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CONSTRUCTING STUDENTS' MATHEMATICAL KNOWLEDGE BY INTEGRATING INTERDISCIPLINARY LEARNING ACTIVITY TASK

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Abstract: This study investigated the use of interdisciplinary learning activity task to construct students' knowledge in Mathematics. A quantitative method using a pre-experimental design focusing on one-group pre- and post-test design was used for this study. The findings were also triangulated with the students' collected reflective journal artefact documents. Each student journal was analysed using the identified learning activity stages within the RBC-model, where the R denotes *Recognising*, B is *Building with* and C means *Constructing*. The results showed an improvement in the students' achievement, and they were able to construct the mathematics knowledge by means of collaboration among group members.

***Keywords*:** Learning activity, secondary mathematics, interdisciplinary

Introduction

Mathematics is one of the core subjects in Brunei Darussalam. The SPN21 (*Sistem Pendidikan Negara Abad ke-21* or the National Education System for the 21st century of Brunei Darussalam) mathematics curriculum aims to meet the students various learning styles and stimulate the students' mind to think critically and creatively (Curriculum Development Department, 2011). In education, students are the main stakeholders while the teacher is facilitator and counsellor.

Literature Review

The SRI International (2012) has designed six rubrics of 21st century learning based on international feedback. For this present study, we focused on the knowledge construction skills based on teacher's designed learning activities (Shear et al., 2011). For a country's economy to develop, education plays an important role. Thus, a teacher plays an important role. Teachers need to use innovative teaching practices to help student achieve better results (Damit et al., 2015; Sulaiman & Shahrill, 2015; Lim et al., 2016). Adolsary (2010) revealed that most teachers still used traditional assessment tools. In this study, an in depth research was designed to see the effectiveness of teachers in designing and using the learning activities to construct Year 9 students knowledge in one of government secondary mathematics class.

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Methodology

This study addresses the usage of learning activities to construct Year 9 students' knowledge in mathematics. Permission to conduct this study at selected school was sought. Data were collected from 43 students from a Year 9 government school. This school was chosen, as it was one of few selected model schools. The two research questions: How did the learning activities assist students to construct mathematical knowledge? To what extent did the learning activities assist students to construct mathematics knowledge and control teacher's conventional way of delivering a lesson in a classroom?

A quantitative method using pre-experimental designs (Creswell, 2014) focused on one group pre- and post-test (refer to Appendix 1) was used for this present study. The learning activities were then executed in between the two tests. The learning activity task design was interdisciplinary as it had learning goals from more that one academic discipline such as Mathematics, English, Art, Geography and MIB (or *Melayu Islam Beraja* in the Malay Language, which is Brunei Darussalam's national philosophy of Malay Islamic Monarchy). Data collection took almost three weeks.

The pre- and post-test data were then analysed and the collected students' quantified document artefacts further supported the results. The students' document artefacts were collected using the students' group planners and student's personal journal. A total of 13 groups were formed with 3 to 4 students per group. The topic on scale drawing was chosen for this present study. The results from the analysis were then related to student's academic achievement.

Results and Findings

Using descriptive statistics shown (in Table 1), the pre-test had an overall mean of 4.35 with marks range from 0 to 12 out of total marks of 27 and standard deviation of 3.32. The post-test had an overall mean of 10.35 with standard deviation of 4.35 range from 1 to 25 by using the same format items as in pre-test.

Table 1. Descriptive statistics of pre-test and post-test results (N = 43)

	Range		Mean	Std. Deviation
	Minimum	Maximum		
Pre-test	0	12	4.35	3.32
Post-test	1	25	10.35	4.35

Referring to the paired samples test statistics between post-test and pre-test (in Table 2), it had shown significant 2-tails values of 0.000, where $p < 0.05$. This showed that the designed learning activity had a positive impact on the students' academic achievement as the mean difference between the post-test and pre-test was 6.

Table 2. Paired samples test statistics between post-test and pre-test

	Paired Differences		T	Sig. (2-tailed)
	Mean	Std. Deviation		
Post-test – Pre-test	6.00	4.15	9.49	0.000

Table 3 showed that learning activity had significant impact on all the four sub-topics of main scale drawing topic in pre-test and post-test result items.

Table 3. Paired samples test statistics on 4 sub-topics of main scale drawing topic

Comparing Post-test and Pre-test	Paired Differences		T	Sig. (2 tailed)
	Mean	Std. Deviation		
Basic ratio	2.23	1.51	9.70	0.000
Conversion of scale 1:*n*	2.14	1.93	7.25	0.000
Word problem on map scale conversion	0.47	1.22	2.50	0.017
Application on scale drawing	1.16	2.36	3.23	0.002

The learning activity task was designed in a story. In the 13 group planner artefacts, it can be observed that students were able to plan as groups (refer to Table 4).

Table 4. Students' group planner evidence works on rearrange the class learning activity

Plan for	Percentage
Measuring the floor space dimensions including doors and windows	100
Making a scale blue print (including labeling)	100
Making brief explanation for presentation	100
Measuring the furniture dimensions (tables, chairs, white board, posters)	100
Making a 3-dimension model	76.9
Discussing/ Planning for the furniture arrangement	76.9

During the execution of the learning activities, individual students were asked to write down their own personal responses in the student's reflective journal tables provided according to interest; value; importance; needed skills; needed resources; and needed time.

The analyses using the RBC-model, the planning stage of Recognising (R) was observed in the student's journal. More than half of the 27 students, 55.6% wrote that they valued the importance of working together as a team. Less than 50% of the students wrote in their individual reflective journal that they expressed their interest to work as a team in contribution of ideas, discussion and planning, and the importance to prepare necessary resources for the completion of the learning activity task.

Conclusion

The learning activities designed tasks generally improved the students' academic performance, which was further supported from students' journals. The limitation of the research is small sample size and time constraints. We recommend that mathematics teachers should be encouraged and supported to design authentic learning activities that are learner centred so as to cater the different needs of the students to meet the 21st century skills demand.

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Appendix 1

The Pre-test and Post-test

Answer **ALL** questions. Calculators are not allowed. Uses of Geometrical instrument sets are allowed.

1) Simplify the following ratios to their lowest terms.
(a) $58 : 696$ (b) $\frac{5}{6} : \frac{1}{3}$ (c) 40 cm to 1 m

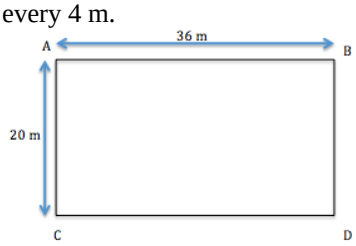
2) Express the following ratios in the form of 1 : n.
(a) $22 : 770$ (b) $8 : 0.64$ (c) $35 : \frac{5}{7}$

3) A map is drawn to a scale of 1 : 10 000. If two objects are 3 cm apart on the map, how far apart are they in real life? Give your answer in metre.

4) A model boat is drawn to a scale of 1 : 50. If the length of the real boat is 12 m, calculate the length of the model boat in cm.

5) A map is drawn to a scale of 1 : 50 000. If the real distance between house A and house B are 4.5 km apart, how far apart are they in map? Give your answer in cm.

6) A rectangular pool measures 20 m by 36 m as shown. Construct a scale drawing of the pool, using 1 cm for every 4 m.



7) A plan of a living room is shown below. Using a pair of compasses, construct a scale drawing of the room using 1 cm for every metre.