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**LABORATORY-MODIFIED ARGUMENT DRIVEN INQUIRY (LAB-MADI) MODULE: CONTENT VALIDITY PROCESS**

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**ABSTRACT**

**This paper aims to determine the validity of the Lab-MADI module using the Content Validity Index (CVI) and Percentage Calculation Method (PCM). The survey was conducted through the evaluation of six experts via purposive sampling. The instrument used for the evaluation was content validity instrument. Based on the results of the analysis, the mean scores of CVI and PCM of the Lab-MADI module were 0.97 and 87.22%, respectively while the mean scores of CVI and PCM of eight practical activities based on the seven stages on MADI model is 0.98 and 81.88% respectively. The results of the study indicate that the module has high validity. Therefore, this module has great potential as a good module. This module is therefore recommended to be used and tested for its effectiveness. The module is also a form of alternative teaching method to guide biology teachers so that they can add value to students in terms of argumentation skills, science process skills and Biology concepts through practical work.**

**Keywords:** Argument-Driven Inquiry, Content Validity, Practical Work, Argumentation, Inquiry-based science instruction

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**INTRODUCTION**

Over the last two decades, many empirical researches have studied ways to promote argumentation in science classrooms and to scaffold students as they learn how to participate in argumentation. Many opportunities could be provided through the development of new pedagogical practices (Berland & Hammer, 2012; Osborne, Erduran, & Simon, 2004), technology-enhanced learning environments (Clark & Sampson, 2007, 2008; Sandoval & Reiser, 2004; Skoumios, 2018), innovative argumentation curriculum (Mcneill, 2009) and laboratory environment (Çetİn, Metİn, & Kaya, 2016; Hakkikkadayigci, 2016; Sampson & Gleim, 2009; Sampson, Grooms & Walker, 2009a, 2011a; Walker, Sampson, & Zimmerman, 2011). Teachers can use these updated pedagogical practices as a way of integrating argumentation into their teaching of science lessons.

Efforts have continued in designing science teaching processes as well as science inquiry to develop students’ habit of constructing and communicating argumentation. Nonetheless, according to Sampson and Gleim (2009) many science teachers are unassertive of how to prepare lessons that would engage students in argument-driven inquiry in a way that would improve students’ understanding of important science concepts and science practices including in biology. Scholars in science education believe that there is not enough for teachers to teach science as a process of inquiry without giving their students the opportunity to engage in argumentation (Clark & Sampson, 2007; Driver, Newton, & Osborne, 2000). This is because argumentation is one of the most important processes of scientific inquiry (Demircioglu & Ucar, 2015; Sampson, Grooms & Walker, 2011). Therefore, construction argumentation explicitly is a must as a guide for engaging students in the inquiry process to help them to understand the science phenomenon and also as a foundation for science teachers to prepare the inquiry-based science instruction.

Studies on promotion of argumentation skills are relatively new in the Malaysian context. One example is the study by Foong and Daniel (2013) where skills of argumentation were introduced through socio-scientific issues for Form Two students in the Confucian learning environment. However, the findings revealed that the Confucian students were weak in constructing rebuttal in their argument. Such a finding is not surprising as the method of constructing argumentation based on socio-scientific issues is a new approach in science teaching in Malaysia. A more suitable approach in engaging students to communicate argumentation in scientific inquiry in the context of Malaysian secondary school science teaching would be inquiry through the conduct of practical work. Nonetheless, students need to be explicitly taught the elements of scientific argumentation and be involved in group-based argumentation sessions so that they could learn to justify their claim with evidence after the practical work sessions. By promoting the development of argumentation skills, students would be more confident in facing the challenges of the 21st century workforce as they would be able to practice higher order thinking skills (HOTs), communicate effectively, be more innovative, and solve problems through negotiation and collaboration. Indeed, all these skills are essential for the 21st century workforce.

Argumentation is a specific form of discourse in which reasoned claims made are supported by data or evidence. Practical work could be used to show not only what we know but how we know and that ideas presented must be argued and supported. Revision and modifying traditional practical work were made so that traditional practical work more inquiry and argument oriented (Llewellyn, 2007, 2009, 2013). During argumentation sessions, students would express ideas, provide evaluation, discuss and further revise their ideas collaboratively. In this study, a practical work module named Lab-MADI was developed with the focus to explicit instruction of scientific argument in practical work to engage students in the development of argumentation through practical-based inquiry. The name “Lab-MADI” is a combination of two words; the first word “Lab” is the acronym for “laboratory” and the second, “MADI” is an acronym, for “Modified Argument-Driven Inquiry”.

The MADI model in this study was grounded in social constructivist theories of learning, cognitive constructivist theories of learning and cognitive load theory. The MADI model is used as the instructional model and the model was adapted from the original Argument-Driven Inquiry (ADI) model (Sampson et al., 2014). This study used the 5E model (Bybee 2015) that systematically guided the steps in the ADI model. The 5E instructional model was chosen as the foundation in combination with the steps in the ADI model because it is widely used in the literature and in actual classrooms. Moreover, it is also the model recommended by the Malaysian Ministry of Education. The teaching and learning of biology with 5E instructional models is often used to improve achievement, knowledge, skills and attitudes (Balta, 2016; Bybee et al., 2006). The Lab-MADI module was developed in order to find a more suitable approach to scientific inquiry in the context of teaching science to Malaysian secondary school students where the module is more of an inquiry-based approach in conducting practical work in the science classroom. The conceptual framework of this study is shown in Figure 1.

Constructivist theories

Cognitive load theory

MADI Model

Elicit Phase

Engage Phase

Explore Phase

Explain Phase

Elaborate Phase

Evaluate Phase

Extend Phase

Argumentation skills

 Science process skills

Concept of diffusion and osmosis

Learning Theory

Argument-driven Inquiry Approach

Effectiveness of Lab-MADI module

**Figure 1.** Conceptual Framework of the Study (Adaptation of 5E Model (Bybee, 2015) and Argument-Driven Inquiry Model (Sampson et al., 2011)

The MADI model is an instructional model with seven phases and its corresponding steps are presented in Table 1. The seven steps are: (1) Elicit phase: Eliciting students’ prior knowledge, (2) Engage phase: Identifying the problem statement and experimental planning, (3) Explore phase: Partaking in practical work experience where small groups of students have the opportunity to carry out experiments and collect data, (4) Explain phase: Production of tentative claim after data analysis on a subject matter among members of the same group, (5) Elaborate phase: Conducting the argumentation session where groups share their arguments and their explanations and are then critiqued by other group members, (6) Evaluate phase: Conducting a reflective discussion about the inquiry, (7) Extend phase: Carrying out application in practical assessment or experimental planning. In the 7E model, the engage phase in 5E is expanded into elicit and engage phases while the elaborate and evaluate phases in 5E are expanded into elaborate, evaluate and extend phases. The ultimate goal of the 7E learning cycle is to highlight the importance of arousing existing students’ understanding of students during the elicit phase and transferring the concepts to a new context in the extend phase (Balta & Sarac, 2016).

Teachers and students both are play important roles in science teaching and learning process. Often when discussions are used in science lessons they are ‘teacher-led’. However, in an argumentation activity discussions should be ‘student-led’. The process of argumentation aims to demonstrate that scientific explanations are constantly evolving, and it is often the case that claims have to be revised in light of new data or further evidence becoming available. The teacher’s role need more than as a facilitator (Walker et al., 2011) he or she also need to acts as motivator, mentor or coach in the inquiry-based science instruction (Llewellyn, 2007, 2009, 2013). The student’s role will different following the role of teacher. The student acts as a problem solver

when the teacher acts as a facilitator; the student acts as an observer when the teacher acts as a motivator; the student acts as a researcher when the teacher acts as a mentor; student acts as a direction follower when the teacher acts as a coach. The roles of the teacher and student corresponding with the seven phases in the MADI model are presented in Table 1.

**Table 1.** The role of the teacher and student in the Modified Argument-Driven Inquiry – the MADI Model (Combination of 7E Model and ADI Model)

|  |  |  |  |
| --- | --- | --- | --- |
| Phase | 7 Steps | Teacher’s roles | Student’s roles |
| Elicit | Step 1: Elicitation of students’ prior knowledge | Motivator, Mentor, Coach | Observer, Researcher, Direction follower |
| Engage | Step 2: Identification of problem statement and experimental planning | Facilitator, Mentor, Coach | Problem solver, Researcher, Direction follower |
| Explore | Step 3: Experimentation and collection of data | Facilitator, Mentor | Direction follower, Researcher |
| Explain | Step 4: Data analysis and development of tentative claim | Coach, Facilitator, Mentor | Direction follower, Problem solver, Researcher |
| Elaborate | Step 5: Argumentation; Peer review | Coach, Facilitator, Mentor | Direction follower, Problem solver, Researcher |
| Evaluate | Step 6: Reflective discussion | Facilitator, Mentor | Problem solver,Researcher |
| Extend | Step 7: Application | Coach | Direction follower |

After preparing the instructional materials in the Lab-MADI module, a series of formative evaluation including small-group evaluation and pilot test were conducted during the field trial to collect data which were used to identify problems with the instruction or opportunities to make instruction better. The initial draft of the Lab-MADI Module for laboratory investigation developed by the researcher was pilot tested in one of the schools with a group of twenty-two (n=22) grade 10 students (aged 16 years) from a pure science class taking biology as an examination subject. The findings from the feasibility study of the La-MADI module during the pilot test including the reliability of the module based on the pilot test with the target learners will presented in another paper. After revising, the developed module is with the theme of Investigating Cells as A Unit of Life consists of Topic 1: Introduction to Biology, Topic 2: Cell Structure and Organisation, Topic 3: Movement of Substances across the Plasma Membrane and Topic 4: Chemical Compositions of Cells as shown in the Table 2. The students’ understanding of this theme in Biology subject is the prerequisite for their understanding of basic biological functions and its content can be easily modified to fit the argument-driven inquiry (Sampson et al., 2014).

**Table 2.** The theme of the module along with its practical activities

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Theme | Topic | Practical Activities |
| 1. | Investigating Cells as a Unit of Life  | 1 - Introduction to Biology | Lab 1: Introduction to Biology: Applying Scientific Invetigation |
| 2. | 1 - Introduction to Biology | Lab 2: Energy: Determining the energy value in food samples |
| 3. | 2 - Cell Structure and Organisation | Lab 3: The structure of a plant cell and an animal cell |
| 4. | 3 - Movement of Substances across the Plasma Membrane | Lab 4: The permeability of the plasma membrane |
| 5. | 3 - Movement of Substances across the Plasma Membrane | Lab 5: Diffusion: The effect of TSV/V ratio on the rate of diffusion |
| 6. | 3 - Movement of Substances across the Plasma Membrane | Lab 6: Osmosis: The effect of hypotonic, hypertonic and isotonic solution on plant cells |
| 7. | 4 - Chemical Compositions of Cells | Lab 7: Enzyme: The effect of pH on the activities of amylase |
| 8. | 4 - Chemical Compositions of Cells | Lab 8: Enzyme: The effect of temperatue on the activities of amylase |

The evaluation of the module has two fundamental features, namely the validity and reliability of the module which are two most important for a good research (Russell, 1974). The objective of assessing validity is to see how accurate the relationship is between the measure and the underlying trait it is trying to measure (Gaur & Gaur, 2009). Thus in the validity of the Lab-MADI module is the degree to which this module actually measures whether the Lab-MADI module reaches the desired quality level while the reliability is the consistency or dependability of a module to the learners’ performance. Expert judgment evaluation involves judgment of the quality of instructional materials by content experts, learner specialists, or design specialists (Dick, Carey, & Carey, 2015). In this study, the process of checking for content validity was conducted with content experts who are familiar with the characteristics of the argumentation content, the subject-matter and the target leaners.

Following the completion of the practical work module, the expert judgement evaluation is the culminating evaluation of the designed module to meet the desired quality level. It is

crucial that this evaluation is carried out to determine whether the instruction in practical work actually works as intended in the expected context (Dick et al., 2015). Thus, the objective of the study is to determine the validity of the module.

The following are the research questions of this study: What are the experts’ content validity index (CVI) and percentage calculation method (PCM) on the Lab-MADI module?

**METHODS**

In this study, a quantitative approach was conducted by using survey. This approach was chosen as analysis of all the data was performed quantitatively. The validity test process was carried out using one instrument which was adapted from Mohammad Aziz Shah Mohamed Arip (2010) and Sidek Mohd Noah and Jamaludin Ahmad (2005). According to Dick, Carey, and Carey (2015), a questionnaire instrument is often used to evaluate expert’s opinions of the materials in the form of quantitative data. Furthermore, in a descriptive research study, a questionnaire is often the main instrument used to collect data (Lodico, Spaulding, & Voegtle, 2006) as descriptive research is primarily concerned about finding out typical research issues of “what is/are” as stated in the research questions of the study. Accordingly, the use of questionnaire as the research instrument to determine the validity of the Lab-MADI module is considered relevant and appropriate for this study.

The evaluation form consisted of three main parts: the first part – asked for the details and background of the experts, the second part – was on the evaluation of the module’s content based on six criteria, and the third part – was on the evaluation of eight practical activities following the seven phases in the MADI model.

The experts were supplied with copies of all the Lab-MADI module materials including the introduction of the Lab-MADI module which contained the aims of the module and the learning objectives, the learning theory, the MADI model and the conceptual framework of the study, the Lab-MADI teacher module and the Lab-MADI student module. In the second part of the evaluation form, all experts were requested to judge the module according to six criteria: the suitability for target students, feasibility, time allocation, and improving the dependent variables under study: argumentation skills, science process skills and concepts in diffusion and osmosis. In the third part of the evaluation form, all the experts were asked to judge the sequence of the practical activities in the seven phases of the MADI model.

In the expert judgment state, the consensus group invited seven independent experts. The experts were chosen based on their experiences and expert knowledge of the discipline of scientific argumentation research, subject-matter and development of module in practical biology in laboratory learning environment. In line with the recommendation by Lynn (Lynn, 1986) wo suggested a minimum of five and a maximum of ten experts to avoid possible random consensus (Lynn, 1986), a total of six experts accepted the invitation to participate. An eleven-point ordinal Likert rating scale was used to evaluate the content validity of the Lab-MADI module. The eleven-point ordinal Likert rating scale was used because it increases scale sensitivity and is closer to normality; moreover, it can be easily understood (Leung, 2011). The six experts are highly educated, are knowledgeable in the fields they were asked to evaluate and would be able to make the distinctions among the scales. The six experts rated the content validity of overall of the module and each eight activities in relation to seen tasks in the rating protocol. The scale was scored accordingly where 0 denotes mostly disagree to 10 which denotes mostly agree. Results from the six experts’ judgments were then analyzed in the judgment quantification stage.

First in the data analysis, descriptive statistics for the sample was performed. Next, the data were analyzed to address the objective of the study which is to determine the validity of the module based on the calculation of CVI and PCM.

Content Validity Index (CVI) is the most widely used index in quantitative evaluation and is a method of empirically to determining the validity of the instruments used by through analysis of the collected data. This method is easy to administer, is low-cost, saves time and is easy to implement. Therefore, many researchers both locally and internationally use this method to validate their module content (Polit & Beck, 2006; Shi, Mo, & Sun, 2012; Yaghmaie, 2003). One method is often practiced by the researcher based on two main characters, namely Lynn (Polit & Beck, 2006). The procedure for the CVI method is illustrated in Table 3 below.

**Table 3.** CVI procedure by Lynn (1986)

|  |  |
| --- | --- |
| No. | Details |
| 1. | Scale | Ordinal |
|  |  | Divide the ordinal scale into two groups for example scale 1, 2, 3, 4 so that 1 and 2 represent disagree and vice versa. |
| 2. | Formula | CVI = $\frac{n}{N}$ |
|  |  | n – numbers of evaluators who agreed; N – sum of evaluators |
| 3. | Range accepted |

|  |  |
| --- | --- |
| N | CVI value |
| 2-5 | 1.00 |
| 6 | ≥0.83 |
| 7 | ≥0.86 |
| 8-10 | ≥0.78 |

 |
|  |  | Mean CVI is mean of all CVI for each item |

This analysis is important for researchers who want to determine the validity of the instrument in their study. This is to ensure the content validity of the instrument can be measured using methods or procedures that are accurate and correct. In this study, the researcher divided the ordinal scale into two groups, that is, disagree (scale 0 to scale 5) which is equal to 0 and agree (scale 6 to scale 10) which is equal to 1 to calculate the CVI among the six experts following the example provided by Lynn (1986) as shown in Table 2. The results are presented in the Findings section.

Content validity is an important factor in identifying the module content of measuring. However, a single approach is insufficient (Yaghmaie, 2003). Mohd Afifi Baharudin Setambah, Nor’ain Mohd Tajudin, Mazlini Adnan, and Muhamad Ikhwan Mat Saad (2017) suggested that the percentage value of a module that has been assessed by experts should be calculated. According to Sidek Mohd Noah and Jamaludin Ahmad, (2005), the content validity percentage can be calculated using the formula as below:

$$Content validity percentage (PCM)= \frac{Total Expert Score}{Total Maximum Score} X 100\%$$

**RESULTS AND DISCUSSION**

The background of the experts engaged for expert judgement evaluation are listed in Table 4 below to show the coverage of expertise for the entire domain of the module (argumentation content, subject-matter expertise in biology and target leaners).

This is then followed by the presentation of the experts’ scores of CVI (Content Validity Index) and experts’ scores of PCM (Percentage Calculation Method) on the Lab-MADI Module based on the six criteria (suitability for target students, feasibility, time allocation, improving the dependent variables under study: argumentation skills, science process skills and concepts in diffusion and osmosis). Finally, the summary of the experts’ scores of PCM (Percentage Calculation’s Method) and CVI (Content Validity Index) on the eight practical work activities based on the seven phases in the MADI model are presented.

**Table 4.** Background of experts

|  |  |  |
| --- | --- | --- |
| Experts’ Title/ Post | Institution | Expertise  |
| E1: Associate Professor | University of Sultan Idris (UPSI), Perak, Malaysia. | Biology education, Science laboratory management, Module evaluator, Module developer |
| E2: Associate Professor | University of Technology Malaysia (UTM), Johor, Malaysia. | Chemistry education, Environmental Science, Scientific argumentation, Module evaluator, Module developer |
| E3: Senior lecturer | Sarawak Teachers Institute, Miri Sarawak, Malaysia. | Biology education, Module developer |
| E4: Practical teacher | Government secondary school in Sarikei, Sarawak, Malaysia. | Biology education, Teaching English Language |
| E5: Biology excellent teacher | Government secondary school in Kuching, Sarawak, Malaysia. | Biology education |
| E6: Biology excellent teacher | Government secondary school in Sibu, Sarawak, Malaysia. | Biology education |

Based on Table 4, the experts represented experts in scientific argumentation (n=1), subject-matter (n=3) and development of biology teaching module (n=2). Additionally, among the group of experts, two are biology excellent teachers (*Guru Cemerlang* or GC), one is a practical teacher (*Guru Amali* or GA), three held PhDs, of whom two are associate professors in two local public universities and one a senior lecturer in a teacher training college. Each of the experts has more than 10 years of working experiences and all the lecturers (PhD holders) though currently teaching in university and teacher training college have had at least 5 years of teaching experience in secondary school with students of the same level as the target learners of the module. All the experts have specialization in science and biology education.

**Table 5.** Descriptive statistics of experts’ scores of CVI on the Lab-MADI Module

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Items | E1 | E2 | E3 | E4 | E5 | E6 | CVI |
| 1. | The content of this module is suitable for the target students. | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| 2. | The content of this module can be implemented perfectly. | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| 3. | The content of this module corresponds to the time allocated. | 1 | 1 | 0 | 1 | 1 | 1 | 0.83 |
| 4. | The content of this module can further improve argumentation skills. | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| 5. | The content of this module can further improve science process skills. | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
| 6. | The content of this module can further improve the concept of diffusion and osmosis. | 1 | 1 | 1 | 1 | 1 | 1 | 1.00 |
|  | Total Score & Mean CVI | 6 | 6 | 5 | 6 | 6 | 6 | 0.97 |

Remark: Disagree (0-5) = 0; Agree (6-10) = 1

Based on Table 5, the result of CVI from the six experts’ scoring was in the range of 0.83 to 1.00 while the result of the calculation of PCM from the six experts’ scoring was 0.97. This shows that this module has high percentage of content validity in the six criteria assessed (suitability for target students, feasibility, time allocation and improving the dependents variables under study: argumentation skills, science process skills and concepts in diffusion and osmosis).

**Table 6.** Descriptive statistics of experts’ scores of PCM (Percentage Calculation Method) on the Lab-MADI Module

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Items | E1 | E2 | E3 | E4 | E5 | E6 | CVI |
| 1. | The content of this module is suitable for the target students. | 9 | 9 | 10 | 10 | 9 | 8 | 9 |
| 2. | The content of this module can be implemented perfectly. | 9 | 6 | 8 | 9 | 10 | 8 | 9 |
| 3. | The content of this module corresponds to the time allocated. | 9 | 8 | 5 | 9 | 7 | 8 | 9 |
| 4. | The content of this module can further argumentation skills. | 10 | 8 | 9 | 10 | 9 | 8 | 10 |
| 5. | The content of this module can further science process skills. | 9 | 9 | 10 | 10 | 9 | 8 | 9 |
| 6. | The content of this module can further the concept of diffusion and osmosis. | 9 | 9 | 9 | 10 | 9 | 8 | 9 |
|  | Total Score | 55 | 49 | 51 | 58 | 53 | 48 | 55 |
|  | Percentage | 91.67 | 81.67 | 85.00 | 96.67 | 88.33 | 80.00 | 91.67 |
|  | Mean | 87.22 |

Based on Table 6, the rating result from the six experts’ rating was in the range of 5 to 10 while the result of PCM from the six experts’ scoring was 87.22%. This shows that this module has high content validity in the six criteria evaluated, i.e. suitability for with students, feasibility, time allocation and improving the dependent variables under study: argumentation skills, science process skills and concepts in diffusion and osmosis).

**Table 7.** Summary descriptive statistics summary of experts’ scores of PCM (Percentage Calculation Method) and CVI (Content Validity Index) on eight activities of practical work

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Practical Activities | CVI Mean | PCM Mean |
| 1. | Lab 1: Introduction to Biology: Applying Scientific Invetigation | 0.98 | 83.33 |
| 2. | Lab 2: Energy: Determining the energy value in food samples | 0.93 | 81.43 |
| 3. | Lab 3: The structure of a plant cell and an animal cell | 0.90 | 76.90 |
| 4. | Lab 4: The permeability of the plasma membrane | 0.95 | 79.52 |
| 5. | Lab 5: Diffusion: The effect of TSV/V ratio on the rate of diffusion | 0.95 | 81.67 |
| 6. | Lab 6: Osmosis: The effect of hypotonic, hypertonic and isotonic solution on plant cells | 0.98 | 85.00 |
| 7. | Lab 7: Enzyme: The effect of pH on the activities of amylase | 0.98 | 84.76 |
| 8. | Lab 8: Enzyme: The effect of temperatue on the activities of amylase | 0.98 | 83.57 |
|  | Mean Overall Activities | 0.98 | 81.88 |

Based on Table 7, the result of CVI from the six experts’ scoring on the eight activities based on MADI model was in the range of 0.90 to 0.98. Meanwhile the result of the calculation of PCM from the six experts’ scoring on the eight activities based on the MADI model was in the range of 76.90% to 85.00%.Overall, the mean for the CVI was 0.98 while the PCM was 81.88% for the eight practical activities based on the seven stages in the MADI model. This shows that the eight practical activities have high validity which is supported by the accepted value of CVI which is more than 0.83 (Lynn, 1986) and PCM which is more than 70% (Sidek Mohd Noah & Jamaludin Ahmad, 2005).

Content validity refers to the extent to which a measurement reflects the specific intended domain of content. As Gaur and Gaur (2009) stated, to establish content validity of module, the researchers should first define the entire domain of the study (in this study, argumentation content, subject-matter in biology and target leaners) that needs to be covered by the experts and then assess if the module evaluated truly represents this domain. Subject-matter expert (SME) that can be employed as an SME is a person knowledgeable about a particular content area and is also known as a content specialist or subject-matter specialist. From the background of the experts shown in Table 4, the specialization of the experts are covered the domain of this present study in terms of subject matter (content knowledge) and also pedagogical knowledge in evaluating the Lab-MADI module for teaching explicit scientific argument in practical biology.

Based on the analysis conducted, the mean scores of CVI and PCM of the Lab-MADI module were 0.97 and 87.22% respectively while the mean scores of CVI and PCM of the eight practical activities based on the seven stages in the MADI model were 0.98 and 81.88% respectively. The results of the study provide evidence that the Lab-MADI module has high validity (Lynn, 1986; Sidek Mohd Noah & Jamaludin Ahmad, 2005). Thus, the results demonstrate that the Lab-MADI module which was developed based on the MADI model has high construct validity. This leads the researcher to strongly belief that the Lab-MADI module can be used in the study to examine explicit instruction of scientific argument in practical work through argument-driven inquiry approach among the target students. The engagement for students to the skills of argumentation, science process and concepts in diffusion and osmosis through the usage of this module were regarded as highly important and relevant. These skills may ensure that the students are better prepared for the 21st century workforce and a better future.

There are several things that must be considered by every researcher during the validity testing process. This must be carried out so that the module constructed will performed according to the way that it is meant to perform during the actual conduct of the study. It is very important that a template for reviewing the materials should be included in the module domain including the adequate materials for the given learners’ needs, the designer’s instructional strategy including the preinstructional information, content presentation, learner participation, and assessment, and transfer feasibility analysis about the instructional materials relating to their potential for transferability of knowledge and skills from the learning context to the real site (Dick et al., 2015). Among the consideration, the determination of the validity domain of the module should be carried out and this can be carried out by collecting data from the experts and calculating the CVI and PCM to determine the validity level of the module. Furthermore, the appointment of at the experts at the judgement evaluation stage is important to determine the module’s effectiveness so that the final product can be improved until it reaches the desired level of quality.

**CONCLUSION**

The intent of this paper is to determine the validity of the Lab-MADI module. The Lab-MADI module was constructed as an effort to improve the students’ ability to participate in the development of scientific argumentation and based on the findings, the module seems to be a reasonably good module to implement for explicit scientific argument in practical biology. Findings from the analysis show that this module has very good validity based on rating of experts. Therefore, in the next stage of summative evaluation, a study on the effectiveness of this Lab-MADI module in developing students’ argumentation skills, science process skills in relation to the concepts of diffusion and osmosis will be carried out in an actual field study. However, this module may be limited in its usage as it is specific to the Malaysian upper secondary school biology curriculum.

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**REFERENCES**

 Balta, N., & Sarac, H. (2016). The effect of 7E learning cycle on Learning in science teaching: a meta-analysis study. *European Journal of Educational Research*, *5*(2), 61–72.

Berland, L. K., & Hammer, D. (2012). Framing for scientific argumentation. *Journal of Research in Science Teaching*, *49*(1), 68–94.

Bybee, R. W. (2015). *5E instructional model: Creating teachable moments*. Arlington: NSTA.

Bybee, R. W., Taylor, J. A., Gardner, A., Scotter, P. V., Powell, J. C., Westbrook, A., & Landes, N. (2006). *The BSCS 5E instructional model: origins and effectiveness*. Colorado Springs.

Çetİn, P., Metİn, D., & Kaya, E. (2016). A new approach to laboratory applications: Argument-driven inquiry. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD)*, *17*(2), 223–243.

Clark, D. B., & Sampson, V. (2007). Personally‐seeded discussions to scaffold online argumentation. *International Journal of Science Education*, *29*(3), 253–277.

Clark, D. B., & Sampson, V. (2008). Assessing dialogic argumentation in online environments to relate structure, grounds, and conceptual quality. *Journal of Research in Science Teaching*, *45*(3), 293–321.

Demircioglu, T., & Ucar, S. (2015). Investigating the effect of argument-driven inquiry in laboratory instruction. *Educational Sciences: Theory & Practice*, *15*(1), 267–283.

Dick, W., Carey, L., & Carey, J. O. (2015). *The systematic design of instruction* (8th Ed.). Boston, USA: Pearson.

Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education*, *84*(3), 287–312.

Foong, C. C., & Daniel, E. G. S. (2013). Students ’ argumentation skills across two socio-scientific issues in a confucian classroom : Is transfer possible ? *International Journal of Science Education*, *35*(14), 2331–2355.

Gaur, A. S., & Gaur, S. S. (2009). *Statistical methods for practice and research: A guide to data analysis using SPSS* (2nd Ed.). New Delhi, India: Business Books from Sage.

Hakkikadayifci, A.-C. (2016). Implementation of argument-driven inquiry as an instructional model in a general chemistry laboratory course. *Science Education International*, *27*(3), 369–390.

Leung, S. O. (2011). A comparison of psychometric properties and normality in 4-, 5-, 6-, and 11-point likert scales. *Journal of Social Service Research*, *37*(4), 412–421.

Llewellyn, D. (2007). *Inquire Within: Implementing Inquiry-Based Science Standards In Grades 3-8* (Second Edi). California: Corwin Press.

Llewellyn, D. (2013). *Teaching High School Science Through Inquiry and Argumentation* (Second Ed.). California: Corwin.

Lodico, M. G., Spaulding, D. T., & Voegtle, K. H. (2010). *Methods in educational research: From theory to practice* (Vol. 28). John Wiley & Sons.

Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, *35*(6), 382–385.

Mcneill, K. L. (2009). Teachers’ use of curriculum to support students in writing scientific arguments to explain phenomena. *Science Education*, *93*(2), 233–268.

Mohammad Aziz Shah Mohamed Arip. (2010). *Kesan kelompok imbingan terapi kognitif-tingkahlaku ke atas konsep kendiri, kelangsangan dan daya tahan remaja*. Tesis PhD, Universiti Kebangsaan Malaysia, Bangi.

Mohd Afifi Baharudin Setambah, Nor’ain Mohd Tajudin, Mazlini Adnan, & Muhamad Ikhwan Mat Saad. (2017). Adventure based learning module: content validity and realiability process. *International Journal of Academic Research in Business and Social Sciences*, *7*(2), 615–623.

Osborne, J., Erduran, S., & Simon, S. (2004). Enhancing the quality of argumentation in school science. *Journal of Research in Science Teaching*, *41*(10), 994–1020.

Polit, D. F., & Beck, C. T. (2006). The content validity index: are you sure you know hwat’s being reporte? Critique and recommendations. *Research in Nursing & Health*, *29*, 489–497.

Russell, J. D. (1974). *Modular instruction: A guide to the design, selection, utilization and evaluation of modular materials*. Minneapolis, Minnesota, USA: Burhess Publishing Company.

Sampson, V., Enderle, P., Gleim, L., Grooms, J., Hester, M., Southerland, S., & Wilson, K. (2014). *Argument-driven inquiry in Biology*. Arlington, Virgina, USA: NSTA Press.

Sampson, V., & Gleim, L. (2009). Argument-driven inquiry to promote the understanding of important concepts & practices in Biology. *The American Biology Teacher*, *71*(8), 465–472.

Sampson, V., Grooms, J., & Walker, J. P. (2009). Argument-driven inquiry: a way to promote learning during laboratory activities. *The Science Teacher*, *76*(2005), 42–47.

Sampson, V., Grooms, J., & Walker, J. P. (2011). Argument-Driven Inquiry as a way to help students learn how to participate in scientific argumentation and craft written arguments: An exploratory study. *Science Education*, *95*(2), 217–257.

Sandoval, W. A., & Reiser, B. J. (2004). Explanation-driven inquiry: Integrating conceptual and epistemic scaffolds for scientific inquiry. *Science Education*, *88*(3), 345–372.

Shi, J., Mo, X., & Sun, Z. (2012). Content validity index in scale development. *Journal of Central South University (Medical Sciences)*, *37*(2), 152–155.

Sidek Mohd Noah, & Jamaludin Ahmad. (2005). *Pembinaan Modul Bagaimana Membina Modul Latihan dan Modul Akademik*. Sedang: Penerbit Universiti Putra Malaysia.

Skoumios, M. (2018). Improving the structure of students’ arguments through a teaching-learning sequence on Newto’s Second Law. *European Journal of Education Studies*, *5*(5), 1–11.

Noah, S. M., & Ahmad, J. (2005). Pembinaan modul: Bagaimana membina modul latihan dan modul akademik. *Serdang: Penerbit UPM*.

Mastrogiorgaki, M., & Skoumios, M. (2018). Improving the structure of students’ arguments through a teaching-learning sequence on Newto’s Second Law. *European Journal of Education Studies*, 5(5), 1-11.

Walker, J. P., Sampson, V., & Zimmerman, C. O. (2011). Argument-driven inquiry: An introduction to a new instructional model for use in undergraduate chemistry labs. *Journal of Chemical Education*, *88*(8), 1048–1056.

Yaghmaie, F. (2003). Content validity and its estimation. *Journal of Medical Education*, *3*(1), 25–27.

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