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# DESIGN EDUCATION AND THE TEACHING OF WOODWORK AT SECONDARY SCHOOL LEVEL IN ZIMBABWE

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## ABSTRACT

*This study investigated the prevalence of problem solving and design approaches in the teaching of Woodwork at Secondary School level.*

*A case study of one secondary school was conducted in 1988, involving over 200 pupils in Forms one and three, and five teachers in the Woodwork department.*

*Questionnaires were the main means of collecting data. Informal methods, which included: interviews, document analysis and observations were also used.*

*It was found that pupils had limited autonomy in practical work. For instance, teachers played the major role in deciding the articles made. Also, pupils could not proceed to a new stage without consulting their teachers. Generally, pupils felt, they were not encouraged to come up with their own ideas although the teachers did not agree to this.*

*The results indicated that teaching was still mainly based on craft approaches. Some characteristics of problem solving and design were also identified in the teaching, but they were minimal.*

## **BACKGROUND AND PURPOSE OF THE STUDY**

The provision of technical education in secondary schools dates back to pre-Independent Zimbabwe. Woodwork, Metalwork, Building and Housecraft were the most common technical subjects. They were, however, considered to be more suitable for pupils whose performance in academic subjects was rather weak. Most of the pupils doing these subjects, were intended to join industry as semi-skilled workers.

The syllabuses were drawn up by external boards, such as the Cambridge Examinations Board and London Examinations Board. Eggleston (1976) observes that in Britain, subjects such as Woodwork and Metalwork were intended to provide the necessary pre-vocational training for the rapidly growing ranks of manual industrial workers. The making of artefacts was seen as the primary activity. The main objective seemed to have been the training of industrial workers, who could follow instructions obediently and accurately. The teaching methods were generally authoritarian and uninspiring.

### **Changing Perspectives In The Curriculum**

Examination syllabuses seem to be focusing increasingly on design education. Both the Zimbabwe Junior Certificate and the 'O' Level syllabuses specify the need to foster problem-solving and design skills in pupils. The Woodwork, General Certificate of Education ( G.C.E.) Ordinary Level syllabus, for instance, states that,

Importance will be attached to designing ability, the use of information and the solving of problems. (p.5).

The last section in the examination paper is actually on Drawing and Design, and emphasises the quality of ideas in design as one of the assessment objectives.

## Purpose Of The Study

The purpose of the study was to find out the prevalence of problem solving and design approaches in the teaching of Woodwork at secondary school level in Zimbabwe.

## THEORETICAL FRAMEWORK

### Problem Solving Approaches

Problem solving approaches have been advocated since the time of John Dewey. Problem solving has been implicit in terms such as: 'discovery', 'inquiry-discovery', 'learner-oriented', and 'child-centred' methods. A child is presented with tasks rather than specific facts and processes. The child should seek relevant solutions to these tasks, in a systematic manner. The teacher therefore needs to structure the tasks carefully, so that learning takes place as planned.

Taba (1962) observes that the steps involved in problem solving are essentially the steps of a 'complete act of thought', described in Dewey's idea of the process of inquiry. Taba emphasises the importance of mastering the various elements of thinking, such as: generalising, concept formation, analysis of assumptions, application of principles, and the use of these steps in problem solving. She cautions that if these elements are not consciously recognised, problem solving can turn into:

... a ritualistic process of defining any kind of question, collecting any kind of data, hypothesising any kind of solution, ... (p.184).

Tanner and Tanner (1975) concur with Dewey that a worthwhile activity gives the child a chance to formulate and test solutions to problems and to practice the thinking process. They also agree that problem solving is closely related to Dewey's complete act of thought which is summarised in the following steps:

- (a) defining the problem;
- (b) noting the conditions surrounding the problem;
- (c) formulating hypotheses for the possible solution;
- (d) elaborating the probable value of the various hypotheses;
- (e) testing the hypotheses to see which idea offers the best solution to the problem (op.cit.).

These steps resemble the 'design process' described below. They are not necessarily followed in a strict sequential order. Each problem dictates which step should be considered first. According to Dewey, (in Tanner and Tanner, 1975), the steps are "the indispensable traits of reflective thinking." (p.256) Problem solving approaches are therefore a means of launching a child through the 'complete act of thought'.

Educationists seem to agree that problem solving should not be interpreted as letting children grope with problems blindly. Rather, clear guide-lines should be set out so that, while learning takes place in an unrestricted manner, it remains structured and purposeful. Objectives should be specified, since these will enable proper evaluation of the learning process.

The challenge to teachers is in deciding appropriate problem solving tasks, letting children explore and discover solutions freely, but at the same time, providing the necessary guidance. There is no one general answer, to this dilemma, instead, each situation that arises needs careful consideration. As Dearden, (in Cohen 1983) hints,

A teaching method which genuinely leaves things open for discovery also necessarily leaves open the opportunity for not discovering them. (p.53).

The teacher should ensure that discovery will take place. Cohen (op.cit.), reiterates Dewey's contention that problems posed should grow out of the experience and be within the range of the pupil's capacity. The problem should be such that it stimulates a desire for information and the production of new ideas.

Problem solving approaches have been adopted and redefined in different subject areas. They have changed the nature of teaching in science, mathematics, and other school subjects (Taba, 1962). In technical subjects, they have however only recently been adopted, giving rise to what has been called design education.

### **The Design Process**

The Design Process is a structured technique for solving practical problems, (see for instance: Eggleston, 1976; Shaw and Reeve, 1978; Baynes, 1969; and Brough, 1985). A problem is solved in stages which are sequentially arranged, with particular aspects being emphasised at each stage. The order followed mainly depends on the nature of the problem, but all stages are important at one time or another during the design process.

### **Teaching Based On The Design Approaches**

Teaching within the broader concept of design education is based on problem solving. It follows the principles of the progressive, learner-oriented approaches advocated as far back as Rousseau in the eighteenth century and Dewey, Froebel and Montessori in the nineteenth century.

The design approach lays emphasis on the learning procedure, rather than on mere production of a well made artefact. This does not however imply that the role of manipulative workshop skills should be underplayed. The design process necessarily involves manual as well as mental skills.

In Woodwork, pupils are given a situation from which they identify the problem, work out their own specifications and go through any other relevant design considerations. They only embark on the actual construction of the artefact after exploring several alternative possibilities.

Empirical and theoretical evidence available seems to indicate that the experiences acquired through the design process have educational worth unparalleled by the traditional approaches. According to Eggleston (1976),

The relevance of the design process to the needs of late twentieth century occupations is unmistakable; it may well be argued that it would be irresponsible for the schools not to provide such experience. (p.29)

Problem solving situations offer the opportunity for developing models of thought based on the design process and its application in designing and making activities (Hughes, 1981). The benefits of design education lie in the intellectual demands that arise from the design process as well as its practical nature. Pupils are involved in the design aspects of making, by confronting them with practical problems calling for analytic and creative thinking and for personal research and investigation.

Design activities equip pupils with a systematic and analytic approach to problem solving. This will not only help them in workshop activities but also in other subject areas as well as everyday real-life situations. As children gather information for their design problems, they are bound to come across a wealth

of other information, knowledge and experiences which will enrich their learning experiences. Team-work, discussion and brainstorming are encouraged in design activities and they help improve the communication and social skills of the pupils. These and many other benefits related to design approaches will make workshop activities an essential component of the general education of a child.

Criticisms levelled against the design approaches tend to be about their improper implementation rather than questioning their fundamental principles. Kimbell (1982) suggests that the 'craft skills teacher' objects to the apparent lack of structure and direction in the design approach. It is argued that pupils at the secondary school age and below will not learn the necessary basic workshop skills due to the freedom allowed in design classes. The standard of their workmanship will consequently be low. This is a fair criticism which a design teacher should take heed of when posing tasks to pupils. For instance, the teacher can decide what workshop skills he wants his pupils to experience, such as making a dovetail joint, laminating wood or whatever. He can then develop a design situation involving these. Most of the traditional craft workshop activities can therefore be specified as design problems.

Design problems, according to Kimbell (1982), exist on a continuum ranging between a total problem and a non-problem. The design teacher has the task of devising design problems of a suitable degree of difficulty, depending on factors such as age, experience and knowledge of the pupils. The art to teaching design lies in maintaining a balance between the necessary guidance to pupils and the encouragement of independent thinking on their part. Too much freedom will be as bad as too much direction. Through 'guided freedom', pupils should be able to move in gradual steps, from a situation of almost total dependence on the teacher to almost total independence.

## **METHODS AND PROCEDURE**

### **Methodology**

This study probed into the teaching methods being employed in technical subjects. No research information in this area was found. A case study was therefore decided on as the most appropriate method.

### **Subjects**

An urban secondary school where Woodwork is taught up to form four was chosen for the study. The total enrolment at the school was over two thousand. Both academic and technical subjects have always been included in the curriculum. Woodwork is offered to all Form one and two pupils but only to those Form three and four pupils who are not doing Physics and Chemistry. These latter classes are streamed into ability groups.

A total of twelve classes participated in the study, (all the seven Form one and five Form three classes at the school). Of the 253 pupils in these classes, 202 were available: 126 Form ones and 76 Form threes. These pupils were all males aged between thirteen and twenty. The mean ages were: 14.7 years in form one and 16.6 in Form three. Most of them had started their secondary education at the same school. Pupils in each form all took the same subjects. All the five teachers in the department were also involved in the study.

To ensure thoroughness, all Woodwork classes should have been studied. However, due to the external examinations in progress, only Forms one and three pupils were available.

### **Data Collection Methods**

Both formal and informal methods were used to collect data. The questionnaire method was mainly used. The informal methods included interviews, lesson observations and document analysis.

Two sets of questionnaires were made, one for pupils and the other for teachers. In both questionnaires, items were generally based on a Likert-type, five point equal interval scale. Responses ranged from "Strongly Agree", to "Strongly Disagree".

The questionnaire for teachers was designed to be used as either an interview schedule or a questionnaire. Interviews, were preferable since they are adaptable: questions can be rephrased, expanded or manipulated as the situation dictates. According to Bell (1987),

A skillful interviewer can follow up motives and feelings which a questionnaire can never do. (p.70).

However, teachers were busy and it was found prudent to use the questionnaire method instead.

### **Procedure**

The study was carried out during the November and December examination period, in 1988. A request for the school to participate in the study was made through the University of Zimbabwe and the Ministry of Education.

The researcher administered all questionnaires to pupils with the assistance of class teachers. All pupils were instructed to answer individually, without discussion. It took five working days to meet

all classes. Teachers were asked to complete the questionnaires, at times convenient to them. They returned the questionnaires within a day or two.

Additional information was gathered through informal interviews with the five teachers in the department, twenty-eight pupils in seven classes, the headmaster and three officials in the Ministry of Education. Also, informal observations of some lessons were carried out. In order to reduce the possible effects caused by the presence of the researcher in the lesson, observations were only recorded after the classes had finished.

Pupils' work, which included exercise books, drawings and articles were also examined. The work was randomly picked, but note taken regarding the class to which the pupils belonged. Some of the teachers' schemes and records of work, weekly lesson plans and marking schemes were perused. Examination papers were also analysed to ascertain the aspects emphasised.

The textbooks used by different classes were also examined. This was done in conjunction with official syllabuses in current use. Notes were made regarding how much design or craft material was included.

## **PRESENTATION OF THE RESULTS**

Bar charts and tables are included in the following results to depict the detailed distribution of the responses to some items. All the pupils' responses were computed collectively using a computer statistics program known as 'Stat-View 512'.

### **Main Findings**

It seems that pupils, especially in Form one, had very limited autonomy in the workshop. Responses from the pupils, indicated that:

1. Individual pupils did not decide their own articles.
2. Pupils in Form one did not have a say, but those in Form three decided on the articles together with their teachers.
3. Teachers told pupils what to do at every stage during practical work.
4. Pupils in Form one were not allowed to make changes to their articles, but those in Form three could do so.
5. Pupils were not encouraged to come up with their own ideas

Pupils in both forms were nearly unanimous in their agreement to the statement that teachers decided the articles to be made. Over 90% of the pupils expressed this view.

About 65% of the pupils in each form, disagreed that they decided their own articles. Just over 24% of the Form ones agreed to the statement, compared to over 29% in Form Three. Figure 1 shows the combined responses.

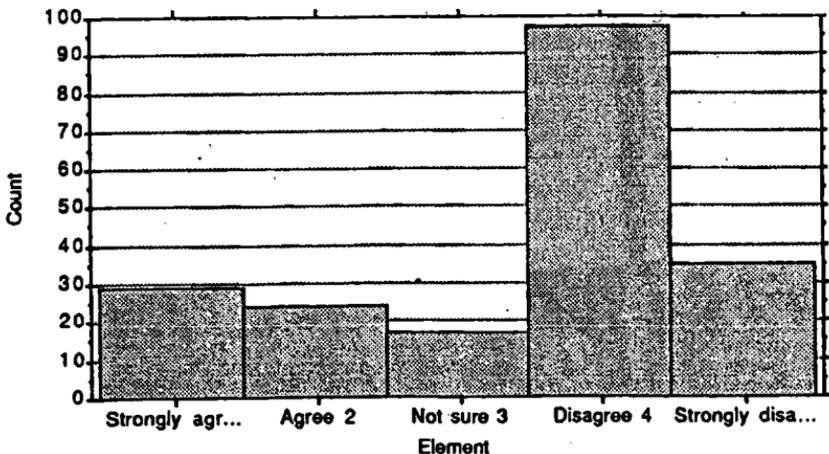


Figure 1. Pupils' agreement or disagreement to item 2: Individual pupils decide their own articles.

While approximately 47% of those in Form one agreed that teachers and pupils together decided the articles to be made, almost 70% of the Form threes agreed that they did. Figure 2 shows the variation in the combined responses.

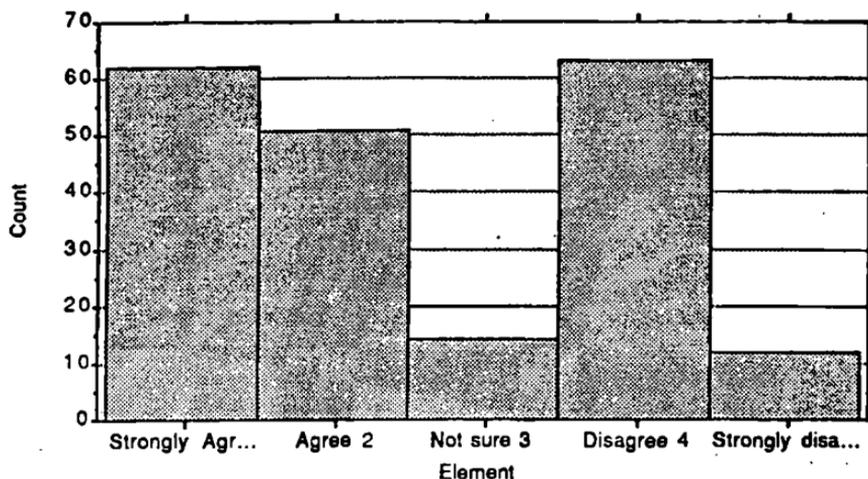
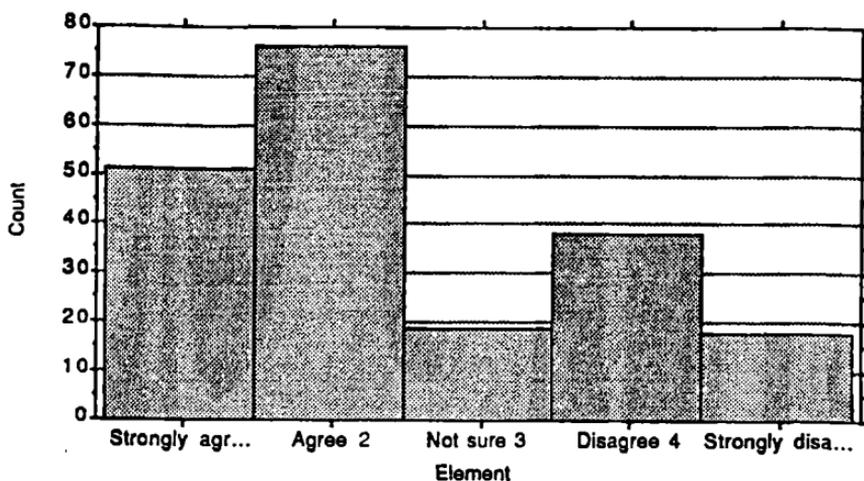


Figure 2. Pupils' agreement or disagreement to item 3: Both the teacher and pupils decide the articles to be made.

Both Form ones and threes agreed that teachers told them what to do at every stage during practical work. About 95% of the pupils gave this response.

Over 68% of the Form ones and 54% of the Form threes agreed that teachers expected them to discuss problems in practical work. The combined responses in Figure 3, depict agreement by almost 63% of the pupils in both classes.



*Figure 3. Pupils' responses to item 8: Pupils' agreement or disagreement to item 8: The teacher expects pupils to discuss problems in practical work and decide how to proceed.*

Over 73% of the pupils in each form indicated that they used sketch-books, files or sheets of paper in practical work. The combined responses are depicted in Table 1.

**Table 1**  
**Pupils' responses to item 9: Do you keep a sketch-book, file or sheets of paper in which you make sketches and notes related to your practical work**

Bar	Element	Count	Percent
1	Yes	148	73.3
2	No	54	26.7

Only 39% of the Form ones indicated that they made models or mock-ups of their articles, compared to 49% in Form three. Overall, as depicted in Table 2, more pupils disagreed that they made models or mock-ups.

**Table 2**  
**Pupils' responses to item 10: Do you make models or mock-ups of the articles to be made?**

Bar	Element	Count	Percent
1	Yes	94	46.5
2	No	108	53.5

More than 67% of those in Form one and 73% of those in Form three agreed that they discussed projects in practical work, as a class. Table 3 shows the combined responses.

**Table 3**  
**Pupils' responses to item 8: Do you discuss and make comments on individual articles as a class?**

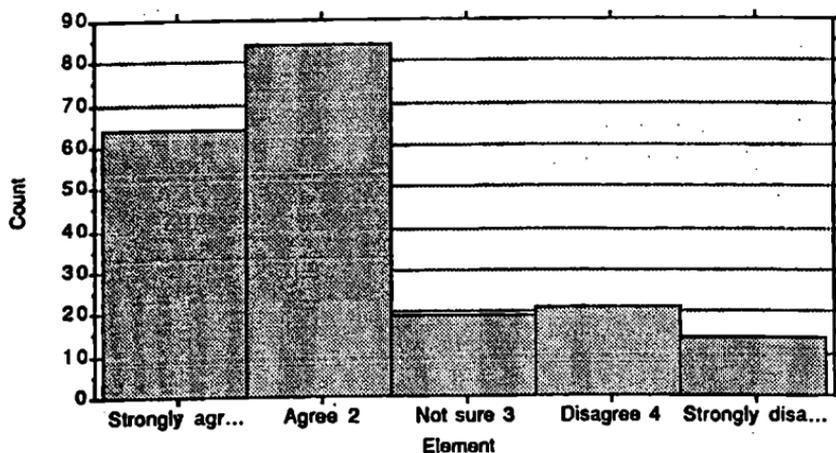
Bar	Element	Count	Percent
1	Yes	139	68.8
2	No	63	31.2

As can be seen in Table 4, most pupils indicated that they evaluated their practical work.

**Table 4**  
**Pupils' responses to item 11: When you finish making an article, do you assess it and suggest how the article could be improved?**

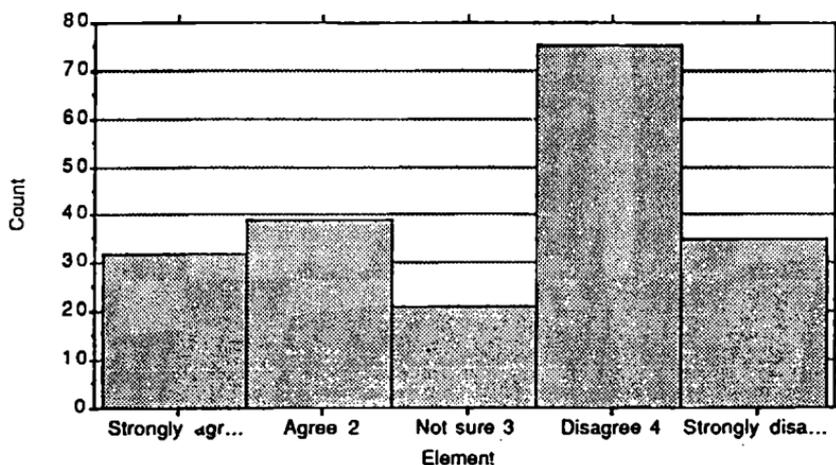
Bar	Element	Count	Percent
1	Yes	152	75.2
2	No	50	24.8

More than 87% of the Form one pupils thought that practical work mainly involved copying. In Form three, however, only 50% thought so, while 34% disagreed. Overall, 73% of the pupils agreed to the item, as can be deduced from Figure 4.



*Figure 4. Pupils' agreement or disagreement to item 12: Woodwork practical work mostly involves copying the teacher's models or working drawings accurately.*

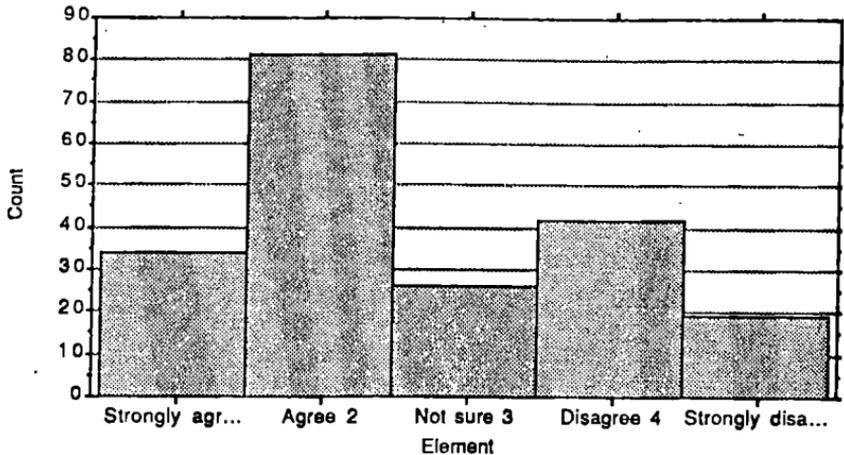
Most pupils in both forms did not think they were encouraged to come up with their own ideas. In Form one over 58%, and in Form three 47%, disagreed to the statement that they were encouraged to do so. Overall, more than 54% disagreed, compared to 34% who agreed in both classes, as depicted in Figure 5.



*Figure 5. Pupils' agreement and disagreement to item 13: Pupils are encouraged to come up with their own ideas about the articles they make.*

Most pupils in both Form one and three felt that the subject required a lot of thinking. Over 81% of them expressed this opinion.

More than 59% of those in Form one and 52% in Form three, agreed that they were encouraged to think independently. Figure 6 shows the overall impression of the responses.



*Figure 6. Pupils' agreement or disagreement to item 16: Pupils are encouraged to think independently without relying on the teacher all the time.*

The results, however, show that pupils had some latitude in their practical work. The following findings support this view:

1. Teachers expected the pupils to discuss problems in practical work. More Form ones expressed this view.
2. Pupils evaluated their completed articles.
3. Form three pupils proposed articles in practical work though the teacher made the final decisions. The pupils were also allowed to make changes to their articles. They used drawing folders for sketches related to their practical work.
4. A larger proportion of pupils in Form three made models or mock-ups, to try out their ideas.

Concerning their own perception of Woodwork, pupils expressed the following opinions:

1. Practical work mostly involved copying teachers' models or working drawings accurately.
2. The subject demanded a lot of thinking.
3. The subject was suitable for both the able and less able students.

The responses from teachers indicated that, while the official syllabuses specified all topics to be covered, teachers were free to use their own methods. Most of the teachers regarded the training of manual skills as the most important aspect in their teaching.

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## DISCUSSION AND RECOMMENDATIONS

On the whole, evidence from the findings seem to imply that teaching was not mainly based on problem solving and design approaches. Rather, it still leaned towards craft approaches. For instance the design process, which is the core of design education, was not evident in the workshop activities. Some characteristics of problem solving and design were however identified in the teaching approaches in use, but only to a very limited extent.

Most pupils conceived practical work as mostly involving copying teacher's models and drawings. This is probably due to their experiences in the workshop, suggesting that teachers employed craft approaches. This viewpoint is confirmed by several findings. For instance, pupils did not feel they were encouraged to come up with their own ideas, they had to consult the teacher at every stage when making articles, and Form ones in particular, were not allowed to make changes to their articles. The demonstrations of skills and processes by the teacher could also lead pupils to believing that practical work was mainly concerned with copying. If teachers performed these demonstrations on articles similar to the ones made by pupils, pupils would tend to emulate both

the skills and how the actual articles were detailed. In a typical design situation on the other hand, pupils perceive practical work as a continuous search for optimum solutions.

The findings show that the official syllabuses only specified the topics, and not the methods to be used. It would appear then that teachers had complete freedom in their teaching. There are however, other factors which could influence the teaching approaches adopted, for instance, the requirements of external examinations. School learning tends to be judged in terms of the performance of pupils in public examinations. In such a situation, teachers are bound to employ teaching approaches that, in their opinion, ensure the highest number of passes.

Although the assessment objectives of the examination syllabuses in use mentioned problem solving and design, the actual questions only asked for factual information and competence in specific manual skills. The examinations did not give much scope for experimentation, which is a necessary part of design work, (for example, the 1987 and 1988 G.C.E. 'O' Level Papers). It is likely therefore, that teachers in their endeavours to meet the requirements of these examinations, found it best to be more directive and specific in their teaching. The marking schemes which were in use, did not stress understanding either. In practical work for instance, assessment was based on competence in executing specified manipulative skills. The researcher believes that examinations have the greatest single influence on the teaching approaches in use.

Another factor which could have some bearing on the teaching approaches, is the amount of time allocated to the subject. Time becomes a very important consideration when teaching is examination oriented. In that situation, teachers tend to aim at getting through the syllabus, and even leave ample room to revise different topics before the examination. Such teachers regard experimentation, personal investigation for information by pupils, and other activities related to problem solving and design, as a luxury they cannot afford.

The experiences of teachers, both during training and in the field, also influence the teaching approaches they adopt. According to the qualifications and experiences of the teachers who participated, it is likely that they did not have sufficient knowledge in design education.

School learning should give pupils the opportunity to develop their cognitive skills, manipulative skills and knowledge, social skills, attitudes and values. Cognitive skills can be developed when learning focuses on enhancing the decision-making skills of pupils, developing critical minds in pupils, and encouraging constructive evaluation of their own and other people's work or products in everyday use.

Manipulative skills and knowledge can be fostered by developing an understanding and knowledge of materials and the safe way to deal with them; providing pupils with the necessary manual skills and knowledge that will help them to gainfully engage in either the formal or informal sector of the economy. Since both the materials and working techniques are changing so rapidly in the modern technological world, pupils should be versatile and innovative, rather than being thoroughly skilled in a specific area only.

The main benefits of technical education can only be fully realised through design education, in which workshop activities are aimed at involving both the mental and manual capacities of pupils. Merely concentrating on developing manual skills without due regard to cognitive development, is educationally void. Practical exercises in the workshop should be aimed at developing both the manipulative and mental skills of the child.

The current study has emphasised the importance of basing the teaching methods in Woodwork, and indeed all technical subjects, on problem solving and design. Some tentative recommendations can be inferred from the results:

- Examination syllabuses should be reviewed, to ensure that questions lay less emphasis on factual information and concentrate more on testing understanding.
- Before teachers are acquainted with design education, more periods could be made available for practical work. However, once teachers get the necessary experience, design tasks may actually require less contact time since, design work continues even outside the workshop and away from the teacher, as pupils seek the solutions to their problems on their own.
- Teachers should be informed more about design education. This could be done through circulars from the Ministry of Education, seminars and workshops. Holiday courses could also be run for teachers, and reading materials should be made available.
- Teachers themselves should aim at making their teaching more pupil-centred, for example, by allowing pupils to make more decisions concerning their practical work.

In drawing the conclusions in this study, it is acknowledged that further studies are necessary to confirm the findings. The characteristics identified in the current study as typifying problem solving and design approaches, could first be reviewed to ensure that they actually do fully cover all the aspects that need investigation. The use of different research methods could yield different, new, or for that matter, more conclusive evidence. More teachers, pupils and schools could also be involved to try and generalise typical characteristics of the teaching approaches in use.

Technical subjects will continue to be looked down upon if they continue to pay insufficient attention to mental skills and only concentrate on manipulative skills. All countries, especially developing countries like Zimbabwe, need people who can come up with original ideas. Zimbabwe needs people who can identify problems and seek relevant solutions. New products, industrial development, the improvement of the material world and of the general develop-

ment of the country, require people who are practical-minded, innovative and versatile. Technical subjects, through problem solving and design approaches, can contribute to the development of manpower resources by inculcating such qualities in the young minds.

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