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Sains Humanika

Automotive Practical Work Practices in Vocational Education: Teacher's Preferences Using Needham Model

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Abstract

Automotive is the one of vocational subject which offered in Vocational Schools in Malaysia. It contained the theory and practical task. A teacher plays an important role in providing an engaging teaching and learning environment. In traditional teaching and learning process, teacher normally dominated the classroom instruction while student passively receive the knowledge conveyed by the teacher. The research was carrying out to identify the practices in teaching automotive practical work. A few teachers have been asked to state their preferences of teaching material and method. The main of teaching automotive contains introduction, body and conclusion of their teaching. Observations of four teachers conducted based on Gary (1996) suggestion in how to conduct practical work effectively. Needham Model (1987) was applied in identifying whether teachers use what technique to gain students knowledge in automotive related with the elements proposed by Gary (1996). Checklist during classroom observation was analyzed in this paper. In summary, teachers should have variety method and approach to teach vocational subject because the vocational students have different characteristics compared to others field.

Keywords: Automotive practical work; vocational school; teaching and learning; passive learning; Needham model

Abstrak

Automotif adalah salah satu mata pelajaran vokasional yang ditawarkan di Sekolah Vokasional di Malaysia. Ia mengandungi teori dan praktikal. Guru memainkan peranan penting dalam menyediakan satu pengajaran dan persekitaran pembelajaran yang berketerlibatan. Dalam proses pengajaran dan pembelajaran tradisional, guru biasanya menguasai pengajaran dalam bilik darjah manakala pelajar dengan pasifnya menerima pengetahuan yang disampaikan oleh guru. Kajian ini dinjalankan untuk mengenal pasti amalan dalam pengajaran amali automotif. Beberapa orang guru telah diminta untuk menyatakan pilihan mereka bahan pengajaran dan kaedah. Pengajaran automotif mengandungi; pengenalan, organisasi dan kesimpulan pengajaran mereka. Pemerhatian empat orang guru dijalankan berdasarkan cadangan Gary (1996) dalam menjalankan kerja amali yang berkesan. Model Needham (1987) telah digunakan dalam mengenal pasti teknik guru dalam membantu pelajar menimba pengetahuan automotif yang berkaitan dengan unsur-unsur yang dicadangkan oleh Gary (1996). Senarai Semak semasa pemerhatian bilik darjah juga dianalisis dalam kertas ini. Secara ringkasnya, guru perlu mempunyai kaedah yang pelbagai untuk mengajar subjek vokasional kerana pelajar vokasional mempunyai ciri-ciri yang berbeza berbanding dengan bidang lain.

Kata kunci: Kerja praktikal automotif; sekolah vokasional; pengajaran dan pembelajaran; pembelajaran pasif; Needham model

1.0 INTRODUCTION

What is an effective teacher? Gary (1996) said a very simple effective teacher was a good person-a role model who met the community ideal, a good citizen, good parent and good employee. He also pointed out that everyone in the classroom would have to achieve affective behavior so that teachers could play many roles to make the classroom an affective classroom. The main role is pedagogy is to determine how they start the lesson, how they approach students, how creative they are in delivery and other ways of making learning interesting. The changing of pedagogy is important especially to a more learner centered approach. In a classroom or at the workshop, teachers should plan and implement new approaches of teaching and learning. Teachers still use traditional methods because they did not expose themselves to new trends of teaching especially for experienced teachers. Nowadays there are various types of methods and materials that can be used in teaching. A suitable method in vocational education which could be used is problem-based learning (PBL), work-based learning, project-based learning and blended learning. Students could use various sources of materials from the internet or discussion besides the text books provided.

■2.0 VOCATIONAL TEACHING METHOD

It is important to remember that not all the facilities and equipment work properly, especially when the section of that practical is conducted by a different group. A good demonstration has three stages: an introduction, a body and a conclusion (Gary, 1996)

2.1 Introduction

During the introduction to the session, you should:

- State the learners session topic, objective and scope
- Interest learners by linking the demonstration to previous work and to what they will be required to do subsequently.

While demonstrating teachers should explain the reason for and the significance of each step. To be effective, plan the demonstration so that teachers will be sure to show the steps in the proper sequence and to include all steps. The direct demonstration approach is a very effective method of instruction especially when trainees have the opportunity to repeat the procedures. Demonstration is the basic skill of instruction for teaching skill-type subject matter (George, 2004). This method is recommended for teaching a skill because it covers all the necessary steps in effective learning. The demonstration step gives students the opportunity to see and hear the details related to the skill being taught. These details are related to the necessary background knowledge, the steps procedure and the safety precautions.

Sketching is a method that teachers use while starting a new topic. Sketching is used in this paper to refer to a subset of drawings, including observational drawing, idea generation, diagramming, design working drawing and doodling. Sketching does not imply that work is necessarily incomplete or ill formed, though it may be both. In effect the process of developing pictorial and diagrammatic representations has traditionally been treated as a skill rather than an essential part of the process of thinking about a design problem and developing a design solution Purcell & Gero (1998).

2.2 Body

During the body session, teacher should:

- Avoid taking short cuts when demonstrating how to do the task.
- Observe all safety precautions.
- Work to standards which are realistic for learners to achieve but also acceptable to the workplace.
- Check learners understanding by asking questions.
- Avoid talking down to learners,
- Avoid time wasting delays by getting equipment and systems operational

2.3 Conclusion

During the conclusion to the session, teacher should:

- Revise the main point of the training session
- Distribute handouts containing exercises and reference information
- Remind learners of how and when they will get an opportunity to practice doing the task.

Teachers have to bear in mind that learners are more likely to learn if their attention is attracted by presentations which are related to the actual workplace, and which are new and varied. It will be necessary to do some research before the demonstration. For example it might involve a new technology of a brake system which was not in your equipment and students will keep asking about the system and yet you don't have any idea about that. Get advice from others who do have first-hand experience, and if necessary carry out a simple task analysis. Teachers have to account for differences between each group, and the sessions will achieve more if it is related to the difficulties that the learners have had and to their previous activities.

■3.0 NEEDHAM MODEL TEACHING MODEL

Constructivism is a learning theory that states learners' learn they attempt to bring meaning to their experiences. In this study, Needham Model is used to explain how teachers deliver the learning content in five phases as proposed in the following model. Richard Needham (1987) categorized the phases into five levels of teaching: orientation, eliciting ideas, restructuring ideas, application of ideas and reflection. Table 1 represents the description of Needham Model.

Table 1 Five phases needham teaching and learning

PHASE	AIMS/USES	METHODS
Orientation	To stimulate interest, attract the attention of students and prepare a conducive setting for active learning	Demonstrating a discrepant event or a phenomenon. Show pictures/diagrams. Present a problem to be thought through. A short practical activity a video clip, CD demonstration, students to recall one or two main ideas that they have discussed in the previous lesson
Eliciting Ideas	The teacher and the students are aware of alternative framework Wrong ideas need not be addressed during this phase	Discussion, brainstorming, discourse in small groups, practical work, concept mapping, question-answer, pictures to illustrate.
Restructuring ideas	Replace wrong ideas and modify. Validating correct scientific ideas	Discussion in small groups, investigations, experimentation, demonstration, practical work and simulation
Application of ideas	Consolidating correct scientific ideas that has been constructed or considering daily application or application in new situation	Problem solving in different but related situations, discourse, innovation, brainstorming, worksheets
Reflection	Helping students realize what and how their ideas have been changed during teaching and learning process	Self-reflection, group reflection, writing reflection

Richard Needham proposed the model through Children Learning Science Project investigating how students learned. Needham and Hill (1987) agree that it is important to produce a learning environment in which students can:

- Recognize and reflect on their ideas
- Realize that other people may hold other conflicting but equally valid ideas
- Evaluate the usefulness of these ideas alongside their teachers' scientific theories

The stages of teaching sequence in the five phases of teaching strategies are described in the table above. Needham and Hill, in Children Learning in Science, described that the purpose of the orientation stage is to focus enquiry on to a particular issue. In elicitation process, children have ideas which they use to make sense of their world. Some of these ideas may keep with those they will meet in school science. Elicitation strategies may include:

- Card sorting into true and false piles
- Concept mapping
- Discussion of responses given by other children
- Written responses to an open-ended questions

However, two points should be borne in mind:

- Pupils are less likely to respond with their everyday ideas if they expect the teacher to reject their answers for not conforming to scientific norms
- The social interaction of small group discussion may stimulate an evaluation of their everyday ideas if they are seen to be in conflict with those of their peers, so small groups are recommend to be used in elicitation phase

Restructuring phase involve the concept that students' ideas may be resistant to change. The exchange of ideas in elicitation phase may provoke students to reconsider their thinking. Each discussion group usually reports back to the whole class so that pupils are made aware of the range of ideas which exist. This process is more effective if each discussion group produces a permanent record of its thinking, such as a poster. Teachers are now in a position to provide learning experience which interacts with students' prior knowledge.

If restructuring ideas and newly constructed ideas are to be accepted by the learner, these ideas have to fulfill certain criteria, such as: are these ideas useful, understandable and are they powerful enough to be applicable to a wide range of situations. Opportunities to apply new ideas in a range of contexts have been explored by the project. In addition to conventional written responses to questions we have tried the following strategies:

- Problem solving
- Explaining new phenomena
- Exploring ideas through drama and role play
- Imaginative writing

■4.0 APPLYING NEEDHAM MODEL IN TEACHING AUTOMOTIVE PRACTICAL WORK (APW)

Needham Model in teaching is used to identify the elements of this model implemented in teaching automotive practical work. Needham (1987) introduced the five phases of constructivism in teaching, which are: orientation (O), ideas (I), restructuring ideas (R-i), applying ideas (A-i) and reflection (Rf). Based on these stages, the feedback from teachers from observation either they in their teaching were investigated. The observation was conducted in theory class with topics in the practical task related to students will do in a practical work session. All teachers implement the phases based on Needham Model. Table 2 illustrates the teaching phases. The topic chosen is Brake System Operation and four teachers were involved in this observation.

Table 2 Teaching observation using needham model

Respondents	Teaching activities/ Topic	Five Phase of Needham Model				
		O	I	R-i	A-i	Rf
1	Brake System Operation	√	√	√	√	√
2	Brake System Operation	√	√	√	√	√
3	Brake System Operation	√	√	√	√	√
4	Brake System Operation	√	√	√	√	√

The observation was conducted with four teachers from four schools. The observation was conducted to identify the differences and patterns of teaching methods that the teachers deliver in APW. The topic chosen for observation is Brake System Operations.

4.1 Respondents' Demography

Table 3 shows the teachers' background, teaching experience and academic qualifications. They are expert in automotives and are also on the panel of Malaysia's Examination Board. All of them have more than 10 years teaching experience.

Table 3 Teachers' background

Respondents	Teaching Experience	Academic Qualifications
1	12 years	i. Teaching Certificate (Automotive) ii. Sijil Kemahiran Malaysia - Basic - Intermediate iii.Degree in Mechanical Engineering
2	19 years	i. Teaching Certificate (Automotive) ii.Diploma in Mechanical Engineering ii. Sijil Kemahiran Malaysia - Basic - Intermediate
3	13 years	i. Teaching Certificate (Automotive) ii. Sijil Kemahiran Malaysia - Basic iii.Degree in Mechanical Engineering
4	17 years	i. Teaching Certificate (Automotive) ii. Sijil Kemahiran Malaysia - Basic - Intermediate

4.2 Comparison Teaching Methods in APW among Teachers

The observation has been done and the field notes describe a few teaching methods that teachers chose. Most of the teachers deliver the content of APW using the same methods. Table 4 presents the comparison among teachers observed in their teaching activities based on Needham Model. The respondents started with their teaching experience. The Needham Model teaching phases present the teaching activities that teachers implemented as described in the previous tables.

In Orientation Phase all respondents prefer demonstration as the teaching methods in the introduction session and to use brainstorming and asking student opinions when beginning the topic. Respondent 2 had 19 years of teaching experience and used three

methods of teaching in introduction of APW which are demonstration, using charts and asking students' their opinions. The second phase in Needham Model is Eliciting Ideas and three respondents prefer to ask the students about the demonstration before and they also conduct questions and answer session to make sure students understand. At the beginning of the APW task, all respondents prefer to demonstrate how to complete the task. They also guide them in small groups. This process of teaching was implemented in Restructuring Phase. During teaching session in Application of Ideas, all respondents give examples of another situation and give students the problem of brake system failure. To conclude the teaching session all respondents asked the students to make report to reflect on the task which has been completed.

Table 4 Comparison teaching methods among teachers

Respondents	R1	R2	R3	R4
Teaching Experience (years)	12	19	13	17
Needham Model Teaching Phase	Teaching Activities			
Orientation- Introduction				
Demonstrate using the model of brake system	√	√	√	√
Using charts of hydraulic brake and ABS system	-	√	-	-
Short practical activities using video of actual system	-	√	-	-
Encourage students' opinion	√	√	√	√
Eliciting Ideas- Body				
Divide students in small groups and give them sub-topics to discuss	-	-	-	-
Teachers illustrate the model of brake system on white board	√	-	-	√
Ask a few students to demonstrate as before	√	√		√
Question-answer to make sure students understand	-	√	√	√
Restructuring ideas – Body				
Ask students' opinion and give feedback	√	√	-	√
Compare students' idea to current automotive technology	-	-	-	-
Demonstrate practical tasks in brake system components	√	√	√	√
Guide students in small groups	-	√	√	√
Application of ideas – Body				
Give students another example with a different situation	√	√	√	√
Ask students about the problem of brake failure and how to solve	√	√	√	√
Handouts describing the process of brake system components	-	-	√	√
Give students another situation and ask them how to solve	-	√	-	-
Reflection - Conclusion				
Conclude students' task in small groups	-	√	-	-
Conclude students' task in the whole class	√		√	√
Ask students to write a report about the whole process of brake system operation	√	√	√	√

■5.0 DISCUSSION

A teacher plays an important role in providing an engaging teaching and learning environment. Dolmas, Wolfhagen, Schimidt and Van der Vleuten (1994) argue that teacher performance towards his or her teaching assumes an important influence on the quality of an educational program. In a similar point of argument, Albanese (2004) asserts that the function of the teacher alone is able to flourish or crush the outcome of students' participant in teaching and learning process. In the traditional teaching and learning environment, teacher normally dominated the classroom instruction while students passively receive the knowledge conveyed by the teacher. Boud and Feleti (1991) also point out the lack of students' participation in a traditional teaching and learning environment. Charlin, Mann and Hansen (1998) also said that learning which occurs in a meaningful context will also be more easily retrieved than that which is acquired in isolation. Therefore the teacher should play the role of a mediator conveying and digesting information from one situation to another.

Needham Model is the constructivism learning theory that states learners' knowledge as they attempt to bring meaning their experiences. Constructivism is the learning process of constructing meaning in how people make sense of their experience (Sharan *et al.*, 2001). This model explained how teachers deliver the learning content in five phases; orientation, eliciting ideas, restructuring ideas,

application of ideas and reflection. From the observation of four teachers in orientation phase teachers preferred to use demonstration and charts followed by encouraging students' previous knowledge. Orientation phase is to stimulate interest, attract the attention of students and prepare an encouraging setting for active learning. Respondent #1 used the model of brake system (teaching aid) and explains how its work while the Respondent #2 demonstrates the brake system based on tasks in the learning module. He also used charts and asked for students opinions during the orientation phase. Respondent #2 used three methods in this phase and students were interested in participating. Respondent #3 also chose demonstration with actual equipment and let students give their opinion with the knowledge they had. Respondent #4 chose demonstration with sketching to make it clearer to students what they learned. All these methods are necessary when teaching practical work subjects such as APW. This matches one of the learning orientations known as behaviorism, which states that this phase of learning is suitable from the aspect of learning competency-based education and skill development and training (Saharan *et al.,* 2001).

The second phase of Needham Model is eliciting ideas which requires that teachers and students are aware of an alternative framework. The methods of this phase are discussion, brainstorming, small group, practical work, concept, question-answer and picture to illustrate. Respondent #1 and #4 chose to illustrate the model of brake system they also asked a few students to do as demonstrated before. Respondent #2 prefers demonstration and question-answer to elicit students' ideas. Respondent #3 only chose one method to elicit students' ideas, which he used to ask students to do the demonstration procedure. This phase is more student centered learning environment in which teachers elicit students' ideas to give them motivation and attention to the task that they will do. It is similar with Margetson (1994) who points out that in student centered learning, teachers were encouraged to question, probe, and encourage critical reflection and provide necessary and adequate information. Moreover, teachers should also establish an environment that puts students at ease to voice his or her opinion and not get penalized for the wrong answer. Keeping up with automotive trends may not be possible for students, so teachers should provide extra information by using videos or other information from internet.

Phase three in Needham Model is restructuring ideas where teachers replace incorrect ideas and modify and also validate correct scientific ideas. The methods used in this phase are discussion in small groups, investigation, experimentation, demonstration, practical work and simulation. Except for Respondent #3, all respondents used demonstrate practical task in brake system, and also asked students opinion and feedback. Respondent #2, #3 and #4 also prefer to guide students in small groups. In this phase teachers observed the students competency to complete the task and as a behavioral approach in behaviorism theory points out, learning is behavior which can be observed and measured. Teachers will assess the students' competency in this phase.

Fourth phase in Needham Model is application of ideas which aims to consolidate correct scientific ideas which have been constructed or to consider daily applications or applications in new situations. The methods used in this phase are problem solving in different but related situations, innovation, brainstorming and worksheet. All respondents gave students an example with different brake system failure situations and they also asked students about the problems of brake failure and how to solve them. Respondents #3 and #4 distributed handouts which described the process of brake system components. Students seem to understand the topic more and it is easier for teachers to teach. Respondent #2 gives students another situation related to the topic and lets them give their opinion how to solve it. This phase is more to problem solving approach and it will teach students how to become creative in problem solving. Students have to use certain mental operations and procedures to store new information in a way which enables them to retrieve it easily when it is required. Rebecca (1994) reveals that people can become good learners in the same way as they become good problem solvers. Teachers should know efficient tools to use in order to solve the problem and to learn new information. Rebecca (1994) also suggested the teaching strategy in VET should be such that learners are enabled not only to store and apply the procedures of task but also to generate new sequence operation when required.

Last phase of Needham Model is reflection which helps students realize what and how their ideas have changed during the teaching and learning process. The methods used are self-reflection, group reflection and writing reflection. All respondents used writing reflection, which asked students to prepare a report about the entire process of brake system operation. Respondents #1, #3 and #4 made conclusions in the whole class while respondent #2 formed a conclusion in each group. Teachers prefer to reflect with the whole class because it saves time especially when needed information is complex. The weakness is that students pay less attention because they know that their friends can give them all the information from teachers later and the longer the teachers talk, the more they begin to tune out. Teacher made reflection in small group is a good devise to develop social skills such as listening, taking view point and communicating effectively. From the observation in APW it helps students hold their attention on the task. It also makes students co-investigators with teachers of the received knowledge and thus active participants in this process.

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