# Development of Mathematics Web-based Learning on Table Set-Up Activities

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***Abstract*—This paper aimed to discuss product design and expert validation of the mathematics web-based learning table set up activities in the hospitality industry. This research was a type of Research and Development, which aimed to develop a new product. The experts involved in this study were four experts. There were two experts in the field of learning technology as media validators and two experts in the field of mathematics education as material validators. In the process of validating the mathematics web-based learning in this study, using a questionnaire that had been prepared to evaluate it as a research instrument. This research had produced mathematics web-based learning which consists of five parts, namely, the initial part to recall about the Cartesian coordinates; the translation sub-material section; the reflection sub-material section; the rotation sub-material section; and the dilatation sub-material section. In the review activity by experts, the average percentage of material validators was eighty five percent, its means is very good and the average percentage of media validators was ninety five its means is very good also. It showed that this mathematics web-based learning can be said to be proper to use.**

***Keywords—Development; web-based learning; mathematics; table set-up; activities***

## I. INTRODUCTION

Mathematics subjects have a quite unique and important part in the competence learning of the tourism department [1]-[2]. Understanding the right concepts in learning mathematics can train transcendental reasoning, range of thinking, and solving a case[3]-[4]. This will make students accustomed to completing case studies in tourism in a more analytical and realistic manner[5]. In general, this is in accordance with the statement which stated that mathematics shows outstanding skills in a person, both in terms of concretizing something abstract, finding the right solution in a case, as well as the power of thinking on an object[6]-[7].

In reality, mathematics is one of the subjects that are less attractive to Tourism Vocational School students[8]-[9]. This is because it is considered a difficult subject to learn and most students have not realized and understood the true meaning of mathematics[10]. This is in accordance with the opinion that most students do not want to focus on learning mathematics because of the assumption that mathematics is difficult, scary, boring and some people hate mathematics so that every time they take part in learning mathematics, someone immediately feels unwell[11]–[14].

Factors from students and teachers become the basis for the reason why many students are less interested in learning mathematics[15]. The factor from the students that became the basis for the reason was the classical view of students, namely that mathematics is a difficult subject to learn[16]. The factor from the teacher that became the basis for the reason was the difficulty of the teacher in finding the right method to lead students to participate in mathematics learning voluntarily without feeling coercion directly[17]. This difficulty causes students to feel bored and not enthusiastic to take part in learning mathematics[18]. This is supported by the opinion which stated that the difficulty in selecting methods that can be used to make students understand in learning mathematics is a teacher difficulty[19]. Another factor that causes students' lack of interest in learning mathematics is because the form of teaching materials has not been able to raise awareness of the importance of mathematics[20]. Teaching materials that still feature algorithms and formula derivations, raise students' assumptions about solid material, feel less clear and it is difficult to understand the material because of a dislike for math subjects[21]. This is supported by the results of research showing that: 1) learning by using textbooks is not liked by students, because it creates a sense of being lost in dense material and emphasizes algorithms so that students have difficulty accepting mathematics learning[22]; 2) The presentation of learning that is commonly done by teachers has not been able to arouse students' desire to learn, so students are not quite ready to receive lessons [23]; 3) students do not feel challenged to work on the questions available in mathematics learning, because the examples of questions and practice questions provided are difficult to understand [24].

In addition, Tourism Vocational School students only focus on the competencies of the majors they choose[25]. Many students think that Mathematics is not so applied in Business World or Industrial World where they carry out On the Job Training or their place to find work after graduating from Vocational High School[26]. Some explorations have also been carried out by Mathematics teachers, but the number of students who have an interest can still be counted on the fingers[27]. Students' understanding of the many mathematical concepts that can be applied in solving problems related to the tourism sector is still so minimal[28]. This causes the sinking of students' desire to study mathematics voluntarily[29].

Overcoming these problems requires the development of teaching materials that can make Tourism Vocational Schools' students interested in learning mathematics. The teaching materials is able to developed can be in the form of mathematics web-based learning[30]-[31] . Applications in the form of colorful pictures with interesting characters and

mathematical material treats in it[33]-[32]. The reality in the field is that there are many mathematical learning applications that have been developed. Some even carry applications with the STEM concept[34]. However, there is no mathematics web-based learning that carries the theme of tourism practice, so that Tourism Vocational School students understand that mathematics learning is also used in the work practice of the tourism industry.

Based on this, this research was conducted to develop an application for learning mathematics that was raised in industrial work practices in one part of the food and beverage service. The material used in the development of this mathematics web-based learning is Transformation material. Where this Transformation material is raised in the table set up, that is the one of tourism practice activity.

## II. METHOD

This research was a type of Research and Development (R&D), which aimed to develop a new product. The development activities carried out in this research were focused on product design and formative evaluation. The stages carried out consist of the Preliminary Research and Prototyping Stage.

### A. Preliminary Research

The steps taken at this stage were literature studies to look for problems related in schools learning as well as deficiencies in existing mathematics learning. Field surveys to complement and strengthen the findings in the literature study also taken. This stage aimed to obtain information on problems in mathematics material and deficiency of previous instructional media. The field survey consisted of interviews with three teachers and distributing questionnaires to one hundred and eighteen students.

### B. Prototyping Stage

The manufacture and improvement of product prototypes as a problem-solving medium obtained earlier was carried out at this stage, after finding problems in the learning process at the preliminary research stage. This stage consists of designing design guidelines, optimizing prototypes, formative evaluations. In the formative evaluation activity, it is the product evaluation stage (prototype) that had been made previously[35]. The prototype was tested in several stages of formative evaluation, including: 1) Research team members examined the design using a list of important characteristics from the intervention components; 2) A group of experts provide responses related to the intervention prototype. The experts involved in this study were 2 (two) experts in the field of learning technology as media validators and 2 (two) experts in the field of mathematics education as material validators. Usually this is done using open and closed questionnaires or interviews; 3) Walkthrough: through face-to-face researchers together with users (teachers and students) reviewing the intervention prototype; 4) Micro Evaluation was intended to evaluate a small group of users (students) to use the intervention section in normal situations; 5) Try-out a number of user groups (students) using the intervention. On the focus of effectiveness evaluation, evaluators did it by test.

Expert validation questionnaires, student response questionnaires, and teacher response questionnaires were analyzed using a multilevel scale. The data obtained was quantitative data which was then translated into qualitative data. Respondents did not answer one of the qualitative answers on the multilevel scale model, but answered one of the quantitative answers which were provided. Five alternative answers were provided on a graded scale with a range of values from 0 to 4, which are shown in Table I.

TABLE I. CRITERIA FOR GRADED SCALE

| Score | Criteria |
|---|---|
| 4 | Very Good |
| 3 | Good |
| 2 | Enough |
| 1 | Bad |
| 0 | Very Bad |

The percentage of answers for each question indicator can be calculated using the following formula.

$$Percentage = \frac{\sum\ all\ respondents\ score}{\sum respondents\ \times 4} \times 100\%$$

The percentage of answers to all aspects of the question can be calculated using the following formula.

$$Percentage = \frac{\sum overall\ score\ of\ respondent\ criteria}{\sum respondents\ \times \sum item \times 4} \times 100\%$$

In addition to using a multilevel scale in the expert validation questionnaire, the answers to the conclusions from the validation results used the Guttman scale. The Guttman scale yields an unequivocal "yes-no" answer. The "adequate-not eligible" scale was used in this questionnaire. Drawing conclusions about the properly of the media used the following formula.

$$Percentage = \frac{\sum answers\ of\ proper\ from\ respondents}{\sum respondents} \times 100\%$$

## III. RESULT AND DISCUSSION

### A. Preliminary Research

In the Preliminary Research stage, several potentials and problems faced by students were found based on the results of the preliminary research questionnaire presented in Table II. The potential and the problem was that students were less interested in learning mathematics because of the assumption that mathematics has nothing to do with tourism activities. According to them, productive learning activities are more important and more fun to carry out than learning mathematics. Students feel lazy and find it difficult to learn mathematical material contained in textbooks. And there was no mathematics learning media that can link productive learning with mathematics learning. This was supported by the results of interviews with mathematics subject teachers which can be concluded as follows. 1) Most students feel lazy and have

difficulty in learning mathematics; 2) Some students feel less helped by the teaching materials which they use in learning mathematics; 3) The teaching materials used in learning mathematics are quite varied, it's just that there are no learning media that can be collaborated with productive learning; 4) When applying mathematics learning media that can be downloaded from the internet, students play with their cellphones instead of studying; 5) The mathematics material that they should have learned, especially in XI grade, was simply missed when they had carried out the On the Job Training program; 6) Educators expect mathematics material to be linked and collaborated with vocational practice activities; 7) Some students who think that mathematics is not important prefer to participate in vocational activities, even though they already know that they are lagging behind in learning mathematics.

TABLE II. RESULTS OF PRELIMINARY RESEARCH QUESTIONNAIRE

| No. | Subject | Item | | | | | | | | | | | Total | Percentage (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| 1 | P1S1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 6 | 54.55 |
| 2 | P1S2 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 7 | 63.64 |
| 3 | P1S3 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 6 | 54.55 |
| 4 | P1S4 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 7 | 63.64 |
| 5 | P1S5 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 5 | 45.45 |
| 6 | P1S6 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7 | 63.64 |
| 7 | P1S7 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 7 | 63.64 |
| 8 | P1S8 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 5 | 45.45 |
| 9 | P1S9 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 6 | 54.55 |
| 10 | P1S10 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 4 | 36.36 |
| 11 | P1S11 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 7 | 63.64 |
| 12 | P1S12 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 7 | 63.64 |
| 13 | P1S13 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 7 | 63.64 |
| 14 | P1S14 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 5 | 45.45 |
| 15 | P1S15 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 5 | 45.45 |
| 16 | P1S16 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 6 | 54.55 |
| 17 | P1S17 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 5 | 45.45 |
| 18 | P1S18 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 7 | 63.64 |
| 19 | P1S19 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 7 | 63.64 |
| 20 | P1S20 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 8 | 72.73 |
| 21 | P1S21 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 5 | 45.45 |
| 22 | P1S22 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 7 | 63.64 |
| 23 | P1S23 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 7 | 63.64 |
| 24 | P1S24 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 6 | 54.55 |
| 25 | P1S25 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 7 | 63.64 |
| 26 | P1S26 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 6 | 54.55 |
| 27 | P1S27 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 6 | 54.55 |
| 28 | P1S28 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 6 | 54.55 |
| 29 | P1S29 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 6 | 54.55 |
| 30 | P1S30 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 7 | 63.64 |
| 31 | P2S1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 5 | 45.45 |
| 32 | P2S2 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 7 | 63.64 |
| 33 | P2S3 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 6 | 54.55 |
| 34 | P2S4 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 6 | 54.55 |
| 35 | P2S5 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 6 | 54.55 |
| 36 | P2S6 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 6 | 54.55 |
| 37 | P2S7 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 7 | 63.64 |
| 38 | P2S8 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 6 | 54.55 |
| 39 | P2S9 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 7 | 63.64 |
| 40 | P2S10 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 7 | 63.64 |
| 41 | P2S11 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 7 | 63.64 |
| 42 | P2S12 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 6 | 54.55 |
| 43 | P2S13 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 5 | 45.45 |
| 44 | P2S14 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 7 | 63.64 |
| 45 | P2S15 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 6 | 54.55 |
| 46 | P2S16 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 5 | 45.45 |
| 47 | P2S17 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 6 | 54.55 |
| 48 | P2S18 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 7 | 63.64 |
| 49 | P2S19 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 5 | 45.45 |
| 50 | P2S20 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 7 | 63.64 |
| 51 | P2S21 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 5 | 45.45 |
| 52 | P2S22 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 6 | 54.55 |
| 53 | P2S23 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 8 | 72.73 |
| 54 | P2S24 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 6 | 54.55 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55 | P2S25 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 7 | 63.64 |
| 56 | P2S26 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 6 | 54.55 |
| 57 | P2S27 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 6 | 54.55 |
| 58 | P2S28 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 6 | 54.55 |
| 59 | P2S29 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 7 | 63.64 |
| 60 | P2S30 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 6 | 54.55 |
| 61 | P3S1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 7 | 63.64 |
| 62 | P3S2 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 7 | 63.64 |
| 63 | P3S3 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 7 | 63.64 |
| 64 | P3S4 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 6 | 54.55 |
| 65 | P3S5 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 5 | 45.45 |
| 66 | P3S6 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 7 | 63.64 |
| 67 | P3S7 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 6 | 54.55 |
| 68 | P3S8 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 6 | 54.55 |
| 69 | P3S9 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 7 | 63.64 |
| 70 | P3S10 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 7 | 63.64 |
| 71 | P3S11 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 6 | 54.55 |
| 72 | P3S12 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 7 | 63.64 |
| 73 | P3S13 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 8 | 72.73 |
| 74 | P3S14 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 7 | 63.64 |
| 75 | P3S15 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 | 63.64 |
| 76 | P3S16 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 8 | 72.73 |
| 77 | P3S17 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 7 | 63.64 |
| 78 | P3S18 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 63.64 |
| 79 | P3S19 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 8 | 72.73 |
| 80 | P3S20 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 7 | 63.64 |
| 81 | P3S21 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 9 | 81.82 |
| 82 | P3S22 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 6 | 54.55 |
| 83 | P3S23 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 6 | 54.55 |
| 84 | P3S24 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 10 | 90.91 |
| 85 | P3S25 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 5 | 45.45 |
| 86 | P3S26 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 9 | 81.82 |
| 87 | P3S27 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 8 | 72.73 |
| 88 | P3S28 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 6 | 54.55 |
| 89 | P3S29 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 6 | 54.55 |
| 90 | P4S1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 7 | 63.64 |
| 91 | P4S2 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 6 | 54.55 |
| 92 | P4S3 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 6 | 54.55 |
| 93 | P4S4 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 7 | 63.64 |
| 94 | P4S5 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 6 | 54.55 |
| 95 | P4S6 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7 | 63.64 |
| 96 | P4S7 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 6 | 54.55 |
| 97 | P4S8 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7 | 63.64 |
| 98 | P4S9 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 7 | 63.64 |
| 99 | P4S10 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 6 | 54.55 |
| 100 | P4S11 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 | 63.64 |
| 101 | P4S12 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 5 | 45.45 |
| 102 | P4S13 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 7 | 63.64 |
| 103 | P4S14 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 7 | 63.64 |
| 104 | P4S15 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 6 | 54.55 |
| 105 | P4S16 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 6 | 54.55 |
| 106 | P4S17 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 8 | 72.73 |
| 107 | P4S18 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 7 | 63.64 |
| 108 | P4S19 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 7 | 63.64 |
| 109 | P4S20 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 7 | 63.64 |
| 110 | P4S21 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 6 | 54.55 |
| 111 | P4S22 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 6 | 54.55 |
| 112 | P4S23 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 7 | 63.64 |
| 113 | P4S24 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 7 | 63.64 |
| 114 | P4S25 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 7 | 63.64 |
| 115 | P4S26 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 7 | 63.64 |
| 116 | P4S27 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 6 | 54.55 |
| 117 | P4S28 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 9 | 81.82 |
| 118 | P4S29 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 7 | 63.64 |

### B. Prototyping Stage

In the Prototyping stage, the researcher made a plan to determine the Basic Competence and Student Learning Experience and made a feasibility instrument. The selection of subject matter is done based on the consideration of the difficulties of teachers and students in learning mathematics. Transformation material in mathematics vocational high school XI grade was chosen because of the frequent delays in learning this material. This was because when these learning materials must have been given, students instead have to focus on vocational practice activities to face the On the Job Training (OJT) program. The students' too busy with vocational practice activities resulted in the Transformation material being missed and made students start to feel that mathematics was not important, the most important thing was a productive subjects.

This mathematics web-based learning was developed to make students more aware that mathematics can be found in productive subjects. And in order the cognitive load of students in learning mathematics can be reduced, so that students begin to feel that learning mathematics is interesting to understand. At this stage the researchers collaborated between vocational practice activities and mathematics learning, where mathematics learning material was inserted into several steps of vocational practice activities. The parts of the developed mathematics web-based learning can be explained as follows.

At the beginning section of the application before starting the Transformation lesson, students are invited to recall the Cartesian field. The initial part of this application can be seen in the form of Fig. 1.

In this section, students are led to imagine the Cartesian coordinates on the table-set up practice. Students are stimulated to determine the correct Cartesian coordinates for placing flower vases and other table-set up practice equipment.

The second part of the application is the part where learning mathematics begins to enter the sub-section of the translation material. The second of this application can be seen in the form of Fig. 2.

In this section, the table-set-up practice has reached the laying of plates. Here students are led to understand the concept of translation material with cases of shifting plates and shifting other table-set up practice equipment. Students are led to understand that shifts that occur in plates or other items will only change the point of position, not the size or shape of the item.

Fig. 1. Given the Cartesian Coordinates.

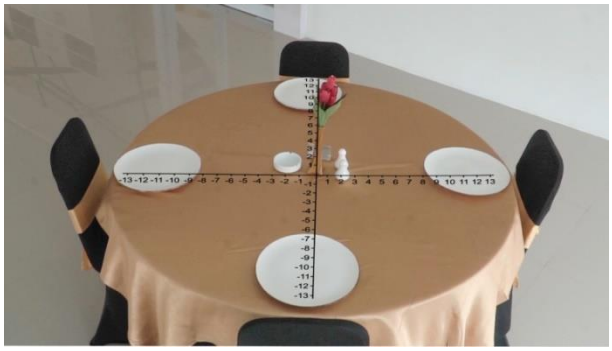

Fig. 2. Translation Sub-Material Section.

The third part of the application is the part where mathematics learning begins to enter the Reflection material sub-section. The third of this application can be seen in the form of Fig. 3.

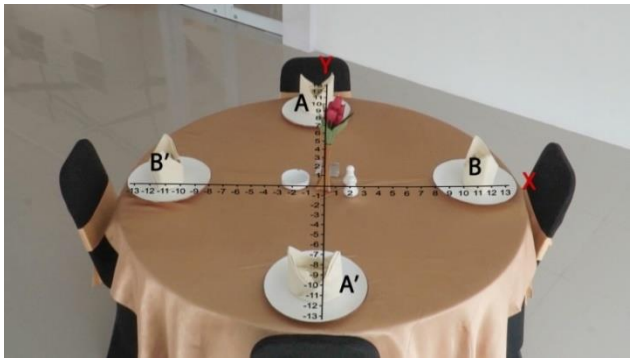


Fig. 3. Reflection Sub-Material Section.

In this section the table-set up practice has reached the laying of the napkin on the plate. Here students are led to understand the concept of Reflection material with the case of a flower vase as a mirror, where the distance from plate A to the flower vase is the same as the distance from plate A' to the flower vase. Students are led to understand the reflection that occurs on plate A and plate B and determine the position of the image according to the coordinates of the points. Students are also led to understand that the mirror in this reflection material can be a point and can also be a line.

The fourth part of the application is the part where mathematics learning begins to enter the Rotation material sub-section. The fourth of this application can be seen in the form of Fig. 4.

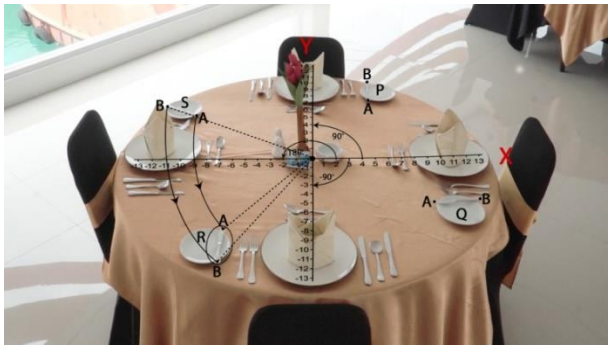


Fig. 4. Rotation Sub-Material Section.

In this section, the table-set up practice is equipped with cutlery placement. Here students are led to understand the concept of material Rotation with cases, rotation of the knife on the B&B plate marked with the letter "S" with the knife on the B&B plate marked with the letter "R". This rotation occurs with the flower vase as the axis. Students are led to understand the rotation that occurs if it is rotated clockwise or counterclockwise at a certain angle.

The fifth part of the application is the part where mathematics learning has entered the Dilatation material sub-section. The fifth of this application can be seen in the form of Fig. 5.


Fig. 5. Dilatation Sub-Material Section.

In this section the table-set up is complete, all the cutlery, crockery, glassware, and linen that are prepared on the table as a utensil to eat for a guest have been set up. Here students are led to understand the concept of Dilatation material with cases: replacement the show plate with B&B plate; And also with the replacement of other cutlery with the same shape but different sizes. Students are led to understand the enlargement or reduction that occurs if there is a replacement in the cutlery.

This developed mathematics web-based learning had been validated by educational technology experts and mathematics education experts. In the process of validating the application of mathematics learning in this study, using a questionnaire that had been prepared to evaluate it as a research instrument. Adjusting the objectives of each questionnaire was taken into consideration in the preparation of this instrument. The questionnaires were media expert evaluation questionnaires and material expert evaluation questionnaires. The activity of reviewing the mathematics web-based learning was carried out by distributing questionnaires to experts.

The results of the validation carried out by two material experts and two media experts on the mathematics web-based learning can be seen in Table III and Table IV.

TABLE III. VALIDATION RESULTS OF MATERIAL EXPERT VALIDATION ON MATHEMATICS WEB-BASED LEARNINGS

| No. | Evaluated Aspect | Number of Items | Validators | | Percentage (%) | Revision |
|---|---|---|---|---|---|---|
| | | | *I* | *II* | | |
| 1 | Learning Design | 16 | 11 | 14 | 78 | No revision |
| 2 | Teaching Material | 6 | 6 | 5 | 92 | No revision |
| Mean | | | | | 85 | |

TABLE IV. VALIDATION RESULTS OF MEDIA EXPERTS ON MATHEMATICS WEB-BASED LEARNING

| No. | Evaluated Aspect | Number of Items | Validators | | Percentage (%) | Revision |
|---|---|---|---|---|---|---|
| | | | *III* | *IV* | | |
| 1 | Software engineering | 10 | 10 | 10 | 100 | No revision |
| 2 | Visual Communication | 13 | 12 | 11 | 89 | No revision |
| Mean | | | | | 95 | |

The validation of the mathematics web-based learning was carried out by four experts, namely two experts in the field of Learning Engineering education and two experts in the field of Mathematics Education. The evaluation carried out on the mathematics web-based learning used several aspects to measure it, including: software engineering, visual communication, learning design and teaching materials. In the aspect of "software engineering", evaluator III assigned an assessment score "1 (proper)" on each indicator with the total number of indicators was 10. Evaluator IV also gave an assessment score "1 (proper)" on each indicator with the total number of indicators was 10. So that obtained a percentage of 100%. By matching the results of these percentages with the percentage level of achievement on a five scale, the "software engineering" aspect was included in very good qualifications, so there was no need to revise this aspect. In the aspect of "visual communication" there were 13 indicator items, evaluator III gave an assessment score "1 (proper)" on 12 indicator items and "0 (it was not proper)" on 1 indicator item. Evaluator IV gave an assessment score of "1 (proper)" on 11 indicator items and "0 (they were not proper)" on 2 indicator items. So that obtained a percentage of 89%. By matching the results of these percentages with the percentage level of achievement on a five scale, the "visual communication" aspect was included in the very good qualification, so there was no need to revise this aspect. In the aspect of "learning design" which consists of 16 indicator items, evaluator I gave an assessment score "1 (proper)" on 11 indicator items and "0 (they were not proper)" on 6 indicator items. Evaluator II gave an assessment score "1 (proper)" on 14 indicator items and "0 (they were not proper)" on 2 indicator items. So that obtained a percentage of 78%. By matching the results of these percentages with the percentage level of achievement on a five scale, the "learning design" aspect is included in good qualifications, so there is no need to revise this aspect. In the aspect of "teaching material" which consists of 6 indicator items, evaluator I gave an assessment score "1 (proper)" on all indicator items. Evaluator II gave an assessment score "1 (proper)" on 5 indicator items and "0 (it was not proper)" on 1 indicator item. So that the percentage obtained was 92%. By matching the results of these percentages with the percentage level of achievement on a five scale, the "teaching material" aspect is included in very good qualifications, so there is no need to revise this aspect.

In addition to the results of the expert validity test, walkthrough activities were also carried out. In this case the author used it as a guide for revising the mathematics web-based learning. The results of the walkthrough activities can be seen in Table V.

TABLE V. WALKTHROUGH RESULTS OF MATHEMATICS WEB-BASED LEARNINGS

| No. | Evaluated Aspect | Students | | | Quantity | Percentage (%) | Note |
|---|---|---|---|---|---|---|---|
| | | I | II | III | | | |
| 1. | Content | 4 | 4 | 3 | 11 | 92 | Very Good |
| 2. | Learning Design | 4 | 4 | 3 | 11 | 88 | Very Good |
| 3. | Implementation | 3 | 4 | 3 | 10 | 83 | Very Good |
| 4. | Technical Quality | 4 | 4 | 4 | 12 | 94 | Very Good |
| Mean | | | | | | 89 | Very Good |

The results of the pretest and posttest of students who were included in the Walkthrough activity can be seen in Table VI.

TABLE VI. PRETEST AND POSTTEST RESULTS ON WALKTHROUGH ACTIVITIES

| No. | Students | Pretest | Posttest |
|---|---|---|---|
| 1 | SPW01 | 65 | 80 |
| 2 | SPW02 | 70 | 85 |
| 3 | SPW03 | 60 | 75 |
| Mean | | 65 | 80 |

In the walkthrough activity involving 3 students, the average increase in student learning outcomes was obtained which in the pretest the average learning outcome was 65% and in the posttest the average learning outcomes increased to 80%. The average student response questionnaire results were also obtained by 89%. If the average value is matched with the percentage level of achievement on a five scale, the walkthrough activity was considered to be running very well. Based on the results of the expert validation and walkthrough activities, it can be concluded that the developed mathematics web-based learning is proper to used. After the formative evaluation of mathematics web-based learning passed through expert validation and walkthrough activities, it was continued with Micro Group Evaluation with a larger number of students. The Micro Group Evaluation results of the Mathematics web-based learning can be seen in Table VII.

The results of the pretest and posttest of students who were included in the Micro Group Evaluation activity can be seen in Table VIII.

In the micro-evaluation activity that involved 15 students, it was found the average increase in student learning outcomes. The average learning outcome in the pretest was 69.3 and in the posttest the average learning outcomes increased to 79.6. The average student response questionnaire results of 97% also obtained. If the average value was matched with the percentage level of achievement on a scale of five, the micro-evaluation activity was considered to be running very well. Based on the results of the evaluation of the micro group, it can be concluded that the developed mathematics web-based learning was proper to use. Furthermore, the flow of formative evaluation continues to the last part, namely the Try-out. The Tray-out results of the Mathematics web-based learning can be seen in Table IX.

TABLE VII. THE MICRO GROUP EVALUATION RESULT OF MATHEMATICS WEB-BASED LEARNING

| Students | Efficiency | Content | Learning Design | Implementation | Mean |
|---|---|---|---|---|---|
| S1 | 4 | 4 | 3 | 4 | 3.75 |
| S2 | 4 | 4 | 4 | 4 | 4.00 |
| S3 | 3 | 3 | 4 | 4 | 3.50 |
| S4 | 4 | 4 | 4 | 4 | 4.00 |
| S5 | 3 | 4 | 4 | 4 | 3.75 |
| S6 | 4 | 4 | 4 | 4 | 4.00 |
| S7 | 4 | 4 | 4 | 3 | 3.75 |
| S8 | 4 | 4 | 4 | 4 | 4.00 |
| S9 | 4 | 4 | 3 | 4 | 3.75 |
| S10 | 4 | 4 | 4 | 4 | 4.00 |
| S11 | 4 | 4 | 4 | 3 | 3.75 |
| S12 | 4 | 4 | 4 | 4 | 4.00 |
| S13 | 4 | 4 | 3 | 4 | 3.75 |
| S14 | 4 | 4 | 4 | 4 | 4.00 |
| S15 | 4 | 4 | 4 | 4 | 4.00 |
| Quantity | 58 | 59 | 57 | 58 | 58.00 |
| Percentage (%) | 97 | 98 | 95 | 97 | 97 |
| Note | Very Good | Very Good | Very Good | Very Good | Very Good |

TABLE VIII. PRETEST AND POSTTEST RESULTS ON MICRO GROUP EVALUATION ACTIVITIES

| No. | Students | Pretest | Posttest |
|---|---|---|---|
| 1 | SPEM01 | 60 | 75 |
| 2 | SPEM02 | 75 | 82 |
| 3 | SPEM03 | 70 | 80 |
| 4 | SPEM04 | 70 | 84 |
| 5 | SPEM05 | 65 | 76 |
| 6 | SPEM06 | 75 | 84 |
| 7 | SPEM07 | 70 | 78 |
| 8 | SPEM08 | 65 | 80 |
| 9 | SPEM09 | 65 | 75 |
| 10 | SPEM10 | 75 | 85 |
| 11 | SPEM11 | 60 | 76 |
| 12 | SPEM12 | 70 | 79 |
| 13 | SPEM13 | 75 | 81 |
| 14 | SPEM14 | 75 | 84 |
| 15 | SPEM15 | 70 | 75 |
| Mean | | 69.3 | 79.6 |

TABLE IX. THE TRAY-OUT RESULT OF MATHEMATICS WEB-BASED LEARNING

| Students | Evaluated Aspect | | | |
|---|---|---|---|---|
| | Implementation | Sustainability | Appropriateness | Acceptance and attraction |
| S1 | 4 | 4 | 3 | 4 |
| S2 | 4 | 3 | 4 | 4 |
| S3 | 3 | 3 | 4 | 4 |
| S4 | 4 | 3 | 4 | 4 |
| S5 | 3 | 4 | 4 | 4 |
| S6 | 4 | 4 | 4 | 4 |
| S7 | 4 | 4 | 4 | 4 |
| S8 | 4 | 4 | 4 | 4 |
| S9 | 4 | 3 | 3 | 4 |
| S10 | 4 | 3 | 4 | 4 |
| S11 | 4 | 3 | 4 | 4 |
| S12 | 4 | 4 | 4 | 4 |
| S13 | 4 | 4 | 3 | 4 |
| S14 | 4 | 4 | 4 | 4 |
| S15 | 4 | 4 | 4 | 4 |
| S16 | 4 | 4 | 4 | 3 |
| S17 | 4 | 4 | 4 | 4 |
| S18 | 4 | 3 | 3 | 3 |
| S19 | 4 | 4 | 4 | 3 |
| S20 | 4 | 3 | 4 | 4 |
| S21 | 4 | 3 | 4 | 4 |
| S22 | 3 | 4 | 4 | 4 |
| S23 | 3 | 4 | 4 | 4 |
| S24 | 3 | 4 | 4 | 3 |
| S25 | 4 | 4 | 3 | 4 |
| S26 | 4 | 3 | 4 | 4 |
| S27 | 4 | 3 | 4 | 4 |
| S28 | 3 | 3 | 4 | 3 |
| S29 | 3 | 4 | 4 | 4 |
| S30 | 3 | 4 | 4 | 4 |
| Quantity | 112 | 108 | 115 | 115 |
| Percentage (%) | 93 | 90 | 96 | 96 |
| Note | Very Good | Very Good | Very Good | Very Good |

The results of the pretest and posttest of students who were included in the Try-out activity can be seen in Table X.

In the Try-out activity involving 30 students, the average increase in student learning outcomes was obtained which in the pretest the average learning outcome was 67.8 and in the posttest the average learning outcome increased to 80.8. The average student response questionnaire results were also obtained by 93.8%. If the average value was matched with the percentage level of achievement on a five scale, the Try-out activity had been running very well. Based on the results of the Try-out activity, it can be concluded that the developed mathematics web-based learning was proper to use.

TABLE X. PRETEST AND POSTTEST RESULTS ON TRY-OUT ACTIVITIES

| No. | Students | Pretest | Posttest |
|---|---|---|---|
| 1 | SPTO01 | 75 | 85 |
| 2 | SPTO02 | 75 | 86 |
| 3 | SPTO03 | 70 | 84 |
| 4 | SPTO04 | 65 | 78 |
| 5 | SPTO05 | 70 | 80 |
| 6 | SPTO06 | 60 | 75 |
| 7 | SPTO07 | 75 | 85 |
| 8 | SPTO08 | 70 | 82 |
| 9 | SPTO09 | 70 | 80 |
| 10 | SPTO10 | 60 | 76 |
| 11 | SPTO11 | 70 | 84 |
| 12 | SPTO12 | 70 | 81 |
| 13 | SPTO13 | 70 | 84 |
| 14 | SPTO14 | 70 | 80 |
| 15 | SPTO15 | 65 | 78 |
| 16 | SPTO16 | 60 | 82 |
| 17 | SPTO17 | 75 | 85 |
| 18 | SPTO18 | 70 | 80 |
| 19 | SPTO19 | 70 | 84 |
| 20 | SPTO20 | 60 | 76 |
| 21 | SPTO21 | 65 | 77 |
| 22 | SPTO22 | 75 | 85 |
| 23 | SPTO23 | 70 | 82 |
| 24 | SPTO24 | 65 | 80 |
| 25 | SPTO25 | 60 | 76 |
| 26 | SPTO26 | 65 | 79 |
| 27 | SPTO27 | 65 | 81 |
| 28 | SPTO28 | 70 | 84 |
| 29 | SPTO29 | 60 | 75 |
| 30 | SPTO30 | 70 | 80 |
| Mean | | 67.83 | 80.8 |

The results of this study support several previous studies. The following is the previous research. Bailey et al. with research title Finding Satisfaction: Intrinsic Motivation for Synchronous and Asynchronous Communication in the Online Language Learning Context. The results of the research showed that students' attention and motivation to learning arise when learning materials are associated with what students enjoy[36]. Ruder et al. with research title Getting Started with Team-Based Learning (TBL): An Introduction. The results of the research showed that stimulating student activity can be done by presenting learning challenges and direct involvement of students in learning practices[37]. Ardana et al. with the research title “The expansion of sociocultural theory-oriented mathematical learning model. The results of the study indicate that learning mathematics must consider 4 pillars (learning to know, learning to do, learning to be, and learning to live together in peace and harmony) [38]. Wares with research title A Gift Box Filled with Mathematics. The results of the research show that the relationship between feedback and reinforcement will be strengthened if it is used frequently and

will decrease or even disappear if it is rarely or never used[39]. Therefore, activities related to repetition are very necessary in learning. Sudiarta et al. with the title Investigation on students' mathematical online discussion: A case study in grade 8 SMPN 1 Denpasar. The research result showed that online discussions are able to create very significant mathematical abilities (conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition) and communication skills (clarification, advice). So in this case web-based learning is needed to support discussion activities. Furthermore, Chen et al. with research title Extending Cognitive Load Theory to Incorporate Working Memory Resource Depletion: Evidence from the Spacing Effect. The results of the research indicated that teachers must be able to regulate learning activities, starting from planning, the implementation process to the final stage, namely assessment or evaluation, so that students can participate in the learning process well without significant differences[40]. Based on the results of the research and several supporting theories, it can be concluded that in vocational mathematics learning there should be a collaboration of mathematics learning materials with vocational practice activities so that in addition to learning in theory students also get hands-on practical experience in learning mathematics.

## IV. Conclusion

This research has succeeded in developing a prototype of a mathematics web-based learning that carries the theme of table set-up industry practice in the Food and Beverage Service department. In the expert test activities, the average percentage of material validators was 85% (very good) and the average percentage of media validators was 95% (very good). In the walkthrough activity, an average increase in student learning outcomes was obtained, which in the pretest was 65 and in the posttest increased to 80. The average student response questionnaire results were also obtained by 89% (very good). In the micro-evaluation activity, it was found that the average increase in student learning outcomes. The average in the pretest was 69.3 and in the posttest increased to 79.6. The average student response questionnaire results of 97% (very good) also obtained. In the Try-out activity, an average increase in student learning outcomes was obtained, which in the pretest was 67.8 and in the posttest increased to 80.8. The average student response questionnaire results were also obtained by 93.8% (very good). Thus it can be concluded that the mathematics web-based learning developed in this study has met the standards of validity, practicability and effectiveness to be said to be proper for use. Future work that can be done is to analyze the factors that are influenced by the use of this mathematics web-based learning and perform a comparative analysis with other equivalent learning applications.

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