STRATAGEMS FOR IMPROVING THE TEACHING METHODOLOGIES IN MECHANICAL TECHNOLOGIES AT THE CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE

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Abstract

This study looked at different strategies and teaching methods in an effort to enhance the teaching of Mechanical Technology to student lecturers at School of Mathematics Science and Technology Education, Faculty of Humanities, Central University of Technology, Free State, South Africa. It assessed the most common and frequently used teaching methodologies used by lecturers. The target population was the student lecturers enrolled for the qualification Baccalaureus Educationist: SP & FET: Technology, Specializing in Mechanical Technology. 10 3rd year students and 15 2nd year students who are enrolled in the mentioned qualification were asked to participate in this study to make this study meaningful and realistic. The instrument used in this research was the Learning Style Preference Questionnaire. The instrument makes use of a 5 point Likert scale as well as questions. The descriptive survey research was employed and both the two research paradigms (qualitative and quantitative) were use. The major findings revealed that the students knew the teaching methods, as it forms part of the training curricula of student lecturers, and that they have their own opinion on the best methods to use in the different situations required for teaching a practical subject such as Mechanical Technology that comprises of two distinct areas namely a theoretical component and a practical, hands on, component. The major challenges identified were the lack of practical experience due to limited time and resources available. Recommendations made include that more time be allocated for practical periods to ensure enough time to master the skills needed and that more resources be made available. The challenge for the students will still be the marrying of the practical part with the theoretical part of the curriculum. The methodologies used in the lecture room and the laboratory needs to be as real as possible. It is also encouraged that a variety of teaching methodologies be used in the lecture room and laboratory to avoid boredom.

Keywords: Mechanical Technology, teaching methods, demonstration

1. INTRODUCTION

Various subjects are on offer in the School for Education in the Faculty of Humanities. The qualification dealt with in this paper is the Baccalaureus Educationis: SP & FET: Technology. This qualification prepares the student lecturer to teach the subjects Technology in the Senior Phase of the school curriculum (Grade 7 to 9) as well as the technical subjects in the Further Education and Training Phase (Grade 10 to 12). The

technical specialisation subject is a combination of the following disciplines:

- Civil Technology
- Electrical Technology
- Engineering Graphics and Design
- Mechanical Technology

The student lecturer has to choose 2 of the subject the be their major subjects. The rest of the curriculum comprises of Micro –Teaching, Education Theory, Life Skills, Technology (SP), Academic Literacy and Communication Studies, Advance Digital Literacy and one of the Communication Languages on offer. (CUT 2017 Calendar). The researcher is currently lecturing Mechanical Technology as well as Technical Methodology for the 1st to 4th year student teachers. The subject Mechanical Technology involves the use of a number of teaching methodologies depending on the topics being covered, level of understanding of the student lecturer, available resources, as well as availability of time. These methodologies are designed to enhance the student's knowledge and skills acquisition. Its hands-on approach enables learners to develop manipulative skills and they end up having refined motor skills. Sprinthall and Sprinthall (1991) likens a baby to a lump of clay that can be moulded and fashioned into any shape by the hands of the master craftsman, who is the lecturer. So if the master craftsman fails to mould the baby well, then malformations are likely to occur and if not rectified in time, these will dwell with the child for a life time. This study therefore, attempts to address ways of improving or enhancing the teaching of Mechanical Technology at university level.

2. STATEMENT OF THE PROBLEM

The challenge today is that of students failing to fully grasp and master the practical side of Mechanical Technology. Thus, development of fine motor skills may not take place effectively, resulting in students developing a negative attitude towards the subject. John Dewey is a pragmatist philosopher, who advocates for marrying practical and theory. Students should not be regarded as passive recipients or on lookers, rather they need to be more practical in their learning. Lecturers on the other hand, may fail to employ proper methods of teaching the various topics in relation to the level of understanding of student, Petty (1993). Certain methods may be of a higher level of comprehension of the student, while the resources available may not support the teaching of a particular topic. By improvising the available resources and being creative is another attribute that lacks in most Mechanical Technology lecturers. The unavailability of infrastructure and equipment has been a great hindrance in the normal delivery of the subject. This has therefore resulted in student not performing at maximum as is expected. When given theoretical work, they perform so well, but when it comes to the practical aspect, student fail to apply the concepts taught during theory. This separation between the practical and theoretical components has been a cause for concern for a long time (Freeman et al., 2014). These mentioned issues have therefore triggered the study to explore ways of enhancing the teaching of Mechanical Technology

3. CONCEPTUAL FRAMEWORK

Mechanical Technology focuses on concepts and principles in the mechanical (motor, mining, shipping, rail, power generation, etc.) environment and on technological processes. It embraces practical skills and the application of scientific principles. This subject aims to create and improve the engineering and manufacturing environment to enhance the quality of life of the individual and society and ensure the sustainable use of the natural environment. (CAPS FET, 2011) The student in Mechanical Technology needs to be interested in any form of mechanical entities. It can be cars, planes, trains, welding, maintenance, etc. In order to be successful the learner also has to enrol preferably in Mathematics, Physical Science and Engineering Graphics and Design, as they all form part of the technical studying field. Mechanical Technology in essence is applied science, as the field of work includes trigonometry, Newton's laws and chemical equations when dealing with certain welding techniques, fuel combustion, fuel injection, cooling systems, etc.

4. WHAT IS A TEACHING METHOD?

Behr (1976), states a teaching method comprises the principles and methods used for instruction to be implemented by teachers to achieve the desired learning by students. These strategies are determined partly on subject matter to be taught and partly by the nature of the learner. For a particular teaching method to be appropriate and efficient it has to be in relation with the characteristic of the learner and the type of learning it is supposed to bring about. No single method will serve equally well in all situations. In as much as lecturers are inclined to favour particular styles and techniques dictated largely by subjects taught as well as their

personality make-up, it needs to be pointed out that no lecturer can solely rely on a single method. In this case, Behr (1976) is implying that in the course of presenting his lessons, the lecturer is invariably required to use a variety of methods. While it is true that each subject has its own special method, leading educationists such as J.J. Rousseau (1712-78), J.H. Pestalozzi (1746-1827), John Dewey (1859-1952), Maria Montessorri (1870-1952) and Hebert Spenser (1820-1903), among many others, have stressed the importance of general method, according to Behr (1976). For instance, Pestalozzi drew attention to the need for personal experience in learning. Spenser on the other hand, provides a number of teaching maxims, such as to proceed to teach from the known to the unknown, simple to complex, concrete to abstract and from the specific to the general. Duminy (1979) share the same sentiments with Behr (1976), remarking that the development of a general educational method does not take place in isolation, but rather is a result of the developments in other domains of education. It has been influenced by changes in theories of psychology of learning as well as the philosophical conceptions of the nature of man.

5. CLASSIFICATION OF TEACHING METHODS

Teaching methods are categorized into two main groups, which are the teacher centred approach and the learner centred approach. In the lecturer centred approach, there is a great deal of expository teaching in which the lecturer is mainly a source of information, for instance the presentation method. In the learner centred method, more attention is given to individuals and group work, where students are required, under guidance, to seek solutions to problems, and they are stimulated to produce and develop their own ideas, Martins (2008). These methods can also be deductive or inductive, according to Petty (1993). In inductive methods, individual examples are used to bring out the general principles underlying them. Most scientific discoveries and creative processes in general are the outcome of the inductive method and are based on the principle of a posteriori logic which proceeds from a particular set of causes or facts of experience to the general law or principle, or from the effects to the cause which is not yet known or understood. On the contrary, the deductive method is based on the principle of a priori logic which proceeds from some general law or premise, the truth or validity of which is taken for granted in advance, to some particular case, or from the cause which is already known and understood to the effect. This method is used extensively used in mathematics, according to Behr (1976) and Petrina (2007)

5.1. What are the most common methods of teaching?

Quite a number of teaching methodologies have been in use for centuries. Others have evolved along the way, while others are mere modifications of some classical methodologies. Kochhar (1997) stresses that the choice of a teaching method/s depends largely on the information or skill that is being taught. It may also be influenced by the ability or enthusiasm of the students. Farrant (1990), Gatawa (1990), Petrina (2007), Westwood (2008), León (2010) Donche (2013) states teaching methods comprise the principles and methods used for instruction. Some of which are mostly used in schools and are going to be elaborated here-in.

1. Demonstration
2. Explaining/ Lecturing
3. Discussion
4. Experimentation
5. Project work/ Problem solving
6. Collaborating
7. Learning by teaching/ peer teaching
8. Guided individual discovery/self-discovery learning

5.2. Demonstration as a method of teaching

As far as practical subjects are concerned, Demonstration is the best known teaching method. It is used to guide the development of the student" psycho-motor skills to be efficient. defines demonstration as a practical form of learning by imitating. On the other hand, defines it as a direct means of explaining things to student. During demonstration, people are informed about how to carry out a particular task, with possible inherent dangers being explained or shown. It has strength in that it calls for an increased degree of attention, concentration and interest which can be further exploited by other techniques, i.e. student will be creative in their way of thinking

5.3. Explaining/Lecture

Explaining or lecturing is the process of teaching by giving spoken explanations of the subject that is to be learned. Explaining or lecturing is often accompanied by visual aids to help students visualize an object or problem. Lectures on the other hand are often geared more towards factual presentation than connective learning. It is a very appropriate method for enhancing learners" acquisition of knowledge. Petrina, S. (2007) highlights the need to have a child taught how to do a task before execution of the task. The lecturer thus becomes the foundation method upon which other strategies are going to be built to complete the process of learning. Other methods like the demonstration or experiment method can only be effective on condition the lecture method has been made proper use of. At the end of the day, it becomes clear that no one single method can work on its own.

5.4. The Discussion Method

This method comes in handy and is most effective when stimulating and facilitating the learning process. The discussions can be carried out in groups or even at classroom level, where learners interact sharing new and old ideas and enriching their knowledge. Discussions are superior in contributing to the application of the materials learnt and building attributes that are important in shaping behaviour patterns. Student easily understand when they discuss what they have learnt as they will be clarifying understood concepts. As such, student will not easily forget what they have discussed. Team spirit or a spirit of oneness is built through discussions. Farrant (1990) posits that discussions enable children to get on well as they are involved in group activities and discussions. Children may have a positive attitude and behaviour towards others.

5.5 Experimentation

This is an approach that involves laboratory work where learners solve their problems with practical apparatus. Student make trials in order to study what happens and gain knowledge and skills through examining, investigating and observing to come up with conclusions. Dewey, who advocated for the pragmatic philosophy to teaching, highly encouraged the use of experimental methods in the teaching of Mechanical Technology. In other words, pragmatism according to Dewey is an overriding philosophy in practical subjects because it is a philosophy of action and deeds, which encourages practical activities by student to be well executed. For instance, in Mechanical Technology, the experiment method can be used when building basic hydraulic demonstration units. Student will be involved in putting the parts together and making necessary observations and making recordings. The experiment method, together with the demonstration method is key in the teaching of Mechanical Technology and they promote content mastery and skills manipulation by the student.

5.6. Project Method/ Problem solving method

This is another teaching methodology which employs a participatory approach. This is whereby student are given tasks to execute and discover on their own as they actively participate as individuals through use of their own hands. Behr (1976) stresses that the project method originated in the USA with the rise of "progressive school movement. " A project was described as a large problem of practical concrete, manipulative type, which challenges the interest of the student and draws out his powers of planning in the actual solution of his problem. Its essence and advantage is that student will remember vividly activities done through this method and promotion of cooperative group work. Student share ideas, experiences and knowledge and they develop a sense of responsibility and display initiative and self-criticism. Behr (1976) concurs with Williams (1982) that the lecturer's responsibility is to ensure that student learn from one another, with each pupil contributing his share on the basis of his ability and interest.

5.7. Collaborating

Collaboration allows students to actively participate in the learning process by talking with each other and listening to other points of view. Collaboration establishes a personal connection between students and the topic of study and it helps students think in a less personally biased way. Group projects and discussions are examples of this teaching method. Lecturers may employ collaboration to assess student's abilities to work as a team, leadership skills or presentation abilities. Collaborative discussions have many forms, e.g. fishbowl discussions. After some preparation and with clearly defined roles, a discussion may constitute most of a lesson, with the lecturer only giving short feedback at the end or in the following lesson.

5.8. Learning by Teaching/ peer teaching

In this teaching method, students assume the role of lecturer and teach their peers. Peer teaching is also known as the monitorial system, (Farrant, 1980). Students who teach others as a group or as individuals

must study and understand a topic well enough to teach it to their peers. By having students participate in the teaching process, they gain self-confidence and strengthen their speaking and communication skills. In this system, student communicate with other student those lessons they have been taught by the master lecturer and this is a way of multiplying the person and skill of the lecturer and encouraging bright student to exercise their gifts. Since the very act of teaching requires that one understands what she/he is going to teach, this becomes very beneficial to the student who are thus helped to develop maturity as a result of the responsibility placed upon them.

5.9. Guided Individual Discovery/ Self-discovery learning

According to Farrant (1980), discovery learning is sometimes known as heuristic method. Behr (1976) also reiterates that apart from being called the heuristic method, the discovery method, as termed by Hebert Spenser, is the art of making children discover things for themselves. Its claims are such that, "… knowledge gained by self-effort and discovery is better assimilated and remembered than that which is merely memorized," (Farrant, 1980). Spenser states that children should be told as little as possible and induced to discover as much as possible. However, it has to be noted that, it is not easy to strike a sound balance between providing too much and too little guidance and the system can only work where there are good supplies of well indexed resource material.

6. OBJECTIVES OF THE STUDY

It was the thrust of the study to:

- Establish the appropriateness of methods of teaching used by the researcher in teaching Mechanical Technology during lesson delivery.
- Devise strategies handy in the teaching of Mechanical Technology.
- Identify the most ideal methodologies and strategies to co-opt during learning and teaching situation.

7. PURPOSE OF THE STUDY

The study purposed to improve or enhance the teaching of Mechanical Technology. A big knowledge gap existed between the stuff leant in theory and the practical aspect in the classroom. This was because what was usually taught in class was not followed by practice in form of practical lessons and the student would end up not being competent. Development and refinement of fine motor skills will be hampered because of this. The significance of this study is therefore to enlighten lecturers on ways of improving the teaching and learning of Mechanical Technology in order for student learning outcomes to be fully maximized.

8. ASSUMPTIONS

The study made the following assumptions:

- That there was a large knowledge gap in student that existed between theory and practice as far as Mechanical Technology was concerned.
- That lecturer was not fully exploiting the variety of teaching methods that that was at his disposal, for the benefit of the students.
- That where resources lacked, the lecturer could still improvise to make the learning environment more realistic.

9. METHODOLOGY AND RESEARCH DESIGN

Methodology can be referred to as the strategies employed in order to collect and analyse research data, Newman (2003). Leedy (1997) stresses the need to organize data so that from it more valuable and meaningful outcomes can be extracted. On the other hand, Cohen and Manion (1994) view research as an overall plan for obtaining answers and testing the research hypothesis. Cresswell (2005) defines a research design as a process encompassing the methodology procedure that is employed to conduct a research. Given that the research design is a detailed plan, it is a print on how the research is to be conducted describing the when, where, what and how of data collection thus helping the researcher to keep focused. A descriptive research design was used to solicit information from students attending the Mechanical Technology class.

Population

According to Best and Khan (1993), a population is a well-defined group of individuals or other entities

having one or more characteristics in common that are of interest to the researcher. It is that group about which the researcher is interested in gaining information and drawing conclusions, Tuckman (1994). For the purposes of this study, 15 2nd year and 10 3rd years student teachers took part.

Instruments for data collection

An instrument is a tool for use by the researcher in a systematic collection, presentation, analysis and interpretation of data in an attempt to provide answers to research questions. The questionnaire was the main instrument used to collect information in this study. Best and Khan (1993) defines it as a data gathering instrument through which respondents answer questions or respond to statements in writing. In this particular study, questionnaires were used to obtain information from the student teachers.

Demographical Information of respondents

The first question sought the ages of the students. Out of the 25, 20 were in the age range of 19 - 25 years, another 5 were in the range of 25 - 30 years. With regards to sex, the study established that the respondents were divided between 20 male students and 5 female students. On the issue of qualifications, all of the participants has grade 12 and are enrolled for the Baccalaureus Educationis: SP & FET: Technology qualification.

10. RESULTS

On the question asked to establish the most effective methods of teaching Mechanical Technology, the following findings were noted. Demonstration was singled out as the most commonly used method of teaching by 23 out of the 25 respondents. It was followed by the lecture method (20/25), experimentation with (18/25), project/ research (18/25) whole class discussion method with (9/25). The least used methods of teaching were group work/discussion (4/25), field trip (4/25), as well as question and answer with (3/25)and lastly, individual work with a single respondent. In justifying the choice of method, demonstration was said to be very efficient, since during practical sessions it helped the student to grasp skills well since they would observe and „experience" the process/skill. Demonstration helps student to understand and master different techniques and skills from the lecturer, and in return they will also be able to practice these skills as student see reality in what they are doing. This therefore ensures good results in practical sessions and quick grasping of ideas. This method also helps student to identify and remember steps and equipment used. Above everything else, demonstration is effective as it uses a multi-sensory approach e.g sight, feeling, smelling, hearing and smelling. The question and answer question was also justified as appropriate especially when one wants to check whether students have understood what was taught. The lecturer gets to know problematic areas of students which can therefore be corrected. In other words, the question and answer method helps lecturer to detect strong and weak points and thus work towards achieving better results. The lecture method was said to enhance learners" acquisition of knowledge. It is through this method that student get to understand what they are going to prepare during practical sessions well in advance. On the other hand, group work was justified as being helpful to student in promoting cooperation and sharing of ideas among student in class. Every individual is likely going to participate and this is also an ideal method during practical lessons. Class discussion was also selected by some lecturers because of the easy interaction it offers among student. There is sharing of ideas amongst student and also between lecturer and student. Other contributions obtained from the respondents were the need to introduce labour saving devices and more modern equipment electrical equipment such as Laser cutters, CO2 welding machines. Lack of equipment results in use of unnecessary alternatives, which tend to confuse student. Material need to be bought on time, so that practical work flow smoothly. Student should be given opportunity to work as individuals, not in groups every time.

11. DISCUSSION

From the findings explained above, there is need to revisit some grey areas. Being a male dominated environment, women may feel that they will be or can be discriminated against. Limited exposure to practical experience also limit one's competence. The most appropriate method was the demonstration method and it is very ideal for practical sessions. However, in as much as this method was in use, challenges still existed. The choice of method is acceptable, but the challenge is on its practicality or applicability. The fact that some classes are too big for one to manage a single demonstration, it therefore calls for the lecturer to be more vigilant in ensuring that every student benefits at the end of the day. The lecturer can also make use of peer educators, those with more refined motor skills will assist with demonstrations to their peers in their respective groups. The lecturer will then move around correcting and or reinforcing where necessary. There is no single method that can be used on its own successfully, without depending on the other. Demonstration if used on its own will leave some areas grey. Ideally it should be used together with the lecture method to

explain certain actions. For instance, when welding two pieces of steel together, the lecturer while demonstrating the correct electrode angle, should explains the purpose of the correct angle. This should be by word of mouth. However, lecturing, if used on its own has many demerits especially for the level of understanding of student because the students will have difficulty in visualising the correct method. Lecturing as suggested to earlier is best used together with demonstration or with the question and answer approach. The question and answer method cannot be used well on its own but requires the lecture method to underpin and or correct certain concepts. It might also be used in combination with the demonstration or the experiment method which allows for observation to be made and conclusions to be realized. Where there is shortage of equipment, the lecturer can opt for pictures or videos for student to be able to grasp the context and size of the equipment. Students can be given tasks or assignments to go and do research on methods used in the industry and this will go a long way in bringing life to the learning environment. It is difficult to take students on field trip to the relevant industries because of budget restraints as well as the time factor, the lecturer need to improvise so that he brings reality to the classroom. The invitation of experts from the industry will go a long way in facilitation a topic as well as videos can be of great assistance.

12. CONCLUSION

Various aspects have been identified as being the major hindrances to the smooth flow of teaching and learning activities during Mechanical Technology lessons. Chief among these are the unavailability of resources such as equipment and material to use during practical lessons. The student therefore sees no link between these two. The Mechanical Technology lab are not well equipped and therefor the promotion of learning is impaired as well as the fact that some pieces of equipment are outdated and no longer functional. This causes confusion on the part of the student during practical sessions, because what is written in the text book is not what is on the ground to use. Lack of the financial resource has resulted in the lecturer conducting more theory lessons at the expense of the practical sessions thereby creating a barrier between theory and practical components. Overuse of only one or two methods of teaching has been another challenge resulting in monotony and student end up getting bored by the same approach every time. The study has therefore tried to address these ailments in order to enhance the teaching of Mechanical Technology.

13. RECOMMENDATIONS AND WAY FORWARD

Given the findings and discussion given above, the following recommendations have been given for a possible way forward.

- Attending training and departmental workshops to facilitate staff development among technical lecturers
- The Lecturer to employ team teaching strategies so that he offers the best to his student and that their weak areas will be covered by their peers who excel at the necessary skills.
- Ensuring that a variety of methods be applied during the teaching-learning process
- The Lecturer to improvise as much as possible where resources are scarce in order for learning to be realistic and more meaningful to the learner.
- The lecture to budget and motivate the expansion of equipment to enhance training.

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