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The Expert Perception on Development and Usability of Teaching Aids "Aquaponic Mini Models" for Aquaculture Course

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Abstract: Due to the pandemic of Covid-19, all universities and institutions in Malaysia are closed during the pandemic to avoid the spread of Covid-19. The face-to-face learning and teaching session are replaced by online learning and teaching session. Online learning was being implemented to deliver a seamless teaching and learning process so that the academic session can continue with the new norm through MCO and social distancing. There are barriers to conducting the practical class or hands-on practice for aquaponic topics due to the teaching and learning online classes. Therefore, this condition may affect the knowledge and understanding or performance of the student on aquaponic topics that require hands-on teaching and learning. Moreover, students at home who do not have the necessary equipment and tools for the practical session are among the challenges of doing practical sessions. Some materials, such as Rockwool and net pot, must be purchased as a set, but students may only require a portion of them, making the purchase burdensome to complete on their own aquaponic. To overcome the problem, the teaching aids "Aquaponic Mini Models was developed. The purpose of this study was to identify the expert perspective on the development and usability of teaching aids "Aquaponic Mini Models" for aquaculture course. The teaching aids "Aquaponic Mini Models" was created using the ADDIE model through five phases: analysis, design, development, implementation, and evaluation. The research method used in this study is a quantitative method (questionnaire survey). In this study, a set of questionnaires was used to elicit data from the experts. Nine experts from the Faculty Technical and Vocational were chosen for their experience developing learning aid kits and teaching pedagogy. All data obtained were analyzed using computer software Statistical Package for Social Science SPSS version 24' to obtain the frequency, percentage, and mean through descriptive analysis. The result showed that the expert perception on the essential elements of teaching aid, necessary features for teaching aid, the development of the Aquaponic Mini Model Learning Aid Kit (Design and Layout) and the usability of the Aquaponic Mini Model Learning Aid Kit has the overall mean perception of 2.00, implying perceptions were good. Therefore, Overall, the result showed that the Aquaponic Mini Models Learning Aid Kit could be developed and used as a learning aid kit for aquaculture courses to increase student understanding and skills in teaching and learning. Moreover, using the Aquaponic Mini Model Learning Aid Kit, students will develop and build the learning kit independently and the results will be more precise and more understandable. For a teacher, the use of teaching aid can save time in determining efficient teaching and learning processes.

Keywords: Aquaponic, learning aid kit, ADDIE model, online learning and technical and vocational education

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1. Introduction

Aquaponics is specified as the cultivation of plants and fish in controlled recirculation systems (Rakocy, 2012). From relatively old farming practices that only planted plants, aquaponics has been incorporated of fish culture with plant production (Konig et al., 2016). Aquaponics is a modern and evolving industry that plays an important role in the world of agricultural products and technical variations of combining aquatic culture with plant crops (Knaus & Palm, 2017a). The aquaponic topic is one of the essential topics in aquaculture subject. A student taking an aquaculture subject will have a three-hour learning session and a one-hour practical session in a typical situation. Theoretical aquaponics lesson taught in the classroom. In contrast, hands-on lesson, such as setting up an aquaponic system and rearing fish, was taught in the practical session. To understand the aquaponic topic, practical and theory must be conducted in the classes. It is essential for students to master practical and theory to produce students with competent human resources and skills.

Due to the pandemic of Covid-19, all universities and institutions in Malaysia are closed during the pandemic to avoid the spread of Covid-19. The face-to-face learning and teaching session are replaced by online learning and teaching session. Online learning was being implemented to deliver a seamless teaching and learning process so that the academic session can continue with the new norm through MCO and social distancing (Mastor et al., 2021). There are barriers to conducting the practical class or hands-on practice for aquaponic topics due to the teaching and learning online classes. Therefore, this condition may affect the knowledge and understanding or performance of the student on aquaponic topics that require hands-on teaching and learning. Practical learning is crucial because it is implicit, reactive, or deliberative learning and can be realistic. Practical usually use a skill that employee needs including decision-making, training, and problem-solving (Eraut, 2000). Skill can be polished by doing hands-on practical activities conducted in the classroom (Ibrahim et al., 2006).

The problem faced by educators is to teaching aquaponic topics in a practical session. The student cannot have access to all aquaponic equipment, laboratory, and instruments in university, because they are at home due to the Movement Control Order (MCO). Students cannot set up an aquaponic system in an online class that used to be in a practical session because it requires guidance and tools to set up.

To overcome the student's problem, the educator prepared the learning aid kit Aquaponics Mini Model to help the student understand the aquaponic topic. The teaching aids "Aquaponic Mini Models is a teaching aid kit consisting of low-cost materials such as containers, rock wool, seeds, aquarium soil, and a net pot. The student will assemble all the material with the help of a manual. This teaching aid kit will assist educators in helping students better understand aquaponics, which is a subject that requires both practical and theoretical knowledge. Besides that, students can learn about different types of medium, fish, and seeds used in aquaponics and how to perform fish acclimatization operations and manage their pet fish by using these learning aids kits. Teaching and learning effectiveness depend on the educator's strategies and techniques to make the learning process interactive (Kamarul Azmi et al., 2011). Researched has shown, that learners' outcomes increased in teaching and learning kits that educators use during learning sessions (Mohamad Mohsin & Hassan, 2011). Therefore, the development of teaching aid must align with the objectives and related to the subject taught. Therefore, in this study, it is important to have an expert perception to answer the following questions: (1) What are expert perceptions of the elements for the development of the teaching aids "Aquaponic Mini Models? (2) What are expert perceptions of the development (design and layout) of the teaching aids "Aquaponic Mini Models? (3) What are expert perceptions of the usability of the teaching aids "Aquaponic Mini Models system?

1.1 Theoretical Framework (Addie Model)

The ADDIE model is a framework for educational development that guides the creation of educational and software materials based on user requirements (Wang & Hsu, 2009). ADDIE model aims to create lesson plans and learning materials that will improve the effectiveness and efficiency of teaching presentations (Stapa & Muhammad, 2019). Aquaponic Mini Model Learning Aid Kit work plan was structured around the ADDIE model, consisting of five phases: analysis, design, development, implementation, and evaluation. The ADDIE model is a framework for educational development that guides the creation of educational and software materials based on user requirements (Wang and Hsu, 2009). ADDIE word is an acronym for (A) analyse (D) design (D) develop (I) implement and (E) evaluate (Moradmand et al., 2014). ADDIE model aims to create lesson plans and learning materials that will improve the effectiveness and efficiency of teaching presentations (Stapa & Muhammad, 2019). The ADDIE model is a standard and widely accepted instructional model that can be used to develop and design e-learning (Nichols Hess & Greer, 2016). Different learning and teaching software have been designed and developed using ADDIE instructional design models (Moradmand et al., 2014). The ADDIE model is easier to use than the others, and it offers a comprehensive approach to designing and implementing learning experiences (Ebru, 2020). There are five phases (Fig. 1) in the ADDIE Instructional Model: analysis, design, development, implementation and evaluation.

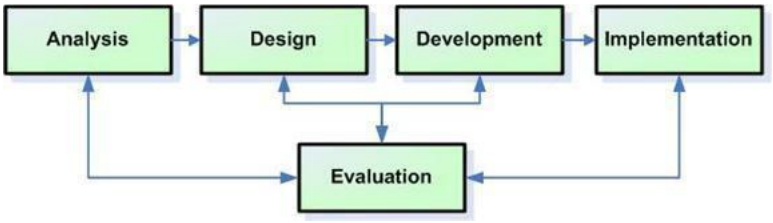

Fig. 1: ADDIE framework (Carey and Dick, 1996)

The analysis stage is a process that defines what the learners will learn, namely to conduct a needs evaluation (analysis needs), identify problems (needs), and conduct an analysis mission (Trisiana & Wartoyo, 2016). In the design stage, researchers begin developing their project. The data collected during the analysis phase and instructional design hypotheses and models are intended to demonstrate how the learning will be acquired (Drljača et al., 2017). In the development stage, it involves creating or selecting materials and media by the researcher, and the conduct of formative evaluations (Seel & Glasgow, 1998). The implementation stages of the ADDIE model are referred to as the point at which the actual model is presented to the real-world environment and provides assistance to users (Budoya et al., 2019). The final evaluation stages are based on consumer acceptance would assess the learning aid kit's performance in achieving the desired learning outcome. This input is critical in ensuring the learning aid kit's functionality and preparation for real-world study (Nadiyah & Faaizah, 2015).

2. Materials and Methods

2.1 Analysis Phase

In this phase, a needs analysis was conducted to gain information from a student to determine if the teaching aid is necessary or not to be built in this phase. A set of questionnaires was distributed to the student using a google form. The questionnaire contains sections A (Demographics) and section B (Needs Analysis Study - 12 items). This study used a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

2.2 Design Phase

In this phase, the researcher begins drafting the project design. The data collected during the analysis phase, instructional design hypotheses, and models are intended to demonstrate how the learning will be acquired (Bacotang et al, 2016). The analysis is mostly performed in the design phase, the researcher will design and plan for the whole project. One of the researcher's responsibilities is to define the goals, identify approaches to meet those objectives, determine what methods will be used, and carry out an efficient distribution of those objectives (Seel & Glasgow, 1998). During the design process, details or data gathered from the analysis phase will be considered (Peterson, 2003). During the design phase, the researcher will determine how goals will be evaluated and the types of assessments that will be used, and ensure that the objectives and evaluations are consistent and meaningful (Tanner, 2001). Among the objectives of this stage are establishing learning objectives and deciding the methods of learning and teaching (Gustafson & Branch, 2007). In this study, Aquaponic mini models Learning Aid Kit are constructed using inexpensive materials such as containers, net pots, Rockwool, aquarium sand, and seeds. The Aquaponic Mini Model Learning Aid Kit's height and width are 16cm x 11cm making it ideal for students to keep at home (Fig. 2).

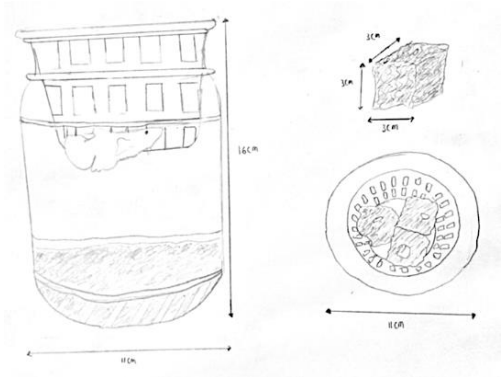

Fig. 2: Illustration of the aquaponic mini model learning aid kit

2.3 Development Phase

This phase of change shifts the researcher's job from analysis and design to development (Peterson, 2003). This stage involves creating or selecting materials and media by the researcher, and the conduct of formative evaluations (Seel &

Glasgow, 1998). Before the final product is involved in the implementation, the researcher must determine whether the product can benefit students or the general public and suggest ways to enhance it (Peterson, 2003). The development phase aims to provide students with the knowledge necessary to accomplish the learning objectives developed during the design stage (Larson & Lockee, 2014). The Aquaponic Mini Model Learning Aid Kit (Fig. 3) is divided into component during the development stage, including seeds, rock wool, container, manual, net pots, and aquarium sand. After putting all of the pieces together, they should have a complete reservoir aquaponic system.

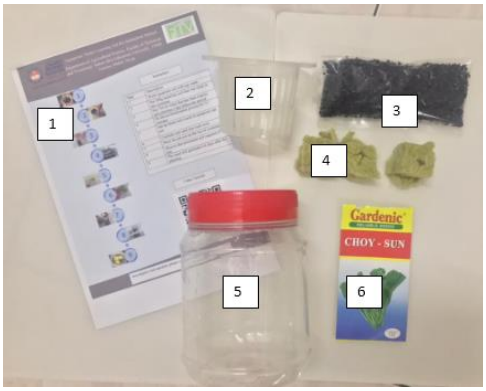

Fig. 3: Aquaponic mini models learning aid kit component; (1) manual and instruction; (2) net pot; (3) aquarium sand; (4) rock wools; (5) container; (6) seed

2.4 Implementation Stages

In these stages, the learning aid kit was distributed to an expert to evaluate the development and usability of the Aquaponic Mini Model Learning Aid Kit along with instruction manual (Fig. 4) and video tutorial. A QR code (Fig. 5) was developed to facilitate access to the video tutorial. The expert has been given a week to test the Aquaponic Mini Model Learning Aid Kit to ensure the development and usability of Aquaponic Mini Model Learning Aid Kit.

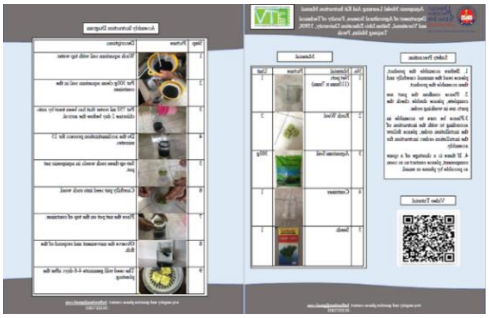

Fig. 4: Instructional manual aquaponic mini model learning aid kit

Fig. 5: QR code for video instruction aquaponic mini model learning aid kit

2.5 Evaluation Stages

In this phase, an expert was given a set of questionnaires that consisted of four sections: demographic**,** needs analysis, development of a learning aid kit analysis, and usability of the Aquaponic Mini Model Learning Aid Kit. The evaluation phase is involving nine experts from Faculty Technical and Vocational. Feedback from an expert is essential to assess whether the Aquaponic Mini Model Learning Aid Kit helps enhance students' knowledge and skill. However, where there are shortcomings, an improvement process needs to be done to operate and function perfectly. The evaluation phase is involving nine experts from Faculty Technical and Vocational.

2.6 Instrument Development (Questionnaire)

The instrument development for this study is a questionnaire. Questionnaires are commonly used and quantitative studies. A questionnaire is a collection of individuals' questions in order to elicit statistically relevant data on a particular subject (Roopa & Rani, 2012). The questions prepared for the expert are based on the provided learning aid package. The questionnaire consisted of four sections. The first section included a total of 5 items of demographic information of respondents. The second section part consisted of 19 items to evaluate the expert perception of essential elements of teaching aid and necessary features for teaching aid. The third section consisted of 14 items to evaluate the expert perception of the development of the Aquaponic Mini Model Learning Aid Kit (Design and Layout). The last section included 14 items to evaluate the expert perception of usability of the Aquaponic Mini Model Learning Aid Kit.

2.7 Sampling and Data Collection

The target expert was lecturers who worked at the Faculty of Technical and Vocational, Sultan Idris Education University. A self-administered questionnaire and Aquaponic Mini Model Learning Aid Kit was distributed to the expert in three department Faculty of Technical and Vocational. The experts were chosen based on their experience in developing learning aid kits, teaching pedagogy, and knowledge of agriculture in practice. A total of 10 questionnaires were distributed and 9 responses were returned, corresponding to a response rate of 90%. The survey was open for a week between June 2nd and April 9th, 2021.

2.8 Data Analyses

The IBM SPSS Statistics 24 was utilized by conducting descriptive analysis to obtain statistics including mean, standard deviation, frequency, and percentage to summarize the data. The Internal consistency of each identified construct was calculated to evaluate instrument reliability through Cronbach's alpha values.

3. Results

3.1 Reliability Test Analysis Study

Considering the identification of appropriate alpha values (Hair, Babin & Anderson, 2010) supported by Pallant (2007), suggest that the ideal value of a Cronbach's alpha coefficient of scale should be 0.700 a minimum to indicate high internal consistency. Based on the result reliability analysis the Cronbach's Alpha values in each question section have a high value of Cronbach's alpha coefficient. This indicates that this construct has excellent reliability strength. Table 1 shows the results of the reliability analysis of each construct.

Table 1: Reliability test analysis study

Variable	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Essential elements of teaching aid and necessary features for teaching aid	0.892	0.911	19
Development of the Aquaponic Mini Model Learning Aid Kit (Design and Layout)	0.747	0.743	14
Usability of the Aquaponic Mini Model Learning Aid Kit	0.837	0.832	14

3.2 Demographic Profiles Respondents

Table 2 shows frequencies and percentages for demographic variables. The majority of experts were females (77.8%, female; 22.2%, male). Most respondents were 35 to 39 years (55.6%) old in comparison to the 35 to 39, 30 to 34 (22.2%), 25 to 30 (11.1%) and 40-44 (11.1%) age groups. The majority of respondents held a certificate of Ph.D. (77.8%) and 22.2% held a Master's degree. Data showed that all experts, 100% are working as a lecturer.

Table 2: Demographic profiles respondents

Variable	Category	Frequency	%
Gender	Male	2	22.2
	Female	7	77.8
Age (Old)	25-30	1	11.1
	30-32	2	22.2
	35-39	5	55.6
	40-44	1	11.1
Level Education	Master	2	22.2

	PhD	7	77.8
Occupational	University lecturer	9	100

3.3 Expert Perception on Essential Element of Teaching Aid

Table 3 presents the means and standard deviation of expert perception on the essential elements of teaching aid. Data interpretation is made based on the mean value obtained, whether weak (0.0-0.1.86), moderate (1.87-1.93), and good (1.94-2.00). The overall mean perception rating was 2.00, implying perceptions were good. The highest mean for the essential element of teaching aid was teaching that related to the topic of learning, teaching aid makes teaching more engaging and creates creativity both for teacher and students. Results show that expert perceptions of essential elements of teaching aid is good.

Table 3: Means and standard deviations of expert perception on essential elements of teaching aid. (TA = teaching aid)

Item	Mean	SD
Teaching aid related to the topic of learning	2.00	.000
The content of the teaching aid is accurate and closely related to the topic to be taught	2.00	.000
Teaching aid help make students learn more about content of the lesson	1.89	.333
TA offers an authentic experience and makes teaching more engaging	2.00	.000
TA can inspire creativity, both in teachers and students	2.00	.000
TA kits contain original and distinctive ideas and designs	1.89	.333
TA contains high pure values (not using materials such as polite pictures or using materials that contain negative elements such as gambling and smoking).	1.78	.441

3.4 Expert Perception on Necessary Features for Teaching Aid

Table 4 presents the means and standard deviation of expert perception on necessary features for teaching aid. Data interpretation is made based on the mean value obtained, whether weak (0.0-0.1.86), moderate (1.87-1.93), and good (1.94-2.00). The overall mean perception rating was 2.00, implying perceptions were good. The highest mean for necessary features for teaching aid was teaching aid concise and achieves learning objective, teaching aid is medium-sized and easy to carry. Results show that expert perception of necessary features for teaching aid is good.

Table 4: Means and standard deviations of expert perception on necessary features for teaching aid. (TA = teaching aid)

Item	Mean	SD
TA is concise and achieves learning objectives	2.00	.000
TA is medium-sized and easy to carry	2.00	.000
TA included with the user or installation manual	2.00	.000
TA can facilitate students	2.00	.000
Innovative learning aid kit (QR code scan and video on how to use or install)	1.89	.333
TA that uses actual materials	1.89	.333
TA using low-cost materials	2.00	.000
TA which is neat and clean	2.00	.000
TA have appropriate graphics and writing (user manual)	1.78	.441
TA can be used many times and is durable	1.78	.441
TA kit is realistic and easy to understand	2.00	.000
TA has physical features - safe, easy to use and store	2.00	.000

3.5 Expert Perception on Development of Aquaponic Mini Model Learning Aid Kit (Design and Layout)

Table 5 presents the means and standard deviation of expert perception on the development of the Aquaponic Mini Model Learning Aid Kit (Design and Layout). Data interpretation is made based on the mean value obtained, whether weak (0.0-0.1.86), moderate (1.87-1.93), and good (1.94-2.00). The overall mean perception rating was 2.00, implying perceptions were good. The highest mean for the development of the Aquaponic Mini Model Learning Aid Kit (design and layout) was are the visuals and audio used in the video on how to use or install this developed Aquaponic Mini Model are interesting and appropriate? and are the components of the Aquaponic Mini Model Learning Aid Kit developed using readily available and inexpensive materials? Results show that expert perceptions of essential elements of teaching aid is good.

Table 5: Means and standard deviations of expert perception on development of aquaponic mini model learning aid kit (design and layout). (TA = teaching aid)

Item	Mean	SD
Does the design of the Aquaponic Mini Model Learning Aid Kit developed suit the learning objectives?	2.00	.000
Is the design and layout of the developed Aquaponic Mini Model Learning Aid Kit convenient?	1.89	.333
Is the design of the Aquaponic Mini Model Learning Aid Kit developed neat and sturdy?	1.89	.333
Is the size of the developed Aquaponic Mini Model Learning Aid Kit (medium size and easy to carry?	2.00	.000
Is the design of the developed Aquaponic Mini Model Learning Aid Kit easy for students to use?	2.00	.000
Is the design of the Aquaponic Mini Model Learning Aid Kit developed suitable for students?	2.00	.000
Is the information on the Aquaponic Mini Model Learning Aid Kit developed easily for students to understand?	1.89	.333
Are the components of the developed Aquaponic Mini Model Learning Aid Kit easily disassembled if misused or installed?	1.89	.333
Are the components of the Aquaponic Mini Model Learning Aid Kit developed using readily available and inexpensive materials?	2.00	.000
Is the user manual that comes with the Aquaponic Mini Model Learning Aid Kit developed attractive and clear?	1.56	.527
Are the instructions on the user manual or installation of this developed Aquaponic Mini Model Learning Aid Kit is clear?	1.78	.441
Is the writing on the user manual or installation of the developed Aquaponic Mini Model Learning Aid Kit clear and easy to read?	1.89	.333
Are the visuals and audio used in the video on how to use or install this developed Aquaponic Mini Model Learning Aid Kit interesting and appropriate?	2.00 2.00	.000 .000

3.6 Expert Perception on Usability of Aquaponic Mini Model Learning Aid Kit

Table 5 presents the means and standard deviation of expert perception on the usability of the Aquaponic Mini Model Learning Aid Kit. Data interpretation is made based on the mean value obtained, whether weak (0.0-0.1.86), moderate (1.87-1.93), and good (1.94-2.00). The overall mean perception rating was 2.00, implying perceptions were good. The highest mean for the usability of Aquaponic Mini Model Learning Aid Kit) was the use Aquaponic Mini Model Learning Aid Kit developed in teaching and learning is more time saving and Aquaponic Mini Model Learning Aid Kit developed in Aquaculture teaching will help students learn to relate real equipment to aquaponics systems. Results show that expert perceptions of essential elements of teaching aid is good.

Table 5: Means and standard deviations of expert perception on usability of aquaponic mini model learning aid kit. (TA = teaching aid)

Item	Mean	SD
Is the Aquaponic Mini Model Learning Aid Kit developed able to achieve the learning objectives?	2.00	.000
Does Aquaponic Mini Model Learning Aid Kit develop to facilitate teaching and learning?	2.00	.000
Does the Aquaponic Mini Model Learning Aid Kit develop work well?	2.00	.000
Is Aquaponic Mini Model Learning Aid Kit developed able to dig out students' creative and critical thinking?	1.89	.333
Can the use of the developed Aquaponic Mini Model Learning Aid Kit replace hands-on activities during online learning?	2.00	.000
Is the use of the Aquaponic Mini Model Learning Aid Kit developed able to hone students' practical skills during online learning?	2.00	.000
Is the level of usability of the Aquaponic Mini Model Learning Aid Kit at a high level?	1.67	.500
The use of the developed Aquaponic Mini Model Learning Aid Kit does not require lecturers or teachers to work overtime to build the Learning Aid Kit	1.89	.333

The use Aquaponic Mini Model Learning Aid Kit developed in teaching and learning is more time saving	2.00	.000
Aquaponic Mini Model Learning Aid Kit developed in Aquaculture teaching will help students learn to relate real equipment to aquaponics systems	2.00	.000
The use Aquaponic Mini Model Learning Aid Kit is a fun and easy way to introduce and illustrate the concept of an aquaponic system	2.00	.000
The use of the developed Aquaponic Mini Model Learning Aid Kit is very important to cultivate students 'curiosity	2.00	.000
The use of the developed Aquaponic Mini Model Learning Aid Kit is very important to increase students 'engagement in learning and teaching activities in the online classroom	2.00	.000
The use of the developed Aquaponic Mini Model Learning Aid Kit is very important to increase students 'understanding of the concept of aquaponic systems	2.00	.000

4. Discussion and Conclusion

The study's findings have proven expert perception of essential elements of teaching aid is at a good level. Learning Aid Kit must be appropriate for learning and teaching activities, the content must be accurate and closely related to the topic discussed (Lambri & Mahamood, 2019). The type of material selected for the development of teaching aid is necessary to achieve the learning objectives outlined (Nurul Haniza, 2017). The use of teaching aids must be parallel to the topic taught and it will provide an advantage to the teacher in raising the morale of students throughout the ongoing teaching and learning process (Omar et al., 2017). According to Lambri & Mahamood (2019), one of the characteristics of a learning aid Kit should contain pure values.

Meanwhile, the expert perception of necessary teaching aid features is at a good level. Teaching aid kits, are inexpensive tools that can make educators' jobs easier during the learning and teaching process to make classes more efficient (McCaughey, 2010). The preparation of a learning aid kit could be accomplished quickly and easily with little or no money to make learning effective, comprehensive, and engaging (Sivakumar, 2014). It is also necessary to include explained techniques such as clear sound, sight size, and color in developing a learning aid kit. Teaching aids linked to specific subjects, become more effective (Rashid, 1989). It shows that multimedia elements such as text, audio, video, animation, graphics, images, and interactive animations can increase students' interest in following the learning and teaching process.

Also, the study's findings have proven expert perception on the development of the Aquaponic Mini Model Learning Aid Kit between good and moderate levels. A study highlighted found that subjects were more considered to use exciting and compelling, by using photos, graphics, videos and voices to help students understand, and remember (Azman et al., 2014). In order to ensure the effectiveness of information delivery, linguistic aspects (words), syntax (sentences), and discourse should all be emphasized in order to avoid interfering with the reader's ability to receive information effectively. Calligraphy and illustration must be large enough to be seen clearly by students who are further away from the aids (Basiran et al., 2021). When colors are used, they should provide strong contrast and be recognizable (Ghulam et., 2015).

The study's findings have also proven expert perception of the usability of the Aquaponic Mini Model Learning Aid Kit is at a good level. When humans make their own things, they will achieve 90% memory and can change their understanding from difficult to easier (Dale, 1969). Moreover, using the Aquaponic Mini Model Learning Aid Kit, students will develop and build the learning kit independently and the results will be more precise and more understandable. For a teacher, the use of teaching aid can save time in determining efficient teaching and learning processes (Azman et al., 2014). Teachers must use appropriate learning kits to improve their understanding of a subject and to save students time and interest (Ahmad & Jinggan, 2015). It is also important that the teaching aid kit has a positive impact, such as streamlining the teaching and learning process, saving time and energy, preventing students from becoming tired or bored, and providing maximum impact with the least amount of time (Ab Aziz & Hassan, 2008).

Based on this study, the level of expert perception on development and usability of Teaching Aids "Aquaponic Mini Models" for Aquaculture Course was at a good level. According to the results, improvements must be made in the Teaching Aid "Aquaponic Mini Model" manual and instruction. Expert suggests the manual instruction can be improved by increasing the size of fonts to make it clearer. The result from the analysis also shows positive feedback among the experts. As for the recommendation, there is some room for improvement in the research, and some suggestions for further study will involve several aspects, including the research instrument and methodology. The research instrument used in this study is an online questionnaire. The online questionnaire that was distributed to an expert is only nine. The researcher can add more experts to get feedback and perception about the Learning Aid Kit Aquaponic Mini Model. Sultan Idris Education University has many experts in developing learning aid kits. This is significantly better because the students utilize the learning Aid Kit to assess students' understanding of aquaponic topics. Researchers can administer a questionnaire before and after using the Learning Aid Kit and then compute the difference in student understanding between the two periods. Therefore, developing a Teaching Aid, an "Aquaponic mini model" for the aquaponic topic is necessary.

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References

Ab Aziz, N. & Hassan, J. (2008). *Faktor-faktor Yang Mempengaruhi Minat Terhadap Matematik di Kalangan Pelajar Sekolah Menengah* (Doctoral dissertation, Universiti Teknologi Malaysia).

Abd Rashid, A.R. (1989). *Strategi Pengajaran Sejarah KBSM*. Fajar Bakti Sdn Bhd. Kuala Lumpur.

Ahmad, A. & Jinggan, N. (2015). Pengaruh kompetensi kemahiran guru dalam pengajaran terhadap pencapaian akademik pelajar dalam mata pelajaran Sejarah. *Jurnal Kurikulum & Pengajaran Asia Pasifik*, 3(2), 1-11.

Azman, M.N.A., Azli, N.A., Mustapha, R., Balakrishnan, B. & Isa, N.K.M. (2014). Penggunaan alat bantu mengajar ke atas guru pelatih bagi topik kerja kayu, paip dan logam. *Sains Humanika*, *3*(1).

Bacotang, J., Mohamed Isa, Z., Mustafa, M.C., Arshad, M. & Omar, A. (2016). Aplikasi Model Addie Dalam Pembangunan Modul Literasi Awal (Modul Lit-A) Untuk Awal Kanak-Kanak. *JPBU Edisi Khas*, *February*, 1–10.

Budoya, C.M. Kissaka, M. & Mtebe, J. (2019). Instructional Design Enabled Agile Method Using ADDIE Model and Feature Driven Development Process. *International Journal of Education and Development Using Information and Communication Technology*. 15(1), 35–54.

Basiran, M.F., Mohd Sharif, S. & Syed Mohd Zahari, S.E.S. (2021). Development of 'Boyles Law Apparatus' Teaching Aids for Thermodynamics Course: Innovation in Teaching Methodology. *ANP Journal of Social Science and Humanities*, *2*(1), 36-45. https://doi.org/10.53797/anpjssh.v2i1.5.2021

Dale, E. (1969). *Audio-Visual Methods in Teaching* (3rd ed., p. 108). Holt, Rinehart & Winston, New York: Dryden Press.

Dick, W. & Carey, L. (1996). *The systematic design of instruction* (4th ed.). New York: Harper Collins College Publishers.

Drljača, D., Latinović, B., Stanković, Z. & Cvetković, D. (2017). *Addie model for development of e-courses.* In Documento procedente de la International Scientific Conference on Information Technology and Data Related Research SINTEZA [Internet] (pp. 242-247).

Ebru, K.O.Ç. (2020). Design and evaluation of a higher education distance EAP course by using the AD Gustafson, K. L. & Branch, R M. (2007). What is instructional design? Dalam Reiser, R. A., & Dempsey, J. V. (Editor), *Trends and issues in intructional design and technology*, (ms. 10-16). Upper Saddle River, NJ: Pearson Education.

Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work, *British Journal of Educational Psychology*, 70,113– 36.

Ghulam, S., Khuram, S.H., Naqvi, H. & Nadeem, I. (2015): Impact of Visual Aids in Enhancing the Learning Process Case Research: District Dera Ghazi Khan. *Journal of Education and Practice*, 6 (19), 226-233.

Gustafson, K. L. & Branch, R.M. (2007). *What Is Instructional Design?* In R. A. Reiser, & J. V. Dempsey (Eds.), Trends and Issues in Instructional Design and Technology (pp. 10-16). New Jersey: Pearson Education.

Hair, Jr, J.F., Babin, B.J. & Anderson, R.E. (2010). A GLOBAL P-ERSPECT-IVIE. *Kennesaw: Kennesaw State University*.

Ibrahim, N.H., Surif, J. & Mustapa, M.S. (2006). *Kefahaman dan Tahap Amalan Pembelajaran Secara Kontekstual di Kalangan Guru Sains Luar Bandar* (Doctoral dissertation). Universiti Teknologi Malaysia.

Kamarul Azmi, J., Ab Halim, T. & Mohd Izam M.H. (2011). Kajian Kes Pengunaan Kaedah Pengajaran Dan Pembelajaran Guru Cemerlang Pendidikan Islam (CGPI) Sekolah Bandar dan Luar Bandar: Satu Kajian Pembandingan. *Jurnal Teknologi*. 56, 179-198.

Knaus, U. & Palm, H.W. (2017a). Effects of fish biology on ebb and flow aquaponical cultured herbs in northern Germany (Mecklenburg Western Pomerania). *Aquaculture*, 466: 51-63.

Konig, B., Junge, R., Bittsanszky, A., Villarroel, M. & Komives, T. (2016). On the sustainability of aquaponics. *Ecocycles*, 2, 26-32.

Lambri, A. & Mahamood, Z. (2019). Penggunaan alat bantu mengajar dalam pengajaran bahasa melayu menggunakan pendekatan pembelajaran berpusatkan pelajar. *International Journal of Education, Psychology and Counseling*. 4 (33), 78-94.

Larson, M. B. & Lockee, B. B. (2014). Streamlined ID: *A practical guide to instructional design.* Oxon: Routledge.

Mastor, H., Salleh, H. & Ibrahim, K. (2021). Students Readiness for Online Learning: Case Study on Commerce Department's Students Politeknik Kuching Sarawak. *International Journal of Modern Trends in Social Sciences*, 4 (15), 88- 96.

McCaughey, K. (2010). *Ten Great Low-Cost Teaching Tools*. In English Teaching Forum (Vol. 48, No. 4, pp. 24-29). US Department of State. Bureau of Educational and Cultural Affairs, Office of English Language Programs, SA-5, 2200 C Street NW 4th Floor, Washington, DC 20037.

Mohamad Mohsin, S.F.A. & Hassan, R. (2011). *Pengajaran dan pembelajaran berasaskan 'streaming video' bagi meningkatkan tahap kefahaman pelajar Abad ke-21.* Persidangan Kebangsaan Penyelidikan Dan Inovasi Dalam Pendidikan Dan Latihan Teknik Dan Vokasional. CIE-TVT 2011, 16-17 November 2011 (pp. 1-14). Pulau Pinang.

Moradmand, N., Datta, A. & Oakley, G. (2014). The design and implementation of an educational multimedia mathematics software: using ADDIE to guide instructional system design. *The Journal of Applied Instructional Design*, *4*(1), 37-49.

Nadiyah, R. S. & Faaizah, S. (2015). The Development of Online Project Based Collaborative Learning Using ADDIE Model. *Procedia-Soc.Behav. Sci*,195,1803–1812.

Nichols Hess, A. & Greer, K. (2016). Designing for engagement: Using the ADDIE model to integrate high-impact practices into an online information literacy course. *Communications in information literacy*, *10*(2), 6.

Nurul Haniza, S. (2017) *Penggunaan Kit Asas Membaca Bahasa Melayu untuk kanak-kanak pemulihan khas / Nurul Haniza Samsudin.* PhD thesis, University of Malaya.

Omar, M.S., Saad, N. S. & Dollah, M.U. (2017). Penggunaan bahan bantu mengajar guru matematik sekolah rendah. *Jurnal Pendidikan Sains Dan Matematik Malaysia*. 7(1), 32-46.

Pallant, J. (2007). SPSS survival manual, 3rd. *Edition. McGrath Hill*, 283.

Peterson, C. (2003). Bringing ADDIE to Life: Instructional Design at Its Best. *Jl. of Educational Multimedia and Hypermedia*. 12(3), 227-241.

Rashid, A.R. (1989). *Strategi Pengajaran Sejarah KBSM*. Fajar Bakti Sdn Bhd. Kuala Lumpur.

Rakocy, J.E. (2012) *Aquaponics-integrating fish and plant culture. In: Aquaculture production systems.* Wiley-Blackwell, Oxford, UK, pp 344–386.

Roopa, S. & Rani, M. (2012). Questionnaire Designing for a Survey. *The Journal of Indian Orthodontic Society*, *46*, 273–277. https://doi.org/10.5005/jp-journals-10021-1104.

Seel, B. & Glasgow, Z. (1998). *Making Instructional Design Decisions*, Upper Saddle River, NJ: Merrill.

Sivakumar, R. (2014). Impact of low-cost teaching aids in teaching science. *Innovative Thoughts International Research Journal*, 2(3), 31-3.

Stapa, M.A., & Muhammad, N. (2019). The use of addie model for designing blended learning application at vocational colleges in Malaysia. *Asia-Pacific Journal of Information Technology and Multimedia,* 8(1) 49-62.

Tanner, D.E. (2001). *Assessing academic achievement*. Boston: Allyn & Bacon.

Trisiana, A. & Wartoyo, W. (2016). Desain Pengembangan model pembelajaran Pendidikan Kewarganegaraan melalui ADDIE Model untuk Meningkatkan Karakter Mahasiswa di Universitas. *PKn Progresif*, 11, 313-330.

Wang, S.K. & Hsu, H.Y. (2009). Using the ADDIE model to design second life activities for online learners. *TechTrends*, 53 (6), 76-81.