

# An active learning approach for improving understanding and skills of school teachers in database design

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**ABSTRACT** – Learners of database design subject in Secondary Schools in Malaysia are facing difficulties in understanding the abstract and complex domain of database design due to lack of active learning elements. A program named *Jom! Mereka bentuk Pangkalan Data* was held by applying an active learning approach to enhance teachers' database design skills and knowledge. In particular, identification and discussion of common mistakes discovered from database design is the active learning element under study. To evaluate the implication of this active learning element, a research is conducted among the program's participants (33 ICT teachers), where a pre-test and post-test technique is adopted through questionnaires. The results show improvement in skills and understanding of database design through the proposed active learning approach, that will become the basis of future research in active learning involving ICT-related subjects.

## 1. INTRODUCTION

Delivering a technical content with theoretical back ground is a big challenge in school. Since 2017, a subject dedicated to ICT content was introduced in Malaysia. In a study by [1], a SWOT analysis was conducted to highlight the Strength, Weaknesses, Opportunity and Threat of this subject being introduced in school. One of the strengths highlighted was the "school teacher expertise". And one of the weaknesses listed was the "the level of student mastery is yet to be determined".

In technical content subject, traditional method of teaching and learning has become less sufficient. An alternative technique is suggested to engage the student with doing things and thinking into what they are doing. This is called an active learning [2]. In [3], role playing has been adapted as an active learning strategy in teaching a database course. Their teaching strategy shows improvement of students' self-learning, engagement and higher order thinking skills by using multiple in-class case studies, student teams, and students' roles.

This study proposes an active learning approach that involves the identification and discussion of common mistakes discovered from database designs made by the learners through group activities. The proposed approach has been implemented in a program named *Jom! Mereka Bentuk Pangkalan Data* that was participated by 33 ICT teachers. An evaluation has been undertaken using pre-test and post-test questionnaires to

determine if there are any improvements in terms of skills and knowledge acquisition of the participants through the implementation of the proposed approach.

## 2. METHODOLOGY

A program named *Jom! Mereka bentuk Pangkalan Data* has been held to 33 ICT school teachers from all around Malaysia. This is a two (2) days program where the objective of the program is to enhance teachers' database design skills and knowledge. This program includes two (2) main topics of database design which are Entity Relationship Modelling and Normalization. The active learning approach was implemented in this program, where the participants need to identify and discuss the common mistakes of database designs made by other groups for a given case study.

Questionnaires about the teachers' understanding of database design have been given to the teachers before the program activities as a pre-test for the proposed approach. The questionnaires used a five points Likert Scale, which are Strongly Agree (5), Agree (4), Neutral (3), Disagree (2) and Strongly Disagree (1). After group work activities and discussion about the common mistakes, the same set of questionnaires were given to the teachers as post-test for the proposed approach. The results of the pre-test and post-test were analyzed and compared to see whether the proposed active learning approach can improve the teachers' understanding and skills of database design. The phases in the proposed approach are explained in more details in the following subsections.

### 2.1 Group Discussion and Presentation

The teachers were divided into six (6) different groups and were given the same case study to design an Entity Relationship Diagram (ERD) using Chen notation and perform normalization for an unnormalized table. After group discussions, each group was required to present the ERD and normalized tables for the given case study. The sample ERD designed by one of the groups which contains some common database design mistakes is as shown in Figure 1.

### 2.2 Identify and Discuss Common Mistakes Made in Database Design

Based on the ERD and tables presented by each group, the teachers are required to identify the main common mistakes made by each group. The following

common mistakes have been identified and discussed by the teachers:

### A. Entity Relationship Modeling

#### i. Un-necessary relations between entities

In the most ERDs designed by the groups, there were many unnecessary relations exist between entities. The teachers explained why the relations were unnecessary and why they were not required in the ERD for the case study.

#### ii. No associative or bridge entities to represent many-to-many relationships

There were ERDs without associative entity to represent many-to-many relationship. The teachers drew the associative entity in the ERD and explained why it is important.

#### iii. No other important attributes identified for the associative or bridge entities

The important attributes for the associative entities other than their primary keys were not identified by most of the groups. The teachers identified attributes required for the associative entities and highlighted the importance of having those attributes.

### B. Normalization

#### i. No associative or bridge tables left after removing Partial Dependency

Partial Dependencies were removed from the 1NF table by creating new tables without leaving the original table with its primary key and other attributes that have full dependencies on the primary key. The teachers compared the tables with the ERD for the same case study to show the importance of having associative entity to relate the entities.

#### ii. No foreign keys left in the original table after removing Transitive Dependency

Transitive Dependencies were removed from the 2NF table by creating new tables without leaving the table with the determinant as foreign keys. The teachers compared the table with the ERD for the case study to show the importance of having foreign keys to relate the tables.

### 2.3 ERD and Normalized Tables Corrections

The correct ERD and normalized tables for the case study were exposed to all the teachers by the facilitator at the end of the program. The sample data was provided in the normalized tables to show the reduction of data redundancies in the normalized tables and the relationships between the tables.

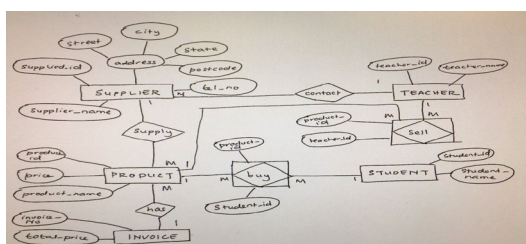


Figure 1 A sample of ERD design with mistakes

### 3. RESULT AND DISCUSSION

Figure 2 depicts the results of the survey on participants' understanding and skills before (and after) attending the program. The results are ordered ascendingly in terms of the "Before" average scores for questionnaire items (I1-I9) yielded from 33 respondents. From the results we can learn that participants understanding and skills had improved for all items with item 8 (I8) and item 2 (I2) show the highest improvement (30%), as illustrated in Figure 3. The results indicate that the understanding of data modelling (I2) and skills of Normalization (I8) gained the highest improvement.

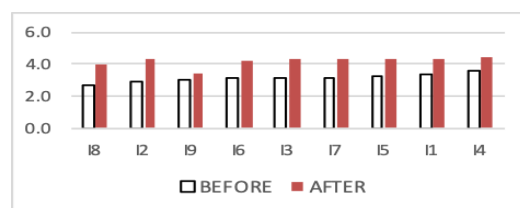


Figure 2 Results of survey

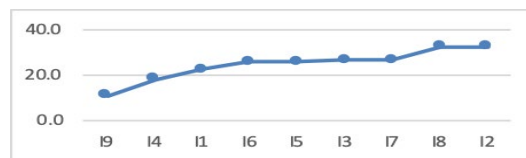


Figure 3 Improvement rate of understanding scores

### 4. CONCLUSIONS

In conclusion, the result of this research shows that the proposed active learning by identifying and discussing the common mistakes discovered from database designs through group activities has improved the skills and knowledge of database design of the teachers under study. Therefore, this approach can be applied in teaching database design courses in schools or higher institutions to enhance learners' understanding of database design.

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