PERJ
Physics Education Research Journal
ISSN 2685 - 6190 (p)
ISSN 2714 - 7746 (e)
Department of Physics Education
Faculty of Science and Technology
UIN Walisongo Semarang-Indonesia

Development and Usability of the Specific Heat Capacity Application Kit Among Form 4 Students

Mohd Norzaidi Mat Nawi

Department of Physics Education, Universiti Pendidikan Sultan Idris, Malaysia

ARTICLE INFO

Article history:
Submitted : March 21st, 2023
Revised : May 24th, 2023
Accepted : July 16th, 2023

Keywords:
Usability; Application Kit; Physics, Specific Heat Capacity

ABSTRACT

This study aims to develop an application kit for the specific heat capacity subtopic of the topic of heat and assess the degree of usefulness of the application kit for specific heat capacity among Form four students in Malaysia. This development design study based on constructivism theory uses the ADDIE model. A total of 36 Form 4 students were chosen as research participants using a simple random sample procedure to assess the usability level of the application kit. The study tool utilized is a 4-point Likert scale expert validity assessment form and a research question form on the usability of the Specific Heat Capacity Application Kit. The expert approval percentage approach is used to assess expert validity. The Cronbach Alpha reliability coefficient was calculated using the Statistical Package for the Social Sciences (SPSS) software, and the data for the usability study questions were analyzed using descriptive statistical analysis to determine the mean value and standard deviation. The study's findings revealed that the expert approval value for the application kit and instrument was high, with 95.5% and 97.5%, respectively. It received a high dependability rating of 0.82 for the research instrument. The findings also revealed that the application kit is entirely usable (M = 3.84, SP = 0.36). As a result, this application kit is appropriate for use as teaching and learning material for the Form 4 subtopic of specific heat capacity. This application kit will aid in the development of a more active and two-way learning environment between the learner and the instructor, as well as improve the learner's comprehension of the Specific Heat Capacity subtopic.

Introduction

According to the Malaysian Ministry of Education (2006), human development should be balanced and comprehensive regarding intellectual, spiritual, emotional, and physical development for education programs in this country, particularly at the school level, formulated based on the National Education Philosophy. To reach that aim in this context, a creative and critical method of thinking should be utilized to solve a problem or address a situation with the simplest but most effective actions. In line with the Malaysian Education Development Plan (2013-2025) objectives of understanding the current performance and challenges in Malaysia's education system, creating a clear vision and aspirations, and focusing on a comprehensive transformation of the education system, including significant changes in the ministry.

This inventive and creative inclination may be utilized to teach and learn (Runco, 2014), for example, by developing learning kits to help students grasp the learning themes. According to Saadah et al. (2020), one method for making it simpler for pupils to comprehend ideas in learning is to employ learning kits to overcome students' learning issues. The study's findings show that Kit media can be used and utilized as a teaching aid in addition to increasing the

*Correspondence email: norzaidiurrg@gmail.com
doi: 10.21580/perj.2023.5.2.14888

knowledge and understanding of students, particularly those with learning difficulties.

The development of the specific heat capacity application kit among Form 4 students in Malaysia is a research project aimed at creating a learning tool to help students understand the concept of specific heat capacity and its practical applications. Specific Heat Capacity, which falls under the "Heat" subject, is a topic with numerous application examples and is strongly tied to everyday living in society. The notion of heat may already be in students' brains. However, this concept frequently encounters conceptual problems among pupils (Rohayu et al., 2021; Akaygun & Ozkan, 2011; Seraphin & Philips, 2019). As a result, this issue must be prevented by proper activities that must be done to guarantee that pupils comprehend. This is because if there is a proper explanation, pupils will likely be able to handle this issue. Science students believe that the idea of heat is challenging to grasp (Cajas, 1999a; Cajas, 1999b).

Thus, a Specific Heat Capacity Application Kit was developed as a result of this investigation. As a result, the study's objectives are to develop a Specific Heat Capacity Application Kit under the topic of heat for Form 4 students and to identify the level of usability of the Specific Heat Capacity Application Kit among Form 4 students.

Methods

Research Design

The design and development methods were used in this study. The design and development of this application kit refers to the ADDIE model, which includes five main phases: analysis, design, development, implementation, and evaluation (Morrison, 2022). The ADDIE model is used as a kit application design because this model has a thorough and system-oriented procedure to form good application kit design data (Mohmad, 2022).

Respondents

This study included three sorts of respondents: specialists from physics lecturers and instructors to assess the level of face validity and content of the application kit and the usability questionnaire. Fourth-grade students evaluate the application kit's dependability and usability in the second and third categories. Two experts were chosen to assess the application kit and questionnaire's validity. A simple random sampling approach was used to pick samples for the dependability of the respondents, 22 students, and the usefulness of 36 out of 44 students. Table 1 displays responder information by purpose and number.

Table 1
Respondent Information by Purpose and Number

No.	Purpose	Respondent	Number
1	Application kit validity	Expert	2
2	Reliability of the questionnaire	Student	22
3	Usability of the application kit	Student	36

Instrument

The Expert Validity Form and the Usability Questionnaire were employed in this investigation. The expert validation form is divided into two sections: face validity and content validity. Two experts gave this study validity before it was evaluated in a pilot and actual studies. Expert validity is required to assess the item and measure the construct depending on the model utilized (Musa et al., 2020).

A four-likert scale usability questionnaire was used to assess the degree of usability of this Specific Heat Capacity Application Kit. This form is used to collect quantitative information from responders. The USE questionnaire (Lund, 2001) was used to administer this survey, which comprises four primary constructs: usefulness, ease of learning, ease of use, and satisfaction. This usability questionnaire is divided into Part A and Part B. Part A comprises information about the assessor. Part B has 35 questionnaire items based on the four primary components.

Data Analysis

The data collected from the study will be analyzed using descriptive statistics, i.e., mean and standard deviation, through the Statistical Package for the Social Sciences (SPSS).

Table 2
Data Analysis Methods

Research Questions		Data Analysis Method
Does the Specific Heat Capacity Application Kit under the Heat topic have good validity?	Validity Percentage	Expert Agreement
What is the Usability Level of the Specific Heat Capacity Application Kit among Form 4 students?	Reliability	Cronbach Alpha

Expert validity was assessed using the expert agreement percentage. It is considered to have a high level of validity when the percentage value of expert agreement exceeds 70% (Tuckman & Waheed, 1981). Table 2 is a data analysis conducted to answer the research question.

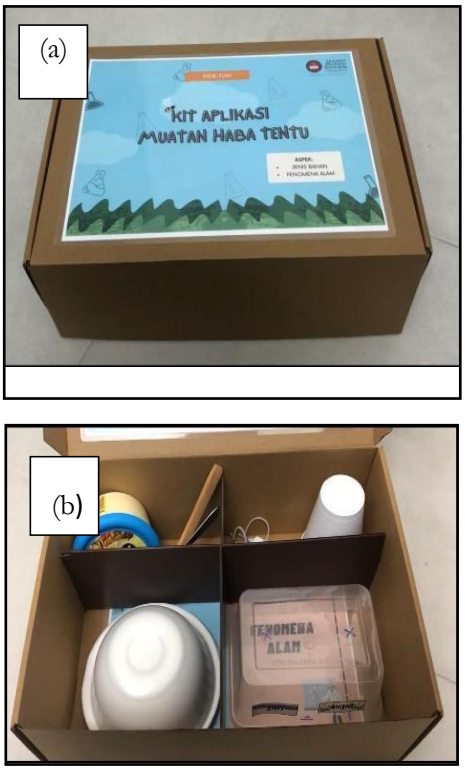
Result and Discussions

The analysis of the research findings obtained is based on the description of the analysis data to determine the validity, reliability, and usability of the Specific Heat Capacity Application Kit developed.

Specific Heat Capacity Application Kit

ADDIE model was chosen for this application kit development research. The researcher examines the study title, aims, and application kit material during the analysis phase. This step requires the researcher to outline the problem statement and the most recent educational concerns related to creating this application kit. Among the concerns observed was that the student's level of comprehension could have been better when instructional materials were not used throughout the learning session.

Figure 1
Specific Heat Capacity Application Kit (a) Front Cover (a) and (b) Contents inside box.



Researchers need particular heat capacity data throughout the design process to assemble an application kit that would appeal to students. The development phase follows, during which the researcher will create a specific heat capacity application kit based on the analysis and design discovered in the first and second phases. In addition, the researcher must create a usability questionnaire to assess the usability of the Specific Heat Capacity Application Kit. The application kit Kit is shown in Figure 1.

Collaborative activities that involve physical movement are one of the initiatives that teachers can take to improve students' understanding of a topic (Nuria & Mat, 2019). This kit is suitable as a material or self-learning activity to help students improve their understanding of this Specific Heat Capacity subtopic. This is because the students can carry out the activities from this kit and are suitable for independent learning. Indirectly, students can use this kit at any time to improve students' understanding of this subtopic. This Kit comes with a guide module to carry out the activities found in the application kit. Figure 2 is the front page of the guide module where the language used in the guide module is in Bahasa Malaysia. This guide module also has a QR code that users can access to discover the steps or procedures for carrying out activities. These source materials have been researched and selected by DSKP KSSM Physics Form 4 guidelines under the topic of Heat. The guidance modules are provided by the content and learning standards presented by the Malaysian Ministry of Education. Notes and exercises are provided in an exciting form and contain graphic elements, which also help teaching and learning sessions become more attractive.

Figure 2
Front Page of Specific Heat Capacity Application Kit Guide Module

This kit was developed by having two activities that include aspects of specific heat capacity: material and natural phenomenon. From the material aspect, this kit focuses on the type of material: wood and iron. Users will be able to know the difference in specific heat capacity for wood and iron. At the same time, the second activity focuses on aspects of natural phenomena, namely land breeze and sea breeze. Users will better understand the concept of land breeze and sea breeze by using this kit instead of just reading.

After the development stage, expert validation has been done for improvement reasons throughout the deployment phase of the Specific Heat Capacity Application Kit and questionnaire. A pilot study with 22 respondents was surveyed once the percentage of expert agreement reached a high level and modifications were made. The Cronbach Alpha coefficient was calculated using SPSS software once the data was collected. The usability questionnaire was then delivered to 36 respondents to collect actual research data. The fundamental research data was examined in SPSS utilizing the descriptive statistical analysis approach. Finally, modifications and ideas for further research are made.

Face and Content Validity

Face and content validity are essential in ensuring a valid and reliable measurement instrument for measuring the construct of interest. While face validity ensures that the instrument appears to be measuring the construct correctly, content validity ensures that it covers all the relevant aspects of the construct. The results from the specific heat capacity application kit, the usability questionnaire, and the expert agreement validity percentage all showed results with excellent and high levels of validity (above 95%). The findings indicate that the research instrument is adequate and that pilot and real-world studies may be conducted to test its usefulness. The interpretation of the proportion of expert agreement for the study instrument is shown in Table 3.

Table 3
Findings of Validity Expert Agreement Percentage on Average

Type of Validity	Percent Validity (%)	
	Specific Heat Capacity Application Kit	Usability Questionnaire
Face Validity	97.5	95.0
Content Validity	93.5	100.0
Average Score	95.5	97.5

Reliability

Based on its pilot research findings, Cronbach's alpha was used to assess the reliability of this usability questionnaire. The Cronbach Alpha coefficient for the pilot research is shown in Table 4. Based on Table 4, for the "usefulness" construct, the Cronbach Alpha coefficient value is 0.69, while for the "easy to learn" construct, the coefficient value is 0.91. Next, the "easy to use" construct has a Cronbach Alpha coefficient value of 0.84, while the coefficient value for the "satisfaction" construct is 0.83. On average, the value of the Cronbach Alpha coefficient for the findings of the pilot study is 0.82

Table 4
Cronbach Alpha Coefficient Value of the Pilot Study

Construct	Number of Items	Cronbach Alpha Coefficient Value
Usefulness	9	0.69
Easy to Learn	8	0.91
Easy to Use	9	0.84
Satisfaction	9	0.83
Overall	35	0.82

Usability

Usability studies were carried out on 36 respondents who were grade four students to evaluate the level of usability of this Specific Heat Capacity Application Kit in terms of usefulness, ease of learning, ease of use, and satisfaction. The mean value and standard deviation for each question in their respective constructions will be discussed below.

The usability of an application kit can be evaluated by assessing its usefulness. This involves determining whether the kit meets the needs of its users and provides them with the necessary features and functions to achieve their goals. Table 5 shows the usability analysis of usefulness constructs.

The ease of learning is another crucial aspect of usability. A usable application kit should be easy for users to learn and understand, with clear instructions and intuitive navigation. Table 6 shows the usability analysis of learnable constructs. The ease of use of an application kit refers to how easy it is for users to perform tasks using the kit. A usable kit should be intuitive and easy to navigate, with clear instructions and an uncluttered interface. The ease of use can be evaluated through user testing and observation, where users are asked to perform tasks using the kit, and their interaction with the kit is observed and measured. Table 7 shows the usability analysis of ease-of-use constructs.

Table 5
Usability Analysis of Usefulness Constructs

No.	Statements	Min Score	Standard Deviation
1	My lesson performance on Specific Heat Capacity improved when using this application kit.	3.81	0.40
2	My understanding of Specific Heat Capacity increased when using this application kit.	3.83	0.38
3	My interest in Specific Heat Capacity increased when using this application kit.	3.67	0.48
4	I was more active in class when learning this topic of Specific Heat Capacity through the application kit.	3.69	0.47
5	I support if, during the learning session, the application kit is used primarily for the Specific Heat Capacity topic.	3.97	0.17
6	I need this manual to carryout the activities carried out.	3.56	0.70
7	This manual is handy for me.	3.86	0.35
8	This manual does notfocus on activity procedures only but interesting exercises.	3.86	0.35
9	This manual can improve my understanding.	3.81	0.40
	Overall	3.78	0.41

Table 6
Usability Analysis of Learnable Constructs

No.	Statements	Min Score	Standard Deviation
1	I was able to learn to use this application kit veryquickly.	3.89	0.32
2	I quickly remember how to use this application kit.	3.86	0.35
3	I can easily use this application kit quickly.	3.86	0.35
4	I quickly mastered using this application kit.	3.81	0.40
5	I can easily understand the activity instructions.	3.94	0.23
6	Appropriate language is easy to learn.	3.94	0.23
7	I am interested in the design layout because it is easy to understand.	3.92	0.28
8	I am obvious with the procedures.	3.92	0.28
	Overall	3.90	0.30

Table 7
Usability Analysis of Ease-of-Use Constructs

No.	Statements	Min Score	Standard Deviation
1	I easily use this application kit.	3.86	0.35
2	I was able to use this application kit successfully.	3.86	0.35
3	The materials and tools used are readily availableanywhere.	3.89	0.32
4	I can use this application kit without a manual.	3.50	0.74
5	Without a teacher's guidance, I can make this Specific Heat Capacity application kit even at home.	3.89	0.32
6	Appropriate size and easy to carry.	3.75	0.50
7	This manual is suitable for carrying in various places.	3.83	0.45
8	It is easy to use this manual.	3.78	0.42
9	This manual is very suitable for all students who want to understandthe topic of specific heat capacity.	3.89	0.32
	Overall	3.81	0.42

Table 8
Usability Analysis of Satisfaction Constructs

No.	Statements	Min Score	Standard Deviation
1	I am satisfied with thisSpecific Heat Capacity application kit.	3.94	0.23
2	I will recommend this Specific Heat Capacity application kit to my friends.	3.97	0.17
3	I have a lot of fun using this Specific Heat Capacity application kit.	3.92	0.28
4	This Specific Heat Capacity application kit works precisely as I want it to.	3.83	0.38
5	I am comfortable using this Specific Heat Capacityapplication kit.	3.92	0.28
6	I would like to have thismanual to understand the topic of Specific Heat Capacity better.	3.75	0.44
7	I will recommend it to my friends.	3.86	0.35
8	I will be very interested inthe contents of this manual.	3.81	0.40
9	This manual is very essential for this application kit.	3.83	0.38
Overall		3.87	0.32

The last aspect is user satisfaction, which is a critical aspect of usability, as it measures how well the kit meets the needs of its users and how satisfied they are with their experience using it. Table 8 shows the usability analysis of satisfaction constructs.

Table 9
Average Usability Score Value and Standard Deviation

Construct	Min Score	Standard Deviation	Interpretation
Usefulness	3.78	0.41	High
Easy to Learn	3.90	0.30	High
Easy to Use	3.81	0.42	High
Satisfaction	3.87	0.32	High
Usability Average	3.84	0.36	High

The average usability score value and the standard deviation are tabulated in Table 9. As a result, a minimum score of 3.84 has a high interpretation, according to Nunnally and Bernstein (1994). Additionally, Ramlee (2002) claims that a low standard deviation number suggests a high level of agreement. As a result, a standard deviation of 0.5 or less has a high level of agreement among responders. Overall, the data analysis findings reveal that this Specific Heat Capacity Application Kit has high usability among Form 4 students due to the high interpretation of the mean score and standard deviation acquired.

Conclusions

This study comprehensively demonstrated that the Specific Heat Capacity Application Kit for the issue of heat effectively achieved the study's aims and answered the study's questions. The validity of this study varied from 95.5% to 97.5%. The usability questionnaire also has a good level of dependability (0.82). The usefulness construct has a mean value of 3.78 (SP = 0.41), the easy-to-learn construct has a mean value of 3.90 (SP = 0.30), the easy-to-use construct has a mean value of 3.81 (SP = 0.42), and the satisfaction construct has a mean value of 3.87 (SP = 0.32). Based on data analysis, this Specific Heat Charge Application Kit is appropriate for fourth-grade students studying Physics.

Acknowledgments

This research has been carried out under the Fundamental Research Grants Scheme (FRGS/1/2021/STG07/UPSI/02/2) provided by the Ministry of Education of Malaysia. The authors would like to thank UPSI, which helped manage the grants.

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