBL is appropriate for overcoming students' motivation problems.	0 0	2 4.0	29 58.0	19 38.0	96.0%	3.34	0.557
6	IBL is appropriate for addressing students' learning problems.	0 0	1 2.0	31 62.0	18 36.0	98.0%	3.34	0.519
3	IBL fits both low and high achieving students.	1 2.0	7 14.0	25 50.0	17 34.0	84.0%	3.16	0.738
	Overall					95.0%	3.34	0.569

1 – Strongly disagree; 2 – Disagree; 3 – Agree; 4 – Strongly agree
TA – Total agreement; M – Mean; SD – Standard deviation

Table VI presents the distribution of responses to the items measuring the science teachers' practices of IBL. It shows that three items have the same mean score values (M=3.42). All respondents agreed with Item 4 (i.e., I give opportunities for my students to explain their own ideas) (SD=0.499, 100.0%) followed by Item 2 (i.e., I give my students easy questions followed by harder questions) (SD=0.609, 94.0%), and Item 7 (i.e., I ask my students to draw conclusions from an experiment they have conducted) (SD=0.642, 92.0%). The next two items that share the same mean score value (M=3.28) are Item 5 (i.e., I let my students have discussions about the topics) (SD=0.671, 88.0%) and Item 3 (i.e., I ask my students to work collaboratively in pairs or small groups) (SD = 0.757, 82.0%). About 90.0% of the respondents agreed with Item 6 (i.e., I let my students do practical activities) (M=3.22, SD=0.616) and Item 1 (i.e., I let my students learn through doing exercises) (M=3.14, SD=0.572). However, only 72.0% of the respondents agreed with Item 8 (i.e., I give students opportunities to do an investigation to test out their own idea) (M=3.04, SD=0.832), indicating this to be the least common practice of IBL among the teachers.

TABLE VI: DISTRIBUTION OF RESPONSES FOR TEACHERS' PRACTICES OF IBL (n = 50)

No.	*Item*	*1*	*2*	*3*	*4*	*TA*	*M*	*SD*
		n %	**n %**	**n %**	**n %**			
4	I give opportunities for my students to explain their own ideas.	0 0.0	0 0.0	29 58.0	21 42.0	100.0 %	3.42	0.499
2	I give my students easy questions followed by harder questions.	0 0.0	3 6.0	23 46.0	24 48.0	94.0 %	3.42	0.609
7	I ask my students to draw conclusions from an experiment they have conducted.	0 0.0	4 8.0	21 42.0	25 50.0	92.0 %	3.42	0.642
5	I let my students have discussions about the topics.	0 0.0	6 12.0	24 48.0	20 40.0	88.0 %	3.28	0.671
3	I ask my students to work collaboratively in pairs or small groups.	0 0.0	9 18.0	18 36.0	23 46.0	82.0 %	3.28	0.757
6	I let my students do practical activities.	0 0.0	5 10.0	29 58.0	16 32.0	90.0 %	3.22	0.616
1	I let my students learn through doing exercises.	0 0.0	5 10.0	33 66.0	12 24.0	90.0 %	3.14	0.572
8	I give students opportunities to do an investigation to test out their own ideas.	1 2.0	13 26.0	19 38.0	17 34.0	72.0 %	3.04	0.832
Overall						88.5 %	3.28	0.650

1 – Strongly disagree; 2 – Disagree; 3 – Agree; 4 – Strongly agree
TA – Total agreement; M – Mean; SD – Standard deviation

The challenges to implement IBL are examined in three aspects: time management (Items 6 and 1), students (Item 8, 3, 4 and 5) and materials and resources (Item 7 and 2). The descriptive analysis for teachers' challenges is tabulated in Table VII which shows that Item 6 has the highest mean score value (M=3.06, SD=0.867), where 78.0% of the respondents found it difficult to implement IBL due to insufficient time allocated in the curriculum. This is followed by the class size being too big for IBL to be effective (M=2.84, SD=0.912, 66.0%); not having enough time to prepare IBL lessons (M=2.80, SD=0.881, 62.0%); students' discipline being more difficult to handle in IBL lessons (M=2.62, SD=0.945, 54.0%); and not having sufficient resources such as computers and laboratory apparatus to conduct IBL (M=2.58, SD=0.950, 50.0%). Less challenging situations for the science teachers were: not having adequate teaching materials to use IBL (M=2.56, SD=0.705, 48.0%); students getting lost in their learning in IBL lessons (M=2.54, SD=0.788, 52.0%); and finding it difficult to manage students during the group work for IBL (M=2.30, SD=0.678, 34.0%). Based on the results, teachers most likely do not experience any great difficulties in handling students and getting them involved in IBL lessons. The problems appear to be mainly related to time constraint, the lack of IBL teaching spaces, and the lack of IBL materials and resources.

TABLE VII: DISTRIBUTION OF RESPONSES FOR TEACHERS' CHALLENGES IN IMPLEMENTING IBL (n=50)

No.	*Item*	*1*	*2*	*3*	*4*	*TA*	*M*	*SD*
		n %	**n %**	**n %**	**n %**			
6	There is not enough time in the curriculum to use IBL.	3 6.0	8 16.0	22 44.0	17 34.0	78.0 %	3.06	0.867
8	The number of students in my class is too big for IBL to be effective.	4 8.0	13 26.0	20 40.0	13 26.0	86.0 %	2.84	0.912
1	I do not have enough time to prepare IBL lessons.	3 6.0	16 32.0	19 38.0	12 24.0	62.0 %	2.80	0.881
3	Students' discipline is more difficult to manage in IBL lessons.	6 12.0	17 34.0	17 34.0	10 20.0	54.0 %	2.62	0.945
7	I do not have sufficient resources such as computers and laboratory	6 12.0	19 38.0	15 30.0	10 20.0	50.0 %	2.58	0.950

	apparatus to conduct IBL.							
2	I do not have adequate teaching materials to use IBL.	1 2.0	25 50.0	19 38.0	5 10.0	48.0%	2.56	0.705
4	In IBL lessons, my students are often lost in their learning.	3 6.0	23 46.0	18 36.0	8 16.0	52.0%	2.54	0.788
5	It is difficult to manage students while doing the group work.	4 8.0	29 38.0	15 30.0	2 4.0	34.0%	2.30	0.678
	Overall					58.0%	2.66	0.841

1 – Strongly disagree; 2 – Disagree; 3 – Agree; 4 – Strongly agree
TA – Total agreement; M – Mean; SD – Standard deviation

The relationships among the constructs—teachers' beliefs about IBL, their practices of IBL and the challenges in IBL implementation—were examined using the Pearson product-moment correlation analysis. The results indicate a significant positive correlation, at a moderate strength, between teachers' beliefs in IBL and IBL practices, $r = 0.419$, $n = 50$, $p < 0.01$, with high levels of beliefs in IBL associated with high levels of IBL practices. There was also a significant negative correlation between teachers' beliefs in IBL and challenges, $r = -0.284$, $n = 50$, $p < 0.05$, with high levels of beliefs in IBL associated with low levels of challenges. The strength of this association was, however, low. However, the association between teachers' practices and challenges was not statistically significant, $r = -0.151$, $n = 50$, $p > 0.05$. The association was an inverse one where high levels of IBL practices are associated with low levels of challenges. A summary of the correlation results is given in Table VIII.

TABLE VIII: SUMMARY OF THE CORRELATION RESULTS (n=50)

Construct	Value	Beliefs	Practices	Challenges
Beliefs	Pearson Correlation (r)	-	0.419**	-0.284*
	Sig. (2-tailed) p-value		0.002	0.046
Practices	Pearson Correlation (r)	0.419**	-	-0.151*
	Sig. (2-tailed) p-value	0.002		0.294
Challenges	Pearson Correlation (r)	-0.284*	-0.151*	-
	Sig. (2-tailed) p-value	0.046	0.294	

This section has discussed the results of data analysis undertaken to establish science teachers' beliefs, practices and challenges in implementing IBL in the science subject. The descriptive statistics and correlation analysis were conducted to answer the study's four research questions. First, it was found that the respondents believed that IBL is important to extend students' scientific knowledge as it promotes their active involvement in the lessons. However, 16% of the respondents said that IBL is not suitable for both low and high achievers at the same time.

Second, it was discovered that the respondents practiced IBL in the classroom by giving students opportunities to explain their ideas, draw conclusions from experimental data, and work collaboratively. On the other hand, 28% percent of the respondents disagreed they allowed students to test out ideas through experimentation. Third, this study also examined the challenges in conducting IBL lessons and found that the three main challenges are related to technical and management issues, such as insufficient time allocation in the curriculum, extensive preparation time for IBL needed by the teachers, and large class sizes that make managing student discipline difficult. In summary, the problems in IBL implementation are mainly related to time constraint, teaching spaces, and the availability of teaching materials and resources.

In regard to the associations among the constructs, the study found a significant positive correlation between teachers' beliefs in IBL and their practices, at a moderate strength. Teachers' beliefs about IBL and challenges are negatively associated, while a significant and large correlation exists between teachers' practices and IBL implementation challenges. The implications of these key findings are discussed in the next section.

VI. DISCUSSION

The results show that the teachers surveyed in the study, who were secondary science teachers in rural Bintulu, have high levels of positive beliefs about teaching science using the IBL approach. Their beliefs about IBL may help students to advance further scientifically and gain a deep understanding of the science content covered in the syllabus (Ismail & Elias, 2014, Oziah 2022). If employed regularly in the science classroom, IBL will likely improve students' achievement over time (Thompson, 2006). Previous studies also found that students who were exposed to IBL actually became better in scientific knowledge, internal motivation and critical thinking abilities (Hernandez-Ramos & De La Paz, 2009, Chen 2021, Kousloglou 2023).

Generally, teachers believe that science should be real, relevant and rigorous if it is to motivate students to learn it (Butler, 2008, Nicolás-Castellano 2023). Ideally, students be exposed to real-world problems and contexts by using their life experiences to explain scientific ideas and understand the world around them. However, the findings of this research show that science teachers do not highly favor giving students the opportunities to explore their own ideas by testing them out in experiments. This refrain may be due to concerns about safety and health in the science lab. Alaimo, Langenhan and Tanner (2010) cautioned teachers and schools about having students perform unsupervised experimentations in science labs as they can get hurt due to inappropriate lab practices and a lackadaisical attitude towards safety. Students often pay little attention to safety measures such as wearing proper and protective lab attire and careful handling of chemical substances (Caymaz, 2021).

The challenges to IBL implementation in science are mainly due to insufficient time, large class sizes and inadequate materials and resources. It has become the most common concern among teachers to teach science with inquiry when they have insufficient time to cover the syllabus (Khalik et al., 2017; Mohamad Hisyam, 2019). In their research, Yelkpier et al. (2012) explained that large class sizes put teachers in a difficult situation to conduct a proper assessment of students' learning, and thereafter, administer remedial teaching for weak students. Inadequate teaching and learning resources will also lead to low academic achievement, high dropout rates, problematic behaviours, poor teacher motivation and unmet educational goals (Okongo et al., 2015; Francom, 2020).

VII. CONCLUSION

The science teachers in this study have expressed positive beliefs about IBL and presumably practice IBL in the classroom to encourage students' critical thinking and promote deeper levels of understanding of the science content taught. Although the teachers disagreed with the view that IBL fits both low and high achievers, they appeared to believe that IBL can motivate and enhance students' active involvement in science lessons. In terms of IBL practices, the teachers made an attempt to develop students' critical thinking by giving them opportunities to explain scientific ideas and draw conclusions from the learning activities. However, they refrained from allowing students to carry out scientific investigations on their own due to safety reasons. The teachers also experienced a number of challenges in conducting IBL lessons mainly because of insufficient time, overcrowded classrooms, and inadequate teaching materials and resources.

The following recommendations are proposed based on the findings of the study. Teachers should provide learning materials that will enhance and stimulate students' curiosity and critical thinking. One of the ways to do this is by equipping the classroom with plenty of reading materials that are related to science explorations and latest discoveries. Teachers should be knowledgeable about the subject matter and the various types of inquiry methods to be able to develop interesting and interactive science lessons. Therefore, the authorities should provide proper training or professional development courses for science teachers to help them teach more efficiently using inquiry. In addition, teacher education institutes also need to prepare student teachers by developing their skills in using IBL and strengthening their pedagogical content knowledge in science teaching.

As for the issue of large classes, the Ministry of Education should recruit teaching assistants to help teachers in handling tutorials for students in small groups. This will offer more room for discussion, especially for weak learners, and allow students to have extensive question and answer sessions on related topics. Another way to address this issue is to improve the facilities by having more classes with reduced sizes so that they can fully participate in the classroom activities and help the teachers to do the evaluation easily on the lessons taught.

In addition, in order to overcome the issue of curriculum overload, it is high time for the Ministry of Education to reform the existing system by applying the decentralized measures of curriculum control. In this regard, the Ministry should give greater autonomy to schools and teachers in curriculum planning, which will enable them to modify the science curriculum to better suit their respective students' needs in light of their individual backgrounds. To generate more insight into this issue, this study can be extended to include bigger samples of science teachers, especially those in urban and rural areas. Qualitative studies using non-participatory classroom observations and document analysis will need to be attempted in order to get more in-depth information about IBL implementation in Malaysian schools.

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