Enhancing Motivational Factors through Personalized Learning Module

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Abstract—**The need has arisen towards the consideration of individual difference in order to enhance motivation in learning fractions. As a result, researchers found that students could improve the level of motivational factors if learn through preferred learning environment. Also, consideration of students' intentions and emotions encouraged students to learn more and effectively. Therefore, personalized learning modules of fractions were developed for each Learning Orientation Profile consists in Intentional Learning Theory, which are Transformance, Performance, Conformance and Resistance Learners. The modules also developed online based on multi-step problem solving involving fractions. In order to investigate learners' motivational factors including value of fractions, mathematical anxiety in learning fractions and self-concept of ability on fractions, scores for each motivational factors are collected thrice and compared. Then, the results are validated with open-ended questionnaires on the effectiveness of the learning modules. The results show that the modules could improve students' motivational factors in learning fractions.**

Keywords—individual; personalized; orientations; motivation; fractions

I. INTRODUCTION

Currently, we are rapidly approaching an era in which technology is widely used in the field of education. The difference between the use of technology in education and its use in general is that technology in education is concern more on its impact towards the teaching and learning process. The use of technology in education is involved in delivering learning materials and contents, and in evaluating students' achievements, providing feedback and encouraging collaborative learning among students [1]. Furthermore, the use of technology in education is differs in how much the technology is used in each subject and how the technology is applied in it. This includes different kinds of learning environments, such as online learning, blended learning and the use of electronic hardware as a teaching aid. Moreover, the use of technology in education is involving the use of computers, projectors, or other kinds of electronic hardware and software in the teaching and learning process [2].

In addition, broadening the use of technology in education has attracted many researchers to study its effectiveness on students' achievement, performance, cognition, emotions, intentions, etc. [1, 3-5]. They found that technology in education supports the students' construction of knowledge [4], supports learner-centred learning [5] and improves learning and educational outcomes [1]. In addition, researchers found that the use of technology in mathematics learning concentrates on learners' differences, reduces misconceptions and hence, also improves students' performance [3]. Furthermore, research carried out into the topic of fractions shows positive results in the use of technology when learning fractions [2, 6]. Researcher found that students' learning outcomes were accelerated after learning whilst using technology [2]. On the other hand, results from a research showed a positive result in relation to students' achievements in fractions and an increase in their satisfaction [6]. In addition, clearly defined educational objectives are the beginning of any successful use of technology [7].

Furthermore, there is a need to consider individual differences in order to ensure that learners are engaged, take responsibility for their own learning development, and are provided with the necessary challenges and opportunities for self-development and learning [6, 8-12]. This is aligned with the term of "personalized learning environment", in which personalized instruction emphasizes individual differences and needs, while providing a student-centred approach [11, 13-16]. Several studies have related the importance of students' individual differences being taken into account when preparing learning [8, 9, 11].

Accordingly, the Intentional Learning Theory [17] (which focused on students' conative, affective, social and cognitive aspects) is referred to in this research in order to design the learning modules of fractions learning. The consideration of the conative aspect is found to be able to connect knowledge and feelings to actions [18]. The Learning Orientations Model introduced in the theory categorized students into four Learning Orientations Profiles, which are Transforming Learner, Performing Learner, Conforming Learner and Resistant Learner. Therefore, in order to emphasize individual differences and needs [11, 14, 16], personalized learning modules have been developed for students with different

This work was supported by the Fundamental Research Grant Scheme (R.J130000.7831.4F246) initiated by MOHE and UTM.

Learning Orientations Profiles. This also assists to fill in the gap of "no such personalized learning" that is considered on the Learning Orientations Profiles [17]. This is aligned with a suggestion by researcher, stating that the learning design must place emphasis on students' own learning orientations, since teaching and learning are ongoing processes [19].

The personalized learning environment is found to be most suitable in an online medium, since online learning provides individualized learning and offers personalization in learning [6, 13, 17, 20, 21]. Moreover, many researchers found online learning to be more beneficial to students. A research found that, through online learning, students are able to diagnose their strengths and limitations, make effective decisions, create new ideas and take responsibility for their own learning [7]. Moreover, students' motivation could easily be measured through their interactions in online learning [22]. Other research also found that online learning supports meaningful learning and improves motivation [23, 24]. What is the important of motivation towards students' learning?

Motivation has an important role to play in students' achievements in mathematics. If students are not motivated to learn mathematics, they tend to place less value on the knowledge of mathematics [25]. These problems were found have a relationship with the low achievement rate in mathematics among learners [26]. These may also lead to a low self-concept of ability towards the learning because it is related to current belief in the learner's own ability, together with expectations of success in the future [25]. As a result, a student can have a low self-concept of his/her ability, become a low achiever, place less value on mathematics and have high mathematical anxiety. In addition to that, motivation is important in problem-solving generally [27] is therefore important in solving mathematical problems. In addition, students with a high self-concept of ability in learning are found to have high problem-solving skills, an ability to perform better and to be a high achiever [28]. Therefore, in order to tackle problems with mathematics, the motivation level of students in learning mathematics needs to be taken into account and must be increased.

Accordingly, motivation can be observed through students' behaviour [7], and online learning is able to capture the behaviour through students' interactions and the total time spent interacting with the system [22]. In addition to that, online behaviour could be observed through students' participation in online learning activities and social activities, such as messaging, chatting and using forums [24]. The research also found that interactive and social activity options motivate students more to log in frequently to the system and, thus, to learn [24]. However, there is still a lack of research into the use of technology that specifically considers investigating the following: students' motivation in terms of how they value mathematics; their mathematical anxiety and, also, their self-concept of ability in mathematics. Therefore, this research is carried out to investigate the effectiveness of technology towards these motivational aspects [25]. These motivational aspects also are investigated regarding mathematics learning, specifically on the topic of fractions. Hence, the researchers applied the pre-experiment and individual differences approach to investigate the effect of the Fractions Website towards students' motivational factors, which includes:

1) Value of fractions,
2) Mathematical anxiety on fractions, and
3) Self-concept of ability in learning fractions.

II. MATERIALS AND METHODS

Thirty five thirteen-years-old grade seven students took part in the study, included 11 males and 24 females. They had received formal instructions on the concept of fractions in grade five and six. The learning modules used in the study was developed by the first researcher of this paper. There are three learning modules that specified for Transformance, Performance and Conformance. The learning modules contain ten subtopics of Fractions that delivered online using flash animation. This approach is applied to encourage students to learn the correct process in solving fractions or Mathematics problems [21, 27]. As can be seen in Fig. 1, Transformance was provided by complex problems of Fractions and guided to solve using deductive problem solving in loosely structured of open learning interface with precise diagrams.

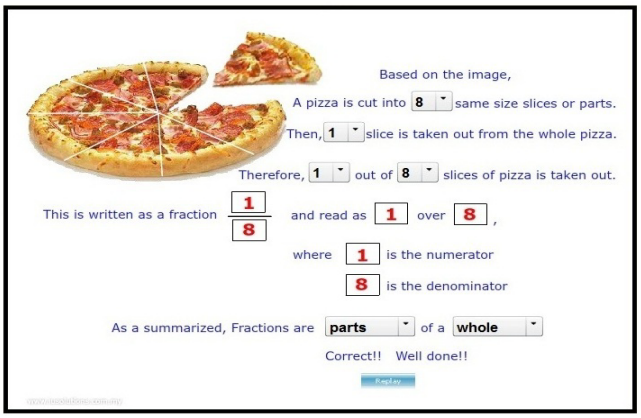

Fig. 1. Transformance Learning Module

Fig. 2 shows learning module for Performance. Performance was provided by regular problems of Fractions and guided to solve using inductive problem solving in semi-complex structured of hands-on learning interface with brief overview of learning.

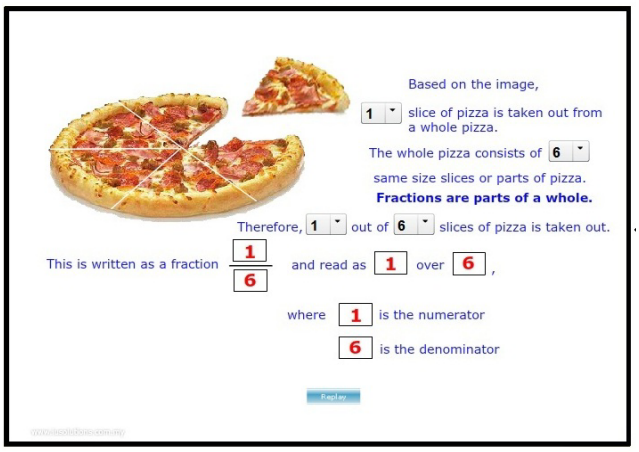

Fig. 2. Performance Learning Module

As shown in Fig. 3, Conformance is provided by simple problems of Fractions and guided scaffoldedly to solve using problem solving skills in simple and step-by-step learning environment.

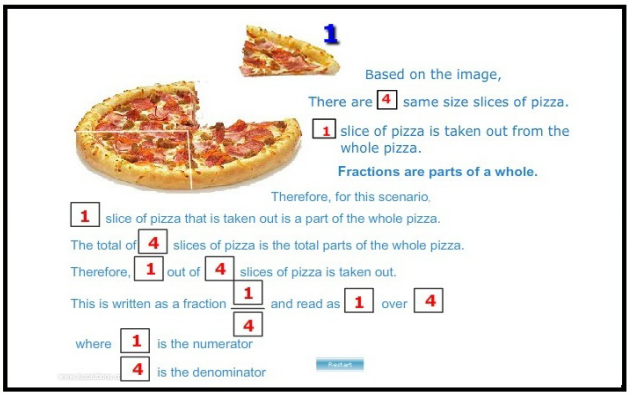

Fig. 3. Conformance Learning Module

On the other hand, Resistance is given freedom to choose his or her preferred learning approach to learn with. Addition to that, students could learn from exercises provided in topical Try This and Test through the links shown in Fig. 4.

Fig. 4. Learning Objectives, Test and Try This Functions

Before the thirty five students started the online learning, Motivation Questionnaires by Newton (2009) are administered to examine students' pre motivation level. The students are then assessed individually through Online Learning Orientations Questionnaires provided by Training Place, Inc. The questionnaires have been used by many researchers, and are found reliable and valid for categorizing students into four Learning Orientations Profiles [13, 29, 30]. The results of the questionnaires are then displayed for students' reference of their profiles upon completion. Afterward, students began to learn in their matched and language preferred learning modules, either English or Malay Languages. After two weeks of learning, another Motivation Questionnaires are administered to compare with the previous administered questionnaires. Then, after another two weeks of learning, the third Motivation Questionnaires are administered to the students. Students' motivation was measured thrice during the implementation period, since it could change over time or even resist change [10]. Also, open-ended questionnaires on the effectiveness of Fractions Website are administered to the students. Then, the researchers:

1) Used Friedman Test to compare whether there were significant differences between pre and post of value of fractions, and self-concept of ability in learning fractions,

2) Used Wilcoxon Signed-Ranks Test to conduct the post-hoc analysis for Friedman Test,

3) Used One-way Repeated Measures Analysis of Variance (ANOVA) to compare whether there were significant differences between pre and post of mathematical anxiety on fractions, and

4) Transcribed the open-ended questionnaires on the effectiveness of Fractions Website for results validation.

III. RESULTS AND DISCUSSIONS

Firstly, the Friedman Test is used to investigate whether there is a significance difference between the value of fractions collected during the Pre Test, in the middle of learning and during the Post Test. The Friedman Test results show that the scores for the value of fractions collected during the Pre Test (R = 2.06), in the middle of learning (R = 2.01) and during the Post Test (R = 1.93) has no significant difference ($\chi 2(2) = 0.350$, $p = 0.839$).

Secondly, the ANOVA is used to investigate whether there is a significance difference between the mathematical anxiety on fractions collected during the Pre Test, in the middle of learning and during the Post Test. The ANOVA results show that the scores for the mathematical anxiety on fractions collected during the Pre Test (M = 3.350, SD = 0.9572), in the middle of learning (M = 3.236, SD = 0.961) and during the Post Test (M = 3.293, SD = 0.980) has no significant difference (Wilks' Lambda = .98, F(2, 33) = .335, $p = 0.718$).

Thirdly, the Friedman Test is used to investigate whether there is a significance difference between the value of fractions collected during the Pre Test, in the middle of learning and during the Post Test. The Friedman Test results show there is a significant difference between the scores for the self-concept of ability in fractions collected during the Pre Test (R = 2.27), in the middle of learning (R = 1.76) and during the Post Test (R = 1.97) ($\chi 2(2) = 6.229$, $p = 0.044$). Following that, post-hoc analysis with the Wilcoxon Signed-Rank Tests was conducted with the application of a Bonferroni correction. This resulted in a significance level set at significance, P lower than 0.017.

The results reveal that that there is a significant difference only between the scores for the self-concept of ability collected in the middle of learning and during the Pre Test (z = -2.823, p = 0.005). These results suggest that students' scores in self-concept of ability have changed during learning through Fractions Website, compared to before commencing learning through the website. However, 43% of the learners showed an increase in the value of fractions, 54% of them had reduced their mathematical anxiety in learning fractions and 46% of them had a better self-concept of ability. These are aligned with the statement by Keller (2010, p.21):

Motivation is like a pile of leaves, can be unstable, frequently changing, elusive, and easily modified by external forces such as "the winds of change". Students can be highly interested and engaged at one moment and "on another planet" at the next moment.

In addition to that, students will become more responsible for their own learning if they could manage their own anxiety [31]. As found in this research, more than half of the students had reduced their mathematical anxiety after learning through the Fractions Website. This means that the website could promote students to become responsible for their own learning. Also, they have improved in terms of interest in learning, as well as awareness of mistakes from learning through worked examples. This is aligned with the research which found that the learning environment that engages with problem-solving contexts may increase students' motivation to learn [32, 33]. Furthermore, Lim, Morris and Yoon (2006) found that students' motivation is correlated with their satisfaction with the learning. This is significant with the satisfaction of students after learning through the Fractions Website, as expressed:

> "I enjoy it because I can learn better and more deeply."
>
> "I do enjoy learning through the Fractions Website. I enjoy it because I can chat and listen to music while learning."
>
> "I enjoy and like the Fractions Website because it contains Try This, tests and games. I can improve my mathematical skills in the topic of Fractions."
>
> "After learning through the Fractions Website, I feel that it was very enjoyable. I like it because the Fractions Website can give me many questions that I never find elsewhere."
>
> "I enjoy and like it because the Fractions Website helps me to continue learning fractions and to improve my performance."

These expressions suggest that student interaction with the interactive and social elements on the Fractions Website is one of the reasons for students being motivated to learn fractions, as found by Muñoz-Organero, et al. (2010). The use of technology also encourages motivation in fractions [34]. Therefore, our results suggest that technology has a positive impact on students' motivation after learning through fractions learning as suggested by Newton (2009). In addition, various graphics provided on the Fractions Website, the recognition of students effort and awareness of mistakes in learning activities could increase students' interest in learning [33].

IV. CONCLUSIONS

Even though it is clear that the personalized learning website has potential to enhance fractions concept learning, the website is not specified in enhancing motivational factors in learning Fractions. In order to explore the students' learning effects in the personalized learning website that considered individual differences, pre-experimental design and open-ended questionnaires on the effectiveness were used to analyze whether a student has improve in motivation to learn fractions. The results show that the online personalized learning modules of Fractions could improve students' value of fractions, mathematical anxiety in learning fractions and self-concept of ability on fractions. However, the learning modules only specified for one approach of individual difference, which is learning orientations. Therefore, the researchers suggest further studies could compare the effectiveness of personalized learning environment towards motivational factors between different individual differences, such as learning orientations, learning styles and cognitive styles.

ACKNOWLEDGMENT

The authors would like to thank the Universiti Teknologi Malaysia (UTM) and Ministry of Higher Education (MOHE) Malaysia for their support in making this project possible.

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