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The implementation of design education in lower secondary school industrial arts units

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THE IMPLEMENTATION OF DESIGN EDUCATION IN LOWER SECONDARY SCHOOL INDUSTRIAL ARTS UNITS.

BY

ROD SLATER

PERTH, WESTERN AUSTRALIA
DECEMBER 1989

A THESIS SUBMITTED TO THE SCHOOL OF EDUCATION IN CANDIDACY FOR A BACHELOR OF EDUCATION WITH HONOURS
ABSTRACT

This study identifies 'if' and 'how' design education is incorporated in lower secondary school Industrial Arts units, and determines if teacher training and teachers' perceptions of certain issues, are influential in the use of design education. A stratified random sample (50 teachers in 25 schools) was taken from all government secondary schools in W.A. The participants were surveyed with a postal questionnaire, and a follow-up interview was conducted with a selection of the respondents. There was a return rate of 84%.

Data analysis determined the frequency distribution for structured questions and organized the data for non-structured items into groups with a common theme. The resultant data illustrated that design was rarely taught as a structured process, but was incorporated in much lower school work as simple design choices and considerations. Current teacher training was not considered a significant factor in design use, however, respondents did give reasons they believed were influential.
The indications are that design education is both educationally and socially desirable. However, for design education to be included in the school curriculum it needs to be given academic status equivalent to other subjects. It also needs to be taught in a structured manner, and for a period of time that would enable students to acquire sufficient skills and knowledge to design effectively.
"I certify that this thesis does not incorporate, without acknowledgement, any material previously submitted for a degree or diploma in any institution of higher education and that, to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where due reference is made in the text."
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Introduction

It is a recommendation of the Beazley Report (1984), that design education become an integral part of the Practical and Creative Arts component of the Unit Curriculum. This study is focussed on Industrial (Manual) Arts, one of the subject areas within the Practical and Creative Arts component. The population for this study is Industrial Arts teachers in government secondary schools in Western Australia. The aim of this study is to survey a sample of the population to determine the degree of use of design education in lower secondary school Industrial Arts units, and the form in which design education is presented in these units. To aid understanding of the use of design education, several major factors which could affect this use will also be investigated.

To date, this has not been a topic of research in Western Australia, so this study will provide a clear description of the current state of design education in lower secondary school Industrial Arts units. The results and conclusions of this study will establish an empirical foundation upon which future decisions about design education can be based. Recommendations ranging from only minor changes to the way design education is currently taught, to a total reassessment of the role of design education in lower secondary school Industrial Arts units are possible.
If a clear understanding of the current 'state of affairs' in design education is available, then decisions concerned with the future of design education can be made with greater confidence.
chapter 1: BACKGROUND TO THE STUDY.

To assist in understanding the role of design education in Western Australian secondary schools, it is necessary to examine the case for design education. This segment will then be followed by the review of the literature. The literature review gives an insight into what is known about design education and the topics and debates that surround the subject. It also ensures that the answers to the research questions are not already known. The background to this study is extensive. Because of the relative 'newness' of the concept of design education, it is essential that the forces and issues concerned with the concept be understood. This background provides an insight into the concerns that prompted the study.

1.1 The Research Questions.

i) Is design education taught in lower secondary school Industrial Arts units in Western Australian government schools? If so how is it taught?

ii) Is teacher training, and are teacher perceptions, significant determinants in the use of design education in lower secondary school Industrial Arts units in Western Australian government schools?
This study, then, focuses on lower secondary school Industrial Arts units because information at this level is sparse. In contrast, all accredited upper school Industrial Arts units are moderated by the Secondary Education Authority. Information about these units is readily available from this body.

1.2 The Case for Design Education

Sir John Carrick, the chairperson of the New South Wales Government Review Committee into Education in 1988, provides a frank look at Australia's current economic plight, the reasons for this plight, and briefly, what needs to be done. Carrick (1988) shows through statistics, that judging by our inflation rate, trade deficit, overseas debt, and other common indicators, there is little wonder Australia's living standard has fallen from the highest in the world to about twenty-fifth in the world. Carrick indicates that unlike most other countries with high living standards (countries having about 60% of their exports manufactured or processed) only 20% of Australia's exports are, and we are heavily dependent on two "very chancy" commodities, that is, farming and mining (p. 8). To help reverse this increasingly worsening situation, Carrick outlines "why we need for the future to look at technology, why we need to look at education" (p. 8).
Carrick (1988) implies that Australian education must be put under review, both for whole of life and for vocation. This issue is discussed in the review of the literature. Carrick (1988) believes it is evident that other countries with rising living standards are achieving more in education. He reiterates and reinforces the conce of that education has a definite role to play in the economy of a country, and in the country's society as a whole.

When considering whether there is a need for design education in the Australian education system it is necessary to address two issues. The first is to determine if the concept of design education is educationally desirable. There is significant evidence that design education is educationally advantageous. The second issue that needs to be addressed is whether or not design education will benefit society. As Carrick (1988) pointed out, Australian society does have some fairly serious needs that must be addressed if it is to retain a high standard of living.

The Federal Government has signalled its desire to promote the development of manufacturing of exportable products through the establishment of the Industry Research and Development Programme (1988), which offers generous tax incentives for companies undertaking research and development of manufactured exportable items. One component of this scheme is the National
Teaching Company Scheme which promotes links between companies and tertiary educational institutions. The aim of this scheme is for industry and tertiary education to work together for their mutual benefit.

According to the Andrich Report (1989), the above scheme could have far reaching consequences within secondary education. The Andrich Report recommends that TEE and non-TEE subjects be related explicitly to TAFE courses wherever possible. Davis and Broadbent (1987) support the views of Carrick and Andrich. Davis and Broadbent, through their research, show a growing recognition that Australian industry must "...win international market success for their products if our nation is to achieve economic growth and continue as a developed, first world, country" (p. 1). They believe the countries that Australia must compete with in the international arena have developed their own cultures that we cannot mimic, and Australia must develop its own technological culture "...based on our unique heritage, social mix, location, and resources" (Davis and Broadbent, 1987, p. 1). Our educational system is an instrument for cultural, social, and technological change.

Davis and Broadbent (1987) show that design is a major component of an industry's ability to achieve market success by suggesting that "...up to 44% of the costs of technological innovation may relate to design" (p. 1). They also indicate that it is the role of
tertiary education to provide the personnel with the knowledge and expertise to fulfil these design requirements.

What do Davis and Broadbent (1987) reveal about the role of design education in secondary schools? They state, that whilst design is widely presented as an art or craft activity in our primary and secondary schools, there is widespread ignorance in the community about the nature and significance of design activities. This ignorance about design education may be due partly to the relative newness of the concept as an area of study in secondary schools. The consequences of this include a lack of design awareness within the community, and the discouragement of suitably talented children from considering design education at the tertiary level. This gives rise to the issue of the academic status of the practical and creative subject areas.

Davis and Broadbent (1987) believe that the nature, adequacy, and funding of design education in primary and secondary schools needs to be urgently reviewed. They propose that design education in primary and secondary schools be "...substantially improved to create a broader societal awareness of the nature of technological change and design activity " (Davis and Broadbent, 1987, p. 4). Effective design education in primary and secondary schools is most important, according to Davis and Broadbent, both in preparing students for
tertiary level design studies and as a part of the longer-term process of creating a more design-aware society in Australia.

The purpose of examining the case for design education was to highlight the issues that dictate the need for design education in secondary schools. It has been shown that Australia's economic condition requires urgent attention. Government incentives are one means of addressing these economic needs. The education systems of Australia are another. The Andrich Report (1989) and Davis and Broadbent (1987) are two studies that look at the desired relationship between secondary education, tertiary education, and industry. These studies could be criticized for focussing on the economic consequences of design education, whilst not emphasizing the benefits to the individual. It must not be assumed that the role of design education, and similar educational concepts, exist primarily to help industry. The Organisation For Economic Co-Operation And Development (OECD) (1981) indicates that the role of education is multiple. "It must advance the causes of theory, concept forming, and science as well as those of social relevance and vocational skills" (p. 78). The function, or rationale of design education is discussed later in the chapter.
1.3 Literature Review.

Design education is a comparatively recent educational concept and the scope of the literature available in the area is limited. The recurrent topics in the literature form the basic themes for this review. To understand the issues within design education it is necessary to first have a distinct understanding of design education's definitions and distinctions. The reasons for the development of design education will then be discussed. Following this discussion, an examination of the features and theoretical constructs that make design education attractive as an educational activity will be conducted. Finally, the manner in which the literature relates to the specific research questions will be explored.

The literature on which this review is focussed consists of all relevant books and reports, but the majority of the journal articles are from 1986 on. The journal articles are restricted because the latest issues are the most relevant. The year of 1986 was an arbitrary mark, but the literature published in journals since this time is considered to accurately represent the literature in general.
Definitions and Distinctions

The concept of design education revolves around design. The Schools Council Design and Craft Education Project [Schools Council] (1974) believes design is not applied decoration, or entirely problem solving; it is not investigation, or drawing and model making. The Schools Council’s belief is that each of these factors is one aspect or component of "a whole" (p. 9). That whole is known as design. According to Adams (1989), design is the way we shape and control our environment. Jones (1970) elaborates by implying design is the way we initiate change in "man-made things" (p. 4). Mattick (1987) reinforces both views by saying design "relates to the ordering and formation of the made world" (p. 6). The above definitions indicate that design is the way we influence and organize the made environment.

When discussing design in the practical subject areas (i.e. Industrial Arts), it is necessary to recognize its relationship with another element, technology. In the English educational system this is reflected in the titles of the practical subjects (i.e. Design and Technology or Craft, Design and Technology). The Working Group on Design and Technology (1988) states clearly that there is an "...intimate connection between design and technology" (p. 7). According to Dodd (1978), there have been misunderstandings over the definition of technology and these were probably caused by
people confusing segments of technology with the overall concept (e.g. advanced technology and computer technology). A sound universal definition is offered by Goetsch and Nelson (1987), who imply that technology is people's use of tools, resources, and processes to solve problems or to extend their capabilities. A definition developed by Scriven, Genoni, and Whisson (1987) for Australian education shows Technology is "the systematic process of design, manufacture, maintenance, and improvement of artefacts and the artefacts themselves" (p. 3). Mattick (1987) sums up the intimacy between design and technology by saying "...technology changes through design" (p. 9).

If design is the initiating of change in made objects, what is design education? According to Kimbell (1982), design education is making children think (i.e. recognise and solve problems) in the context of materials and tools. Archer and Roberts (1979) elaborate when implying, design education is not only concerned with the attainment of a result but also with the development of the pupil's knowledge and understanding. Arden (1987) presents a slightly different view by showing design education to be the providing of an environment in which students are exposed to a wide range of issues, which in turn generate questions requiring answers. Arden goes on to say these questions are finite and answerable whilst the answers are infinite. Ayleward (1976) proffers a brief overview of design education as being the educational use of the act of designing
in order to understand society better. To summarize these differing points of view, design education is the providing of an educational environment where the act of designing is used to develop student's ability to identify and solve specific problems in an internal and practical manner.

The Schools Council (1974) illustrates the fact that the activity of design follows a common pattern. The Schools Council believes this indicates that the overall pattern of events and the considerations applied to a design problem are similar, regardless of the particular field of design. This standard pattern of design is known as the design process. When the stages of the design process are cited in literature on design education they are mostly of a similar format. Finney and Fowler (1986) succinctly state the steps as: (a) the design brief, what is intended to design and make; (b) research and ideas; (c) development of chosen ideas; (d) a working drawing and planning procedure; (e) realisation or making; (f) evaluation of the solution. The Schools Council (1974, p.12) presents a diagrammatic representation of the design process. The Schools Council emphasizes that the design process is not an inflexible linear programme that any description or diagram tends to suggest. According to Jones (1970), most design theorists agree that the sequence of the design process can be cycled through many times during the act of designing. Hence, the design process is the cyclical sequence one follows when in the act of designing.
Whilst Mattick (1987) indicates there are certainly points of contact between designing and problem solving, what distinguishes designing from other forms of problem solving? A fundamental difference between design education and other problem solving activities is the focus. According to Mattick, most problem solving activities focus on a given problem but this problem must be clearly defined before the search for a solution can commence. Mattick contrasts this clearly defined problem with the design activity, which instead addresses a perceived need that may consist of a whole set of interrelated problems. Archer and Roberts (1979) show the starting point of the design education activity to be the identification of a need, and this need is then developed through a combination of logical thought and direction influenced by values and attitudes. Archer and Roberts describe design problems as "ill defined" (p. 55). Arden (1987) believes there is little basis for converting need into problems because, if designers were restricted by the requirement to identify a problem many simple needs may be overlooked.

Archer and Roberts (1979) imply that the design process is distinguished from other forms of problem solving activity by the fact that it is generally not possible to determine if the end result is the "correct" or "only" answer (p. 55). However, Archer and Roberts say it must be possible to determine if the finished design is "a proper" or "an acceptable" answer to the requirements (p. 55).
Mattick (1987) indicates that forms of problem solving that do not contain design seek to provide a single solution to a single problem. This solution is often the final solution. Mattick classifies the solutions to design problems as "recursive" (p. 7). The automotive industry is a good example because the automobile is in a continual cycle of design and redesign.

The Major Reasons For The Development Of Design Education

Why was design education developed in the first place? As a concept, Beazley (1984) informs us that design education was developed in the late 1960's in the United Kingdom. Beazley cites the major reasons behind its development as the low academic status of the practical subjects, the strong pressures for a re-examination of curricula in all subjects, and the dramatic changes in the way things were done – that is, new technologies. On the first point of academic status, it would appear that Genoni (1989) agrees, by identifying a "disdain" for the manual activity due to it being regarded as subservient to the higher status "academic" subjects (p. 2). It must be pointed out that this is not Genonis' opinion but rather a perception on the part of others. According to Dodd (1980), "One of the errors of the past has been to equate the activity of making with industrial practice and, as such, it has been accorded lower status within schools" (p. 27). The absence of Industrial Arts
subjects from the Tertiary Entrance Examinations indicates that the element of status is real.

There is much evidence that Beazley's second point about pressures for re-examination of the curricula is a valid one. Dodd (1980) highlights one such element when claiming there is a "mismatch between educational content and industrial/economic need" (p. 26). Powell (1988) agrees by saying the school curriculum should be relevant and meet the needs of both the students, and their parents, and the community. According to Carrick (1988), other countries with rising living standards are achieving more in education than Australia and that the quality of our education at all levels must be put under review, both for whole life and for vocation.

The current competitive academic curriculum has been criticised for attempting to educate all students to a university entrance level, and therefore not addressing the true educational needs of a great many students. This fact is reflected by the W.A. Department of Employment and Training in their latest School Leaver Destination Survey which shows that only 37.2% of school leavers go on to begin higher education on a full time basis. Mobley (1988) implies that it is the same in the United States of America where "87% of today's students will not complete college and in fact, 80% of the jobs in America won't require a college degree" (p. 10).
According to Beazley (1984), there exists "...a situation in which many students experience a curriculum unsuited to their needs or interests and from which they gain little of a positive nature" (p. 44).

The last reason Beazley cited for the development of design education was the dramatic rate of change in society – that is, new technologies. The point has previously been established that technology changes through design. Cook (1987) asserts the benefits of design and technology education in preparing pupils to come to terms with the "real world" (p. 17). Design education is one concept that aims to make education more relevant for today's students.

**The Educational Benefits of Design Education**

Assuming that there is a role for design education, what are the features of design that make it valuable as an educational activity? Cook (1987) points to the "dominant feature" of design education as the bringing together of skills, experience, knowledge, understanding, imagination, and judgement in the execution of a specific task. Churcher (1987) proffers a similar set of qualities when implying that the essence of design education is – original thought; observation; initiative and responsibility; exploration of materials; and realistic problem solving. The Working Group on Design and Technology (1988) believe these special characteristics of
Design enable pupils to learn to operate effectively and creatively in the "made world" (p. 7). They go on to say that this capability involves pupils in "making judgements of many kinds - technical, economic, social aesthetic, and others" (p. 7). Adams (1989) sums up the features of design as an educational activity when indicating design is a means of encouraging pupils to think, to understand, and to take action.

When looking at features that distinguish concepts like design education, it is necessary to identify any theories that may apply to the concept. Archer and Roberts (1979) suggest cognitive modelling is the core of learning-through-design. Archer and Roberts refer to cognitive modelling as the "existence in man of a distinctive capacity of mind" (p. 55). Adams (1989) concurs by classifying cognitive modelling as a "...particular aspect of intelligence" (p. 11). Adams, Archer and Roberts agree that cognitive modelling is the ability of humans to form images in our minds of things and systems as they are, or as they might be. According to Archer and Roberts, the strength of cognitive modelling is the way it can shed light on difficult problems through the use of "...all sorts of schemata drawn from the agent's (pupil's) experience no matter how logically improbable" (p. 55). Adams suggests that cognitive modelling is simply using all our knowledge and experience to mentally develop possible solutions to a 'problem'.
Archer and Roberts (1979) believe cognitive modelling is analogous with language capacity and mathematical capacity. Adams (1989) clarifies this analogy by explaining that the capacity for cognitive modelling is not confined to the professional designer, but is one that everyone possesses. Because pupils have the capacity to develop cognitive modelling Adams believes the onus is on educators to "...help create the experience and situations, to introduce the concepts, skills, and methods that will enable our pupils to develop this particular aspect of human intelligence" (p.11).

Another theory that applies to design education is Bloom's taxonomy of cognitive objectives (Bloom, Englehart, Furst, Hill, Krathwohl, 1956). Gage and Berliner (1984) describe Bloom's taxonomy as an attempt to bring some form of order into what teachers say they want their students to learn. Bloom's taxonomy identifies six major areas within which, cognitive objectives may be classified. The lowest level of cognitive objective is knowledge. The objectives then increase in complexity through comprehension, application, analysis, and synthesis up to the highest level of cognitive objective, evaluation. The relevance of this to design education is highlighted by Jones (1970) when he makes the assertion that, one of the most common observations about design, "...upon which many writers agree, is that it includes the three essential stages of analysis, synthesis, and evaluation" (p. 63). Mattick (1987) concurs with Jones' observations that design requires
the use of a number of higher order skills, such as "...analysis, application, evaluation, and so on" (p. 6). Gage and Berliner stress the need for teachers in all subject areas, to concentrate on the higher level cognitive objectives.

The Relationship Between The Research Questions And The Literature

The review of the literature, has to this point, discussed the major issues that appear within the literature. But what does the literature say about the specific issues raised in the research questions? The research questions are concerned only with design education in Western Australia which the literature does not mention in any form. The literature does, however, touch upon some of the issues the research questions raise as they relate to other education systems in other countries and other states of Australia. These issues will be discussed as they may provide a means of comparison between what is known and what will be 'discovered'.

Research question one aims firstly to determine if design education is taught in lower secondary school Industrial Arts units. Within Australia, Lucas (1986) and the Winter Design School (1987) both indicate that design education has become an integral part of Industrial Arts education in New South Wales.
The Winter Design School believes that design is seen as an essential component of the Industrial Arts "...process of design, planning, and construction of any product" (p. 10). Correspondence with education departments in the other states of Australia resulted in South Australia and Tasmania both replying that design was an integral component of their respective practical education areas. Tasmania has established a Technology Education Project and they have retitled their Industrial (Manual) Arts area – Materials, Design, and Technology. The indications are that design education is used in at least three states of Australia other than Western Australia.

Design education in American secondary schools receives no exposure in the literature. Mobley (1988) does, however, show that "...industrial arts, vocational, and technology programs are being cut in favour of scholastic programs" (p. 10).

In the United Kingdom, the situation is the reverse. According to Cook (1987), design education is taught extensively under the subject area of Craft, Design, and Technology; the equivalent of Industrial Arts in Australia. The Department of Education and Science – Welsh Office (1988) indicates a wider application through the assertion that most primary and secondary schools provide some design and technology activities. Standen (1986) outlines The Design Dimension Project, a national curriculum development project that
aims to establish design education as a 'central concern' of primary and secondary education. The literature leaves one in no doubt that design education is used extensively in the United Kingdom.

As for the success of Design education in the United Kingdom, Cook (1987) reveals that Craft, Design, and Technology has variable acceptance throughout the United Kingdom. Cook also makes the point that even when the design approach is followed, it is still necessary to "...cater for the less innovative problem solver" (p. 18).

Research question one also aims to determine 'how' design education is taught in lower secondary school Industrial Arts units in Western Australia. The literature provides no insight into how design education is used in Australia or the United States. There is a little more available on the United Kingdom. Cook (1987) emphasizes a major issue within design education by showing that it can be included in the programmes of one or more of the following departments: Craft, Design, and Technology; Art and Design; Home Economics; and Environmental Education. The Department of Education and Science – Welsh Office (1988) agrees by intimating that design and technology "goes across the curriculum, drawing on and linking in with a wide range of subjects" (p. 7). Design and technology has been referred to as a multi disciplinary activity.
Other general observations on how design education is presented include that by Cook (1987), who places the emphasis of design education on solving problems, designing, and making. Cook goes on to say that whilst the traditional hand skills are not ignored, they have become the "tools of the subject rather than the purpose" (p. 18). Gibbs (1989) agrees with this last point by revealing that practical assessment is being reduced to as little as thirty percent of the final mark. Gibbs reveals a suspicion that Craft, Design, and Technology may become simply Design and Technology with schools offering one "mega subject" rather than a selection of "specialisms" (p. 772). Another observation Cook makes is that the most demanding task in design education is evaluating the final solution against the original need. Whilst these points do not give an in depth view of how design education may be presented, they do give an idea of a few of the factors involved.

The second research question also deals with two issues. One of these is concerned with teacher training in relation to design education. According to Cook (1987), probably the biggest hurdle to the progress of Craft, Design, and Technology has been the radical nature of the shift for teachers from "fine craftsmanship to design and make" (p. 18). Cook (1987) indicates that teachers have been trained to reproduce high craft standards. However, their understanding of design is often hindered by its variety of meanings, with teachers often experiencing frustration and displaying
rejection. The Department of Education and Science/Welsh Office (1988) indicate that a "...considerable in-service training" (p. 7) programme for teachers of Design and Technology is likely to be needed. Standen (1986) reinforces this need for in-service training to focus on learning activities and teaching strategies appropriate for design education. The Winter Design school (1987) implies that Industrial Arts should continually link its endeavours to the real world of industry, and in servicing of teachers must involve professionals from industry. They claim that Industrial Arts teachers can no longer in-service within their own ranks if they are to stay abreast with technology and its application. If teachers are to teach design education effectively they require specialist training.

The second research question also aims to determine teachers' perceptions of certain issues considered integral to the introduction of design education. These issues are specific to this study and Western Australian Industrial Arts education, and as such are not addressed in the literature.

The purpose of this literature review was to explain what the major issues are within the concept of design education and to relate the literature, where possible, with the research questions. To summarize, it is necessary to look at the major issues that were addressed. As the term design education, and the associated key terms, seem to experience a nebulous quality of definition this
presented itself as a logical starting point. Definitions for the key terms were discussed and developed and the distinctions and relationships of these key terms and concepts were also identified.

The review was then focused on the forces that motivated the development of the design education concept in the late 1960's. The review of more recent literature provides evidence that these issues are still behind the 'push' for design and technology education. The features and theoretical constructs which make design education attractive and viable as an educational activity, were then examined. The final issue to be addressed was the way the literature could be linked to the research questions. Certain aspects of the literature were related to the research questions, but since this study is a situation specific, descriptive study, the correlation between it and the literature is, by nature, small.
chapter 2: THE RESEARCH DESIGN

This chapter describes the methodology employed for the research project, and the identification of the population to whom the study applies. The components of the methodology are the instrumentation, data collection procedure, data analysis, and the statistical treatment of the data. Discussion of the population involves sample size and sample selection criteria. This was a descriptive study because it intended to identify and describe the nature of existing phenomena, and as such, there were no hypotheses.

2.1 Method

For this study the most commonly used method in educational research, the survey, was used to gather data. The suitability of the survey method for this study was not only its ability to provide the required descriptive data, but also it allowed access to a population that was scattered throughout Western Australia. A postal questionnaire (see instrumentation) was used to collect the data because although only a sample was used it allowed access to the entire population, and was physically and financially most viable. There are limitations to the postal questionnaire, especially its inability to allow any questioning of a respondent to obtain added
information. To offset this limitation a follow-up personal interview of a sample of the respondents was conducted.

2.2 Population

The population for this study is all the Industrial (Manual) Arts teachers in government secondary schools who teach lower secondary school Industrial Arts units (i.e., years 8, 9, and 10). It is emphasized that the population only includes teachers in secondary schools, because there are primary schools that have secondary 'tops', which means they accommodate some secondary students. There are few of these students in Western Australian schools and their number would have a minimal effect on the results of this study.

The population consists of approximately 580 teachers in 146 schools throughout Western Australia, and is comprised of country and metropolitan Senior High Schools, High Schools, and District High Schools. To minimize any bias that may exist within any one category, information was collected from the different categories of secondary schools using stratified random sampling. Within several of the strata there are subgroups. The Senior High Schools are divided into two categories – Group A, predominantly comprised of metropolitan schools; and Group B, which consists mainly of country schools. The District High Schools are divided into two categories,
Class One and Class two, these being predominantly country schools. The High Schools, those secondary schools that only go up to Year 10, are not categorised in subgroups. The identification of these different subgroups was important because the number of schools selected from each stratum was relative to the total number of schools within that stratum.

In selection of the sample, a procedure referred to as 'sampling through an intermediate unit' (Wiersma, 1975) was used. The school was the intermediate unit and it was comprised of primary units, the teachers. This procedure indicates that whilst the intermediate unit is a stratified sample, the primary unit is a random sample.

When determining an adequate sample size it was necessary to first determine how many schools would be required, and secondly, how many teachers within each school would be sampled. A sample size of 25 schools was considered more than adequate to provide a fair representation of the total population. When calculated on a 'percentage of total schools' basis, this resulted in the selection of: 11 Group A Senior High Schools; 5 Group B Senior High Schools; 4 Class One District High Schools; 4 Class Two District High Schools; and 1 High School. These final figures had been adjusted slightly to give a balanced representation of country and metropolitan schools.
Two teachers from each school were sampled. This sample size eliminated the possibility of the larger schools having too great an influence on the results. The choice of teachers was made by the senior teacher who was asked to select those teachers with the largest lower school component in their timetable. Because of the different possible forms of relationships between teachers and senior teachers, the issue of bias was recognized. However, due to the nature of the postal questionnaire it was necessary to delegate the responsibility, and the senior teacher was the logical choice. It was not considered that any bias on the part of the senior teacher would be a significant factor. As the researcher had no input into the selection of the individual respondents, it can be regarded as a random sample. It was recognized that some of the smaller District High Schools may only have one Industrial Arts teacher, and allowance was made for this by making the sample larger than was considered necessary to achieve a significant result.

2.3 Instrumentation

As indicated, the instrument used to collect the data was a self-completion postal questionnaire. The questionnaire was structured according to the four components of the two research questions and commenced by determining 'if' design was taught, then proceeded to identify 'how' it was taught. It then endeavoured to ascertain teachers' perceptions of elements related to design education, and
finally, addressed the issue of teacher training and teacher in-
servicing and how it may affect the use of design education.

The questionnaire was comprised of 26 questions; 24
structured, 'choose an alternative' type questions, and 2 open ended
questions. The first of the open ended questions sought teachers'
opinions on a specific issue within design education. The second
open ended question, which was the last question, asked for any
comment teachers may wish to make about design education. This
mix of structured and non structured questions was intended to
overcome some limitations of the questionnaire as an instrument.
The limited nature of the structured responses, and the
standardization of data from the non structured items were areas of
concern, and it was intended that the combination of item types
would help to offset this.

The completed instrument was pretested on a pilot group of 18
Industrial Arts teachers undertaking post graduate studies, and two
Industrial Arts lecturers. This group was suitable for testing the
instrument because it consisted mainly of individuals currently
teaching Industrial Arts in government schools. The aim of the
pretest was to identify any ambiguous or nebulous items and to
initiate the process of establishing validity and reliability. The
objectives of the study were explained to the pilot group and they
were given approximately 20 minutes to complete the questionnaire.
Completion of the questionnaire was immediately followed by a review of the instrument with the pilot group. The response was positive and the main criticism of the instrument was that some items required an extra answer option. The pilot group was specifically asked if they experienced any misunderstanding about the meaning of any of the questions. Not one of the group admitted experiencing any confusion. The general consensus was, that given the natural constraints of a postal questionnaire, the instrument adequately addressed the research questions.

Accompanying the questionnaire was a cover letter explaining the aims of the study and outlining the manner in which the anonymity and confidentiality of the individual respondent was guaranteed (see Data Collection). The cover letter was approved and signed by Industrial Arts lecturer Joe Hegney, giving the study greater impact and credibility. Also accompanying the questionnaire was a model of the design process, extracted from Fowler and Finney (1985). This model is the most common form of the design process and was included so the respondents could compare their own interpretation with this common version. Whilst it was possible that the inclusion of this model could be construed as an attempt to influence respondents, it was also essential that they understood what was meant by the term 'design process'. It was not feasible to gauge, prior to the study, what each individual's perception of the design process was.
The validity and reliability factors were further addressed by applying an external criterion. This criterion was an interview to follow up the questionnaire, and was administered by the researcher to a sample of the original respondents. The objectives of the interview were to: (a) establish reliability by replicating the results for the research questions; (b) validate the initial instrument by displaying that it measured what it was intended to measure; (c) to probe several issues in more depth.

The interview was structured into five, distinct areas. The first area asked the respondent for any general comments on the questionnaire and if difficulty had been experienced with any of the items in the questionnaire. The other four areas of the interview related specifically to the four components of the research questions. The area of teacher perceptions is the only area in the interview that deviated in any way from the equivalent section in the questionnaire. This was due to comments made by the respondents in the open ended questions, requiring more in depth examination.

An initial sample size of five teachers from the original sample was considered large enough. If the responses from this sample were all reasonably consistent, as they proved to be, it was thought unnecessary to keep replicating the same results. If the results from the interviews had been inconsistent then the interview sample size
would have been increased. Because the initial respondents to the questionnaire were spread across Western Australia it was not possible to personally interview a true random sample. As a compromise, four respondents were selected and interviewed from a random sample of all the metropolitan schools, and one respondent from the country was interviewed by telephone.

When formulating and conducting the interviews the researcher was aware of the issue of interviewer bias. The interview comprised mainly of structured questions. These questions were objective and did not 'lead' the respondent. Any 'probing' of the respondent was conducted in a manner not intended to prompt a specific type of answer. Because the interviews were conducted within a day of each other, and all by the researcher, there was no variation between the manner in which the interviews were presented and the way the responses were recorded. The metropolitan interviews were conducted at the respondent's schools.

2.4 Data Collection

The questionnaires for the metropolitan area were distributed personally, and those for the country were posted. Each participating school received two questionnaires and a postage paid, return addressed envelope. The envelope was intended to elicit returns and ensure anonymity. All respondents had been assured
anonymity and confidentiality, hence, questionnaires and envelopes did not contain any distinguishing marks. There was one item within the questionnaire that identified the type of secondary school the respondent was from, but this was the only hint of identification. The offer was made to the participants that if they would like a summarized version of the study, they should indicate to the researcher the school to which it could be sent. This would in no way jeopardize the confidentiality of the respondent. A reminder letter was sent to participants two weeks after the initial posting of the questionnaire.

The issue of non-reponse can be a problem with postal questionnaires. From the initial sample size of 50, 36 completed and 6 blank questionnaires were received. In the discussion on sample size, it was stated that the sample was made larger than considered necessary to compensate for the fact that some of the smaller District High Schools may only have one Industrial Arts teacher at the time of testing. This accounted for four blank returns. The other two blank questionnaires were returned from Goomalling, because the school had changed from the status of District High School to Primary School in March 1989 and did not have an Industrial Arts teacher. In essence this represented a return rate of 84% and was believed to be adequate.
As previously outlined, the data from the follow up interview was collected personally by the researcher. It was recorded in note form and was written in more detail immediately after the interview.

2.5 Data Analysis

The data was collected to provide descriptive statistics about the whole population upon which this study focussed. To develop these statistics the data was divided into two distinct types, that from structured questions and that from open or non-structured questions. The data from the structured questions was analysed to determine frequency of response and to determine relationships between certain elements. The data from the open questions was analysed and classified into common themes. When the data was analysed, certain inadequacies within the measurement instrument emerged, and these will be identified and explained in this section and in the section reporting the findings.

All the structured items in the questionnaire were analysed to determine the frequency with which responses were given to the alternative answers. The statistical treatment applied to the frequency of responses was the identification of the modal class for each range of alternative answers. The mode was chosen as the measure of central tendency because, the aim of the statistical
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analysis was to identify the most frequent response to particular questions. The data was tabulated using a frequency distribution table, or summary chart, and was aided by the structured questions being ranked mainly on ordinal scales with the remainder rated as nominal scales. After the completion of the frequency distribution summary chart, a questionnaire analysis computer programme called Lertap, became available. The responses to answers were 'fed' into Lertap and the programme calculated the frequencies, in both straight numerical terms and percentages. The use of Lertap not only enabled the previously tabulated data to be validated, but allowed other statistical treatment to be conducted on the data.

Whilst the identification of the modal class satisfied the requirements of the first research question, the first part of the second research question required a different treatment. To assess if teacher training is a determinant in the use of design education, it was necessary to compare the responses from the different categories of teacher training. Item 22 of the questionnaire asked teachers if they were two year trained; three year trained; four year trained; or 'other'. The first three categories relate to the manner in which the Ministry of Education classifies teachers for rate of payment. The fourth category was included to 'catch' any teacher that did not qualify for the first three, but the number that may fall into this category was believed to be small. Using the four categories of item
22, a cross tabulation of teachers' responses was conducted with Lertap.

Through analysis of item 22 of the questionnaire and the follow up interview, it was perceived that the categories of teacher training may be seen to be inadequate. Within each category there appeared to be variations. It was not within the scope of this study to identify or evaluate the variations, and a more in depth study into teacher training in Industrial Arts may be warranted. For the descriptive purposes of this study the chosen categories were seen to suffice.

It was initially intended to conduct a chi square "...test of independence" (Best, 1981, p. 287) to test if the observed frequency distribution had occurred by chance. However, it was not possible to conduct the chi square test because too many cells in the contingency table had low values. This was partially because two of the teacher training categories had only three respondents each, out of a total of 36 respondents. The 'rules' for low cell numbers are nebulous, but Best (1981) believes there should be no cell with a number less than 10, and Light (1973) indicates that no cell should have a number less than one. A 'rule of thumb' appears to be, that there should be no more than 20% of cells with a frequency of less than 5.
There is a correction for continuity, known as Yates' Correction for Continuity, but this is most appropriate with 2x2 contingency tables, of which the majority of the items in the questionnaire are not. Light suggests "... that little is gained by using the correction" (p. 325). Even though the independence of the response frequencies of the cross tabulation can not be tested, the data that was collected is fact, and is presented with a cautionary note that the element of chance has not been calculated.

Item 21 related to the institution(s) in which teachers undertook their teacher training. Through a cross tabulation of this item, the aim was to identify any relationship between the teacher's training institution and the teacher's use of design education in lower school. However, one of the two Industrial Arts teacher training institutions in Western Australia, CURTIN University, was not represented in the random sample by any respondent who had undergone their complete teacher training there. Even though some respondents had completed certain components of their qualification at CURTIN, and certain components elsewhere, the scope of this study does not allow the calculation of the role the individual institution may have played in this respondent's use of design education. Due to the absence of a solely CURTIN trained respondent, it is not possible for this study to draw any conclusions about the relationship between the institution in which a teacher
underwent their teacher training, and the teacher's use of design education in lower school Industrial Arts units.

The majority of the questions in the questionnaire were structured; and even though there were only two open ended questions, the data they contributed was considerable. The data collected from the open ended questions in the follow-up interview was also invaluable in validating and clarifying the questionnaire's data. There was a large quantity of data collected from these two sources and the analysis of it required the sorting of the data into groups with common themes. To sort the data it was first read then recorded in note form. The notes were then read again and common themes were identified. Because all the information concerned the same 'narrow' topic, it was possible to reduce the common themes to a small number. The headings for the common themes, and the associated data were then stored away for several weeks.

When the data from the non structured questions was looked at again, the process of reading and identifying of common themes was repeated. The notes were also presented to an Industrial Arts colleague for grouping into common areas. The sets of headings were then compared for uniformity. They were common in most aspects. This data was used to support and expand the information from the structured questions, and the data from the questionnaire's
open ended responses could be reproduced verbatim as they had been written by the respondent and not recorded by an interviewer.

The analysis of the large quantity of information collected from structured items in this study centred around the tabulating of frequencies of response for identification of the modal class, and the cross tabulation of one item for identification of possible correlations. It also required the sorting of large quantities of information collected from open or non-structured items into common and legitimate groups. There have been several elements mentioned that prevented some intended data analysis, these were generally out of the control of the researcher and do not significantly affect the outcome of the study. These elements will be discussed in more depth later in this document.
The first results to be discussed reveal whether or not design is taught in lower secondary school. How design is taught is discussed next, along with the factors that determine the manner in which design is presented in lower school. The measurement of the effect teacher training has on the use of design education in lower school was affected by certain statistical factors, but the factual data still allows certain observations to be made about the relationship. Finally, questions were asked of the teachers in an attempt to ascertain their perceptions of major issues related to design education. The issues in these questions were joined by others that teachers raised in their responses to the open ended questions. The results are derived from the initial questionnaire, and are clarified and expanded by the follow-up interview. Unless otherwise stated, comments from the questionnaires are the source of all quotations in this chapter. Discussion about these results will be presented in chapter 4.
3.1 Is Design Taught In Lower Secondary School Industrial Arts Units?

When asked if they teach the design process in lower secondary school Industrial Arts units, 47% of respondents replied 'sometimes', 36% replied 'seldom', 8.5% responded 'all the time' and 8.5% 'never'. In the follow-up interview the five participants all said they did not teach the design process to a whole class, but did allow certain advanced students to choose and design projects. This small segment of students were often given individual instruction on the design process. The remainder of the class did, however, receive exposure to design in some form. When the questionnaire asked respondents for any comment relating to design education, 25% mentioned that design was not taught as such, but was a part of the student's work. The data indicates that design is present in student's work in lower school, but is not widely taught as a structured process.

The participants were asked if, when they teach the design process, they present it to all years in lower school. Thirty-six percent responded that they teach the design process to all years in lower school; 25% replied that they teach it in year 10 only; 16% said they teach it to both years 9 and 10; and 19% replied that they did not teach the design process at all. The respondents to the follow-up interview indicated that when the design process was
implemented with students, it was done with all year groups. Only one of these respondents said he confined it to only years 9 and 10. The respondents also indicated that the parameters broadened as the students progressed. It is necessary to remember, however, that the design process is taught only to a small group of more capable students.

The implementation of the design process in a unit occurred at differing stages. When asked at what stage the design process was introduced: 14% replied at the beginning; 11% responded in the middle; 55% said it varied; and 14% did not introduce it at all. These figures indicate that there is no uniformity as to when the design process is introduced in a unit, possibly because of the limited number of students who receive instruction in the design process.

What are the reasons for the limited application of design education in lower secondary school Industrial Arts units? As these reasons are teachers' own opinions and perceptions the more recurrent themes will be highlighted here, and then pursued further in the discussion of the results of teacher's perceptions. The participants were asked to identify three elements they considered barriers to the introduction of design education. The predominant themes from their responses were: the student's level of skill; the lack of available time; student attitude, enthusiasm, and
motivation. The following quotations from the questionnaires exemplify the responses relating to the three themes.

"Generally the level of design skills of lower school students is very limited because they have very limited understanding of the limitations of materials and constructional procedures".

"...many of them [students] are very poor at drawing and unable to visualise a completed article".

"With the limited time in lower secondary units design must give way to completion of set unit objectives".

"Many students see Manual Arts as a doing subject and have great difficulties with the design components and see them as too drawn out and long winded".

Other reasons cited as barriers to the introduction of design education were: teacher expertise and enthusiasm; lack of resources and facilities; class numbers; lack of commitment by the Ministry; and the Unit Curriculum.

To determine the degree to which teachers, other than those sampled, taught the design process, the participants were asked how many teachers they thought presented the design process in lower school. Thirty-six percent replied that 'most' teachers taught the design process and 36% replied that 'few' taught it, with the remaining 18% divided equally between 'all' and 'no' teachers. To clarify this point, the respondents in the follow-up interview were asked how the other teachers in their schools presented design education compared with themselves. Four of the five respondents believed the other teachers in their school presented design in a
similar manner to the way they did, whilst the fifth respondent said the other teachers in his school were less design conscious than himself. Taking the more in depth probing of the follow-up interview as a guide, the indications are that a great percentage of lower school teachers present design in a fashion similar to that outlined earlier.

**Summary**

The results show that the design process is taught, but only as such to a few more able students. However, design is often a component of student work. When the design process is taught it is more often taught to years 9 and 10 than to year 8's, and there is no one particular stage of a unit at which the design process is introduced. On the basis of the sample it appears probable that teachers in government schools, other than those participating in this study, present design in a similar fashion.
3.2 How Is Design Taught In Lower Secondary School Industrial Arts Units?

In the initial questionnaire the focus for design education was the design process. It has been shown, however, that the design process is taught to only a small percentage of students in lower secondary school Industrial Arts units. The results relating to how the design process is taught will be described, and then the most common form of design inclusion in lower school units also will be discussed.

The respondents were asked how they presented the design process compared with the model provided (see Appendices). Presenting it in a similar form were 64%; 22% said it was not applicable; 8% used a different form, and 6% presented it in the same form. When asked what stage(s) of the design process they employed differed from the model provided, 64% did not reply. This percentage equated exactly with those respondents who said they used a model that was similar, or the same as the model provided. It therefore is possible that the reason for non response was that there was no obvious difference between the stages of the employed model used and the example model, and because the alternative answers did not include such an option. Of those participants who did respond to the question: 8 differed in the "development of chosen ideas" stage; 6 in the "research and ideas" stage; and 6 in the
"working drawing and planning procedure" stage. Respondents often differed in more than one stage.

To determine how design education is taught to lower school students it is necessary to identify if teachers believe resources and guidelines are available to them. Participants were asked if there are specific resources provided by the Ministry to aid the teaching of the design process in lower secondary school Industrial Arts units. Seventy-two percent of respondents answered no, 25% replied yes, and there was one non-response. They were then asked if there had been specific objectives given for design education – 86% replied no, 11% replied yes, and there was one non-response. The participants were also asked if they had received resources for design education from any source other than the Ministry. Seventy-two percent replied no and 27% replied yes. Of the 10 respondents who replied yes, five said they had received resources from another education system, two indicated they had received resources from industry, one said the resources came from another government organization, and two indicated that neither of these categories was applicable to the source of their non-Ministry resources.

One last question was posed regarding the availability to Industrial Arts teachers of resources and associated information relating to the teaching of design education. This question asked participants for the origin of programmes they used that included
the design process. Fifty-five percent said the programmes they used were their own; 17% said they were the schools; 5% indicated they were from another source, and 19% said the question was not applicable.

The results indicate that the design process, when taught, is presented in a form similar to the model that accompanied the questionnaire, and programmes that include the design process are generally developed by the person using it. The results also indicate that the majority of teachers believe there are not specific resources and objectives available for the teaching of design education.

How is design most commonly implemented in lower secondary school Industrial Arts units? All the respondents in the follow-up interview said the way they incorporated design into their units was to offer design choices to students. They said the choices students were given related mainly to dimensions, shape, and materials. A typical example is when students are given a specific project, and one of the requirements of the project is to design the size and shape of one particular component. It was indicated that these choices were simple in the early units of a subject area, and became more complex as the students acquired more expertise and competence. It was stated earlier that 25% of respondents to the questionnaire, when asked for any comment relating to design education, mentioned that design was included as a component of student work.
The following quotations from the questionnaires illustrate the way design is included in lower school Industrial Arts units.

"I generally allow some modification of parts of models and just allow a simple sketch with basic sizes to be done".

"Rather than totally designing a project why not allow students to design part of a project".

Summary

The responses to the follow-up interviews and the unsolicited comments from the questionnaires, show that design is generally incorporated into lower school Industrial Arts units by allowing students certain design choices and considerations, with the majority of students not undertaking any major design projects. However, when the design process was used, it was implemented in a form similar to the example model provided. The participants in the study believed there were very few resources and guidelines on design education available to them, and teachers used either their own or their school's programmes.

3.3 Is Teacher Training A Significant Determinant In The Teaching Of Design Education In Lower Secondary School Industrial Arts Units?

In chapter 2, under the heading of data analysis, there were inadequacies identified in the data relating to this research question. In two of the categories of teacher training there were only
three respondents, which made the results for these categories unreliable. These two categories were for teachers that are classified as two-year trained, and for teachers that fall outside the classification of two, three, or four year trained. It was anticipated that these two groups would be the minorities. However, their low numbers make them statistically invalid.

The data for the other two categories was checked to see if there were any large differences in their responses. There was only one item that showed any statistically significant difference. This item asked participants if they thought more emphasis on the design process would enhance the subject area of Industrial Arts. Of the four-year trained teachers, 35% replied "definitely", whilst not one three-year trained teacher chose this option. The remaining responses were more evenly distributed across the other answer options. This item will be dealt with in more detail when discussing the results for teacher perceptions.

In an endeavour to identify any common trend in the relationship between teacher training and design education use, the participants in the follow-up interview (even though having undergone a variety of teacher training) were asked if their teacher training influenced their use of design education. In essence, they all said no. Four of the five respondents said they had received a moderate amount of instruction on design, and the fifth had a trade
background with a strong design link. All respondents said that whilst they had not received instruction on how to teach design, they had acquired a sound background to design that gave them confidence to introduce design as a component of Industrial Arts instruction. However, they all agreed that even though they had been prepared to teach design, due to a variety of reasons (most of which have already been identified), they generally do not.

One other element that relates to the training of teachers to teach design education was the use of teacher in-service training. The questionnaire asked participants if they had ever received in-service training on the design process: 78% replied "no" and 22% replied "yes". They were then asked if they thought specialized in-service training in design education would be beneficial. Thirty-nine percent said "definitely"; 39% replied "possibly"; 19% said "doubtful", and 3% said "no". These results show that whilst the majority of respondents had not undergone in-servicing in design education, they believed it would be beneficial to them as prospective teachers of design.

Summary

The results from the follow-up interview and the factual data from the questionnaire, suggest that teacher training is not a significant determinant in the use of design education in lower secondary school Industrial Arts units.
3.4 Teachers' Perceptions Of Major Issues Relating To Design Education In Lower Secondary School Industrial Arts Units.

The term "perception" in the context of this study is defined as "understanding" or "awareness" (Johnston, 1976, p. 580). When one expresses one's perception of something it is generally expressed as an opinion. Opinion is defined as "what one thinks about something" (Johnston, p. 547). One's perception of something can be influenced by a multitude of factors, and in the case of this study there is one such factor that requires identification. When this study was being conducted the state school teachers, through their union, the State School Teachers Union, undertook their first industrial action in 20 years. What effect this action may have had on the opinions expressed by the teachers is not known, but it is recognized that the industrial action, and the emotions that accompanied it, could have had some effect.

Teachers' perceptions were expressed in two ways. The first was in the form of structured questions in the questionnaire which related to issues believed to be important to the implementation of design education in lower secondary school Industrial Arts units. The second form in which teachers' perceptions were expressed, was in the open questions. The results from the structured questions,
supplemented by the relevant comments from the open questions, will be presented first.

3.4.1 Results From The Structured Questions.

To help identify if changes are needed to existing resources and facilities, the participants were asked if they thought it possible to include the design process in their current lower school units. Whilst 86% of respondents thought it was possible: 25% believed there were no changes necessary; 17% indicated minor alterations were required, and 44% thought major alterations were necessary. Participants were then asked if it were possible for the design process to be taught in their present workshop organization. Thirty-nine percent replied yes; 30% said yes but it required minor alterations; 31% replied yes but with major alterations. There were no respondents who thought it impossible to teach design in their current workshops.

Design education requires instruction in two very different processes, drawing and manufacture. When asked if this could create an organizational problem, 25% of respondents replied no; 28% said it would create a minor problem; 28% said it would create a significant problem, and 19% believed it would definitely create a problem. The respondents were then asked to outline reasons why this could create organizational problems. The dominant reasons
offered, were the availability of suitable facilities when required, and the incompatibility of drawing and manufacturing in the one room.

Assessment is a major element of education, and design education is no exception. The questionnaire asked respondents – considering that the design process includes drawing, planning, making, and student evaluation, would this be difficult to assess. Fifty-eight percent believed it would not; 8% thought there would be only slight difficulty; 17% said there would be a fair degree of difficulty, and 17% said it would be difficult to assess.

The participants were then asked what they considered the amount of preparation would be, compared with units currently operating. Only 8% believed there would be no increase while 19% thought the increase would be minor, 47% said the increase would be moderate and 25% said it would mean a major increase. The point was made by one of the respondents in the follow-up interview, that there were no ‘ready made’ resources for design education, and if a teacher did want to teach design in its full form, there would be a tremendous amount of work needed before a class could be taken.

As a component of design education, it is necessary for students to do some research into the need (problem) that is being addressed, and this may involve students making enquiries in their own time.
When participants were asked what they thought student response might be towards conducting minor research in their own time, they responded thus: 8% said students would react with enthusiasm; 19% replied their reaction would be indifferent; 58% said students would display reluctance; and 14% believed students would refuse to do research in their own time. These reactions are reflected by the following comment made in a questionnaire.

"Students elect Manual Arts subjects with the object of getting 'hands on' experience. I feel that most of them will object strongly to having even a small portion of that time devoted to design theory, drawing, research etc."

To gauge teachers' opinions of the worth of design education, they were asked if they thought more emphasis on the design process would enhance Industrial Arts. Twenty-two percent said definitely; 42% said possibly; 25% thought it was doubtful, and 11% said no. This indicates that more than half the teachers believe that, design education at least possibly has a role to play in lower school Industrial Arts.

Summary

The majority of respondents believe it is possible to include design education in current units. They also believe it is possible to teach design in the present workshops, but this would require some alterations being made. The combining of drawing and making could create organizational problems, with the main problems being
the availability of suitable facilities when required and the incompatibility of the processes of drawing and making in the one room. Whilst the majority of respondents believed the design process would not be too difficult to assess, they did however, think it would require an increase in preparation. The design process would require students to do some homework, but the majority of respondents believe this would be greeted with a mixture of reluctance and refusal by students. Finally, the majority of respondents indicated that more emphasis on design education could enhance the subject area of Industrial Arts in lower secondary school.

3.4.2 Responses To Non Structured Items

The results in section 3.4 so far have revolved around the structured items from the questionnaire. The remainder of the section will look at the responses to a non structured question that asked respondents to comment on design education in lower secondary school Industrial Arts units. As described in the data analysis section in chapter 2, these responses were grouped according to common themes; these themes will act as headings under which the responses will be discussed. The three common themes identified were: students and design education; teachers and design education; unit curriculum and design education.
Students and Design Education.

A recurring notion expressed by respondents concerned lower school students ability to cope with formal design education. One common response from participants related to the skill level of students. The consensus was that students in lower school did not have adequate skills to cope with design education. One reason was that students had not had the exposure to basic hand and drawing skills, due to their relative inexperience, and the fact that lower school students are doing less Industrial Arts units. One respondent believes:

"It is the exception to find a student who does 2 units/year [sic] in an industrial arts area".

Several respondents expressed the view that students should develop the necessary skills before attempting any work involving the design process. One respondent believed that:

"Students would benefit from being made aware of design from a young age and primary school".

Another reason given for student inability to cope with design education, was that Industrial Arts mainly attracts lower ability students. The following responses are examples of this view.

"Students choosing these subjects are usually of poor academic ability and are trying to avoid theory, paperwork and homework."
"An average ability group would include 25% interested and able to design, 50% apathetic and wanting to make something while learning the skills, and 25% who are either not able to think at a design level, or of such low ability that the time required to guide and stimulate them is simply not available in a normal classroom situation with all the normal duties and short time allocation for each duty".

The reasons given for this concentration of student ability types will be discussed in the unit curriculum section. However, not all teachers feel this is the case within their school. Of the five respondents to the follow-up interview; two said the majority of students in lower school units were in the mid to low academic ability range, and the other three believed they had a cross section of student abilities.

Numerous respondents stated that students elect Industrial Arts units because they prefer the practical aspect of the units. Several of these respondents believed students would not choose Industrial Arts units if design education became a major focus or component of these units. The ensuing quotations typify the comments regarding student preference.

"Students elect M.A. [Manual Arts] subjects with the object of getting 'hands on' experience".

"Students in general come into the room wanting to get away from theory (thinking) and do something!"
The matter of students choosing other units to avoid design education will be discussed in the section on unit curriculum.

Summary

One issue that numerous respondents mentioned, was that students in lower school for one reason or another, had not developed adequate skills to be able to design. It was also felt by some that there was a concentration of lower ability students in Industrial Arts. However, other respondents believed they had a cross section of students in their classes. One other issue that arose was that students preferred the practical aspect of Industrial Arts, and if this practical component were altered then students would not elect these units.

Teachers and Design Education.

Numerous participants indicated that time was a major issue in the implementation of design education. The time factor appears to be related to the unit curriculum, and will be discussed in that section. However, the next comment indicates that it may be a part of an attitude problem.

"I do not believe that teachers have the inclination or the time to in any way risk making more work for themselves or students. Maybe it's an attitude problem?"
Another problem that emerged for teachers, was that of coordinating a group of students with differing abilities. It was felt that this would be difficult with design education, especially if the drawing and the manufacturing were done in different rooms. The following response expresses this difficulty.

"Holding the whole class group together causes major problems in implementation (differing rates of student progress). Some will be designing whilst others are working etc."

As well as the difficulties of coordinating such groups there were concerns expressed about how teachers would supervise groups that were working in two different areas.

The next two quotations highlight issues that are relevant to teachers and design education.

"...any course of design to make inroads into the present courses, must be geared to the other teachers, not just the design zealots!"

"There are many possibilities if teachers are committed to teaching design in a meaningful and realistic manner. To avoid the disastrous effect of failure the teacher must be provided with guidance, assistance and REWARD (not $ [dollars] but recognition)."
Summary

The use of design education is hindered by a shortage of time. The time factor is discussed in the next section, but the point was made that perhaps teachers do not have the time or inclination to risk making more work for themselves. The teacher’s task of coordinating a group that was both designing and manufacturing, maybe in separate rooms, was also considered a potential problem. Other issues that were mentioned, were that any course for design had to be for all teachers and not just the design zealots. It was also considered that there were many possibilities for teachers of design, and they needed encouragement.

The Unit Curriculum and Design Education.

In the structured items of the questionnaire the issue of the unit curriculum was not broached. This omission could be seen as an inadequacy in the instrument. However, the fact that the issue of unitization was raised in the non structured items, and then explored further in the follow-up interview, illustrates that the different elements of the instrumentation were effective. Several participants made comment regarding the limitation of time within the current unit structure. They expressed a concern that the way unitization is structured, with specific objectives, there is not sufficient time to develop concepts like design education.
This concern is reflected in these comments.

"There is not enough time in each unit to really develop design education."

"Full scale design is difficult to incorporate into the existing Unit Curriculum system, because of the availability of time and space."

"With the limited time in lower secondary units design must give way to completion of set unit objectives."

The participants in the follow-up interviews agreed that there was not enough time within the unit structure to cover specific objectives, and to teach additional concepts like design.

The issue of specific unit objectives was also considered a factor by other respondents. The next two responses express similar concerns.

"I do not believe that the concept of design education can be integrated successfully into the present system with its specific objectives as set down."

"Units developed so far contain very little scope for Design Education. In practice students are completing less projects which are smaller than pre unitization. Teachers are locked into covering very specific objectives across a broad curriculum in a short time."

Another issue considered by several respondents to be important was the issue of students choosing 'soft options'. These respondents expressed the concern that if design became a component of Industrial
Arts then students would not elect these units, they would elect units that were easier. One respondent said;

"Students see design as difficult unnecessary paperwork and would choose other options if design became a prominent part of any course."

Several of the respondents in the follow-up interview agreed that they were conscious of student numbers when constructing a units content. They believed they were competing for student numbers with other option areas. A respondent to the questionnaire made the following interesting comment.

"An interesting study if factual material could be obtained is how teachers have had to change courses to maintain student numbers in class."

One other issue that was mentioned by respondents from both the questionnaire and the follow-up interview was the absence of prerequisites in the unit curriculum. They said it was possible for students without any experience or knowledge to come into units that required certain, prior knowledge and skill development. This made it difficult to cover the objectives of the unit as well as cover more complex concepts like design education.

In the section on students and design education, it was shown how a number of respondents indicated that there were mainly students of lower academic ability in their Industrial Arts units.
Several respondents believe this is a direct result of unitization where students of higher academic ability are guided towards those 'core subjects' with a perceived higher, academic status. The following statement from a respondent voices this belief.

"Design education is excellent worthwhile education for confident well motivated intelligent students, these however are few and far between and do themselves a disservice if they do not load their timetables with 'core subjects'."

Summary

Again time emerged as a factor. Many respondents indicated a belief that because of the number of specific objectives in current units it was impossible to teach added concepts like design. Respondents also indicated that due to the absence of prerequisites in unitization, classes often included a number of students who did not possess the necessary prior knowledge and skills to successfully negotiate that unit. This made it difficult to complete the set objectives. Some participants believe it is because of the unit curriculum that there is a concentration of students with lower academic ability in Industrial Arts units. They implied that the more academically able students are directed towards the 'core' subjects. Respondents also voiced the concern that if design education were to become a prominent component of lower school units then students would opt for 'softer' options.
chapter 4: DISCUSSION AND CONCLUSIONS

This is the concluding chapter, and will discuss the findings of the survey and present the conclusions. The results relating to 'if' and 'how' design is taught, and the relationship between teacher training and design implementation, will be discussed first. Teachers' perceptions will be discussed as they correlate with these results.

Following the discussion of the results, the conclusion to the study will be presented. This will not be a summary as the abstract summarizes the study. The conclusion will make some suggestions for the implementation of design education in lower school. It will then conclude with a reiteration of key aspects of the study.

4.1 Is Design Education Incorporated in Lower Secondary School Industrial Arts Units?

The results show that the design process is not taught on a regular basis to whole groups of students in lower school, but is taught to some individuals considered capable of designing and constructing an artefact. These students may be in either year 8, 9, or 10, but are more likely to be in year 9 or 10. Whilst the majority of students in lower school do not receive formal instruction in the design process, elements of design are frequently present in student
work. How these elements are included in student work will be discussed in 4.2.

What are the factors that determine design education use in lower secondary school? One major factor in the limited application of the design process was that most students did not have the necessary hand or drawing skills to be able to effectively design. The indications are that the insufficient level of student skill is simply because students have not undertaken adequate Industrial Arts instruction. This explains why students in years 9 and 10 could receive greater exposure to the design process. There is a higher probability that their skills are more developed.

Whilst some respondents believed there was a concentration of students with lower academic ability in lower school units, there was nothing to suggest that students had any cognitive, sensori-motor, or affective inability to acquire the necessary skills required for design education. Archer and Roberts (1979) claim that the ability to design is analogous with language capacity and mathematical capacity, and as such, some students will have more 'natural' ability than others, regardless of how they fare in other subjects. The natural ability of some students in a particular subject area gives rise to concepts like 'preferred learning style' and 'cognitive style'. However, it is not within the scope of this study to pursue this direction.
Another major reason for limited instruction in the design process to lower school students, the restriction of time, was attributed to an issue that was not addressed in the questionnaire - the unit curriculum. Many respondents indicated that time limitations could be attributed to the unit structure of the unit curriculum. Because units have specific objectives to be covered, in what generally is only a 10 week unit, there is not sufficient time to include concepts like design education in its true form. It is only the more capable individuals in a group, able to finish their set course work ahead of schedule, who may be given the opportunity to indulge in true design work (that which is centred around the design process). The choice of these students appears to be at the sole discretion of the classroom teacher.

Two thirds of the respondents indicating they used the design process, said they introduced it at varying times of a unit. This is consistent with the fact that only a few individuals actually receive instruction in the design process, because it implies that the design process is only introduced when time allows rather than it be a correctly sequenced component of a hierarchy of skill and knowledge development.

A third reason given for the limited implementation of design education, student attitude and enthusiasm, was also linked to the unit curriculum. Numerous respondents believed that students
chose Industrial Arts units to 'make things', and if this element were reduced and a greater component of design included, then students would opt out of these units and choose 'easier' options. They thought the theory and paper work involved in design education would be unpopular with students choosing Industrial Arts units. Several teachers said when structuring courses that they did so with the maintenance of student numbers in mind, because they felt there was direct competition between themselves and the other option areas. There were indications from respondents in the follow-up interview, that the 'easy option' idea was linked to the perceived concentration of lower academic ability students in Industrial Arts units. These students chose, or were guided, into Industrial Arts units because they were seen as less demanding than other subject areas, both academically and in terms of workload.

Other reasons given for the limited application of design education were teacher enthusiasm and expertise; lack of resources and facilities; lack of commitment by the Ministry of Education, and the unit curriculum. Some factors relating to the unit curriculum have already been discussed and others will be presented as they relate to relevant issues. The issues regarding teachers will be discussed in the section on teacher training.
Availability of resources was perceived initially as a factor in 'how' design was taught, and in chapter 3 was dealt with under that heading. However, a lack of resources for design education affects whether or not design is included in lower school units. The consensus amongst respondents was that there were no specific objectives or resources provided for design education. The absence of specific objectives for design education reinforces earlier comments that units have too many specific objectives to allow the addition of extra concepts like design education. However, whilst there were considered to be no resources for design education in lower school, a perusal of the teachers' guides available for Industrial Arts, revealed some material for presenting design to students. This material was not in depth but would be useful when developing design instruction.

The issue of the suitability of existing facilities for design education instruction was addressed in the questionnaire. All respondents said it was possible to teach design education in the present facilities, but two thirds believed alterations would be needed beforehand. The researcher perceived the combining of the two very different activities, drawing and manufacturing, as the major reason for alterations to be made to existing workshops. This was also cited as a major barrier to design education by numerous respondents. When asked if this would create an organizational problem, 75% indicated that it would pose some degree of problem. Comments by respondents indicate that the problems are most
likely to be the creation of a clean, dust-free drawing area, and the organization of a group that has students both drawing and manufacturing.

Two other areas the researcher considered may be influential in the incorporation of design education into lower school units, were assessment and preparation. More than half the respondents believed design education would not be difficult to assess, whilst the remainder thought it would involve some degree of difficulty. This result does not indicate that assessment would be a significant barrier to design education implementation. However, the amount of preparation for design education may be a deterrent to its introduction. Although three quarters of the respondents believe design education would mean at least a moderate increase in preparation, there was no information collected as to what form this extra preparation would take. So, whilst assessment may not meet with resistance by teachers towards design education, the preparation may.

To summarize, the design process is only taught on a limited basis, but elements of design are present in much student work. Major reasons for the limited application of design are: inadequate student skills; restrictions on time due to the unit curriculum; student enthusiasm and motivation, and a lack of commitment by the Ministry in providing specific resources and suitable facilities.
The problems associated with the limited application of design education are not insurmountable. Aims and objectives would need to be formulated and guidelines for teachers developed. Some modification and rearrangement of existing facilities would also be required but this would not necessitate any major capital expenditure. The issue of student's insufficient level of skill would also need to be addressed in the initial planning of units for design education.

Perhaps the greatest obstacle in the way of design education is the question of whether or not the educational benefits warrant the time and effort necessary to implement such a concept. It was shown in chapter 1 that design education has a beneficial role to play in education, by aiding in the preparation of the individual to take a meaningful and constructive place in society, and to contribute to the individual's quest for self realization. While arguments immediately arise concerning what the ideal objectives of education should be, there is a case for the inclusion of design education in our current educational system.
4.2 How Is Design Taught In Lower Secondary School Industrial Arts Units.

It has been described how, in any given class of students, only a few individuals may be taught the design process. When the design process is introduced, over 70% of respondents said they taught in a way similar to the model that accompanied the questionnaire. Of the remainder, 22% said they do not use the design process, but there was no indication that they have an understanding of the design process that is different to the majority of respondents. This illustrates that approximately three quarters of the teachers sampled apply the design process in a form that is consistent with the most common form of the design process.

Implementation and acceptance of a concept is more likely if it can fit into an existing structure. When asked if it was possible to include the design process in existing lower school units, 25% of the respondents said yes, and 60% stated that at least minor alterations to these units would be necessary. The questionnaire did not, however, ask what alterations were needed to the existing units to enable the design process to be included. Results already discussed indicate there are too many specific objectives to allow the inclusion of design education, hence, it is probable that this is one alteration that is required.
The results show that whilst there is limited application of the design process, elements of design are present in much student work in lower school units. These elements of design generally take the form of design choices and considerations. The typical types of choices and considerations students make are: the calculation of one or more dimensions; the choice of a suitable shape for an artefact, and the choice of colours or stains. It is possible for these choices and considerations to become quite complex if the teacher allows this to occur.

Who makes the decisions as to whether the design process will be taught, and what design choices and considerations need to be made? Three quarters of the respondents said that the programmes which included the design process were either their own or their school's. The responses to the follow-up interview indicate that the selection of what design choices and considerations students are offered lies with the teacher. In the absence of specific objectives and resources for design education, decisions about 'how' and 'when' design is taught is the sole responsibility of each individual classroom teacher.

How would students respond to the need to conduct minor research in their own time? Because design education requires students to conduct some research into artefacts of the same genre as the one they are designing, in their own time, the participants
were asked what they thought the student reaction to this would be. Over 90% of respondents believed the student response would be between indifference and refusal, with the majority indicating that the students would be reluctant to do such homework. This statistic concurs with the earlier observation that 'how' design is incorporated in lower school units may be influenced by teacher concern that student numbers will dwindle if too much theory and 'paperwork' is introduced. One of the five schools in the follow-up interview will 'lose' a member of their Industrial Arts staff in 1990 due to a loss of student numbers in their subject area, not related to the fluctuation in school student numbers.

To summarize the discussion on how design is taught in lower secondary school units it is necessary to reiterate that the design process is only taught to a few select individuals, but when taught, it is done so in a form similar to the model that accompanied the questionnaire. The fact that the majority of respondents have a similar perception of the design process provides a base upon which possible design education instruction could be developed.

Even though application of the design process is limited, it has been shown how elements of design are present in much student work, usually in the form of design choices and considerations. The programmes for the units of which these choices and considerations are components, are usually developed by the person teaching them,
or someone from their school. To fit the design process into these units would require alterations to the units structure. One such alteration could possibly be a change in the current structure of specific objectives.

The reasons that determine 'if' design education is incorporated in lower school units, are also applicable to 'how' design education is taught in these units. One other factor that was considered influential in how design is incorporated in lower school units, was the students perceived reluctance to perform set homework. The fact that teachers may structure units with the maintenance of student numbers as one of the priorities, implies something is wrong with the present system.

4.3 Is Teacher Training Influential In The Inclusion Of Design Education In Lower Secondary School Industrial Arts Units?

The statistics relating to this question were marred by some inadequacies. A problem arose with the identification of teacher training categories. A classroom teacher is generally categorized by the years attributed to the length of time the teacher trained, and as such categories of two, three, and four year trained were considered appropriate. Analysis of the data, and the follow-up interview, revealed that within each category there were many variations.
However, the overall findings still give an indication of the role teacher training plays in design education use.

The group of respondents to the follow-up interview alone, revealed significant variation. One participant was trained under a scheme known as an 'internship', where he required a trade certificate for admittance and then worked in a school for two and a half days a week, attending a teacher training institution the other two and a half days of the working week. This training was for a period of two years but the qualified teacher was classified as three year trained. Another of the respondents was trained as a 'one year special', requiring a leaving certificate as well as a trade certificate for admittance. However, he only attended a training institution for one year full time before receiving a qualification as a three year trained teacher. Of the five respondents to the follow-up interview only one trained in the current manner, completing a three year Diploma of Teaching and then a fourth year for a Bachelor of Education. These are only three examples of the different types of training that Industrial Arts teachers may have undergone. To ascertain the type of training teachers in the work place may have undergone warrants a separate study.

Even though there were certain statistical inadequacies in the above data, it was still factual. A comparison of the factual data from the different categories revealed only one significant difference.
In response to a question on whether more emphasis on the design process would enhance the subject area of Industrial Arts, one third of four year trained teachers indicated it definitely would, but not one three year trained teacher indicated the same. This is consistent with the course offered at WACAE where design is given a far higher priority in the fourth year than in the other three years. The comparison between WACAE and CURTIN is discussed next.

Another situation where categorization resulted in statistical data being invalid, was the category of teacher training institution in which the participants underwent their training. This, however, occurred by chance and was due to there being no respondent who had completed their entire qualification at CURTIN University, one of the two institutions in W.A. where Industrial Arts teachers train. Whilst more than 20% of the respondents completed part of their qualification at WACAE and the remainder at CURTIN, it was statistically impossible with this sample, to determine if one institution had more effect on a teacher's use of design education than the other.

According to McKimmie (1990, p. 6), WACAE supplies about 70% of the Ministry of Education's teaching graduates. This statistic raises the issue of sample bias if there is a correlation between the institution a teacher attended and their use of design education in lower school. However, if there is no relationship
between a teachers' use of design education and the institution in which they had completed their training, then the bias of the sample towards WACAE is not significant.

Through informal discussions with lecturing staff from CURTIN, and the fact that the researcher has just completed his training at WACAE, it is suggested that design is given a higher priority at CURTIN than at WACAE, but training at neither institution has a major influence on the use of design education in the classroom. This suggestion was reinforced by the respondents to the follow-up interview who, regardless of the type of training they received, indicated that factors not related to teacher training or training institution determined the degree of use and the form of design education in lower secondary school.

One other issue relating to teacher training that was broached in the questionnaire was, whether or not in-service courses on design education would be beneficial. When asked if they had ever received in-service training on the design process, 77.8% stated no and the remainder yes. The question was then asked if in-service training in the design process would be beneficial. The number that replied 'definitely' and 'possibly', corresponded exactly with the number that had not experienced previous in-service training. The number that replied 'doubtful' and 'no', corresponded exactly with those that had experienced in-service training in the design process.
This exact correlation of figures indicates that the in-service training on design that teachers have undergone, has been inadequate in some way and any such training needs to be structured in a manner that is consistent with the needs of the student, design education, and the individual teaching it. It is recognized that in-service training no longer exists, as such, and has been replaced by a system whereby teachers are given 'free' time for professional development. However, the facility still exists for teachers to receive ongoing training and updating of skills and techniques.

In summary, even though the results aimed specifically at teacher training were adversely affected by certain factors, the overall results indicate that teacher training is not a significant determinant in design education use. The respondents had several opportunities in the questionnaire to make open comment, but only one mentioned that teacher training could have an influence on design education. However, the reasons that have been established as major determinants were mentioned by many respondents. The participants in the follow-up interview were asked specifically if their training influenced their use of design education. The responses were unanimously 'no', and they cited those reasons already mentioned as being the determinants of design education use. Regardless of one's academic preparation to teach design, it
appears difficult to do so in the current structure of lower secondary school units.

Whilst teacher training is not a significant factor in current design education application in lower secondary school, the indications are that there is a need for specialist training for teachers if design is to assume a greater role in Industrial Arts. It is not sufficient for teachers to have a sound knowledge of the design process. They need to be furnished with the skills, strategies, and resources to enable them to teach design to a whole group of students.

The issues relating to teachers' perceptions have been discussed as they apply to the other components of the research questions. However, there is one perception expressed by some teachers that needs to be highlighted as a possible determinant in the application of design education. This perception is that students will decide on easier options if concepts like design education become a major part of Industrial Arts units. Whether the teacher's views are objective or subjective, the fact remains that some teachers feel they need to compromise the true academic worth of their subject area in an endeavour to maintain student numbers, and possibly their own position. It is a source of concern that competition for student numbers may have become an issue in the educating of our young.
4.4 Conclusions.

The conclusions will begin with suggestions for the implementation of design education into lower secondary school Industrial Arts. These suggestions are in the form of a brief outline on how design could be incorporated in lower secondary school Industrial Arts units, and what shape design courses could take. There is adequate evidence in chapter 1 to suggest there is a role for design education in lower secondary school. There has already been discussion on a teachers' preparation to teach design, but this training will also be discussed further in this section. Overall, the problem appears to be more 'how' should design be implemented rather than 'if' it should be.

There are two distinct avenues for the implementation of design education into Industrial Arts. The first is to incorporate design education into existing units, and the second is to develop a separate course of study with design education as the central theme.

The first option would be the more feasible because it utilizes existing structures, but the existing problems would also need to be overcome. Firstly, students would require unit paths that provide the continuity of instruction needed to develop the necessary skills and knowledge for effective designing. This would entail the setting of prerequisites for students, a factor that is apparently not catered
for in Industrial Arts at present. It is envisaged that this option would require a minimum of one unit per term for years 8, 9, and 10. A major problem with this selection is that students still need to be instructed in drawing and manufacture, a combination that is not comprehensively available in current units. This option would also favour the current mode of unit path, which follows the use of a single medium (e.g. wood, metal, or plastic). The ability to work with only one material would inhibit a student's capacity to develop appropriate design solutions. These are only two reasons that idealistically make the second option the preferred one.

Whilst the second option may be educationally preferable, it would also be more difficult to implement, because it involves changing that which is already in place. This choice necessitates the formation of a new specialized area of study within Industrial Arts, design. Design would still be practically based and could either replace some of the existing units, or be taught in addition to them. A design course that included technical drawing, woodwork, metalwork, and plastics would be educationally more beneficial to students in lower secondary school than a sequence of units that centred around only one medium. However, as with option one students would need to complete a minimum of one unit per term, or the equivalent of 12 units in lower school. This continuity is essential for the design process to be presented in a correctly
sequenced manner as well as allowing students to develop the necessary skills to become effective designers.

For both these options it is important that teachers are properly equipped to teach design, and that the role of design in society and industry is an integral component of design courses. To aid both these factors, there needs to be input into teacher training and design courses in secondary schools by industry and tertiary institutions. This will help teachers remain up to date with current technologies and procedures, and promote the relevance of design in the 'real world'. The content for design courses should be developed at the school level so the relevance of the content to the community can be maximized. For example, those things that are applicable to an ocean side community are not necessarily relevant in a wheat belt community. The desirability of a connection between secondary education, tertiary education, and industry has been recognized by both the Andrich Report (1989), and the Federal Government's Industry Research and Development Programme (1988).

If any design course is to be successful, it must be attractive to the full range of student abilities in secondary schools. Hughes (cited in McKimmie, 1990) states, that the 'glamour' of tertiary courses is based on the Tertiary Education Entrance mark. In Western Australian secondary education, the TEE is also the benchmark against which a subject's status is measured and, as
such, students who intend going to a tertiary institution need to choose subjects that will contribute to their TEE aggregate. Hence, for any lower school design course to have the potential to attract a broad cross section of secondary students, it must culminate in an upper school qualification that is going to be of use to graduates. In the present W.A. education system this means having status as a TEE subject. This, however, does not exclude those students not in a TEE programme from participating in the same courses.

The previous point raises an issue that should possibly be answered before any development is considered on design education, or for that matter, any other initiatives in Industrial Arts. What is the role of Industrial Arts in our education system? As indicated earlier, Beazley (1984) believes there is a need to re-examine curricula in all subject areas. Industrial Arts needs this re-examination because the role it has filled in the past is no longer valid. In the past there has been a direct link between Manual Arts, through the subjects of woodwork, metalwork, and technical drawing - and the manual trades. This is no longer the case, and there are now also links to many other areas, such as leisure activities and the 'do-it-yourself' industry. This has seen the emergence of a plethora of different units in Industrial Arts and aims and objectives for the subject area as a whole are not clearly defined. Clearly defined aims for Industrial Arts would aid the development and implementation of concepts like design and
technology education, as well as provide uniform goals for existing units.

These suggestions for the implementation of design education in lower secondary school, developed from the findings of this study, show that whilst there is a place for design education in Industrial Arts, there are several options for its incorporation. One choice is the more feasible because it involves the use of the existing structure. The other is idealistically preferable because a course would be developed with design as the core. The choice of options lies with the Ministry of Education, and depends on whether they are able and prepared to commit the time and resources needed to develop courses for concepts such as design education. Other suggestions revolved around the need to involve industry and tertiary institutions in the preparation of teachers and courses. The need to identify clear and up to date aims and objectives for Industrial Arts was seen as a precursor to any development in design education and Industrial Arts in general.

To conclude this study it is pertinent to cover key aspects and to mention some issues that have arisen from the study. This was a descriptive study focussing on the concept of design education in lower secondary school Industrial Arts. Design education may be seen by some to be an abstract concept. This is not so! It is a set of skills and a sequence of steps that enable a student to develop and
evaluate a solution to a perceived need. The majority of students in lower secondary school are capable of succeeding in design education.

When determining the role of design education in our secondary schools there were economic and educational issues identified. Whilst the economic elements are important, because they give design education relevance in terms of the needs of society and industry, providing the individual with the 'tools' and the environment to maximize his or her own potential should be the ultimate goal when determining the desirability of an educational concept. In the educating of the 'whole person', design education has definite benefits for the practical and creative component of a student's development. Design education is not an economic and educational panacea, and if design courses are not planned and implemented correctly they are prone to failure the same as any badly organized courses.

The unit curriculum emerged as a significant issue in determining design education use. Whilst it was not the role of this study to evaluate the success of the unit curriculum, the findings suggest that in the area of Industrial Arts unitization may have had some detrimental affect. The unit curriculum has also been cited by the press as one of the issues in the recent teachers' industrial action. If this is the case, then it is possible that teachers may
possess some bias towards the unit curriculum that could affect their perception of it. However, the issues that were raised relating to unitization displayed a high degree of consistency, indicating that any bias did not have a significant affect.

Suggestions were made as to how design education may be included into the subject area of Industrial Arts. Beazley (1984) recommended the inclusion of design education into the practical and creative arts. This study shows there has been no obvious developments on design education at the school level.

It is recognized that there were limitations to this study. Firstly, the use of a postal questionnaire restricts the type of data that is collected, but it allows access to a population that it is dispersed across a wide area. A postal questionnaire can also be adversely affected by non returns. This study had a high return rate and the data from the questionnaire was supplemented by the use of non structured questions and a follow-up interview. These measures also assisted in the establishment of validity and reliability. Secondly, other limitations were also created by certain inadequacies in the methodology, and some of the resultant data. It is argued that these limitations did not have a major influence on the success of this study.
To assess the success of this study it is necessary to look at whether or not the objectives of the study have been met. The researcher believes that the question on 'if' and 'how' design education is incorporated in lower secondary school Industrial Arts units has been conclusively answered. The answer to the other question, relating to how teacher training and teachers' perceptions may determine if design education is incorporated in lower school units, was not as conclusive. This question was affected by certain problems, but the results still provided a sound indication of the influence these factors have on the incorporation of design education. There was no prior information on design education in government secondary schools available, and this study provides the foundation on which future work on design education can be built.
APPENDIX A

WESTERN AUSTRALIAN COLLEGE OF ADVANCED EDUCATION
NEDLANDS

Senior Teacher/ Teacher in Charge of Industrial Arts,
xxxxxxxxxxxxx Senior High School,
xxxxxxxxxxxxx.

RE: A STUDY ON DESIGN EDUCATION IN LOWER SECONDARY SCHOOL INDUSTRIAL ARTS UNITS.

There are indications that Design and Technology education is going to assume a higher profile in Industrial Arts units. It may be introduced by steadily adapting the existing framework, or by the use of rapid, more 'radical' structural change. This study aims to determine the current use of Design Education in years 8, 9, and 10, and to identify relevant variables. These variables include the presence of any existing resources, teachers perceptions of Design Education, and the possible need for in servicing in Design Education. The resultant information will form a foundation, 'built' by Industrial Arts teachers for use in developing Design Education units.
The design process is the process through which Design Education is taught. A model for this process is enclosed with the questionnaire. It is for use as a 'gauge' against which any design process you use can be compared.

This study is conducted in 25 schools throughout W.A. The schools are selected randomly. The teachers chosen to complete the questionnaire are those who teach the most lower school units. To ensure anonymity, an addressed return envelope is included. It would be appreciated if the questionnaires could be returned in these by 31st August 1989. Your response will help this study fulfil its aims.

Anonymity and confidentiality are guaranteed. However, if you would like a summary of the findings please include a name and address where it can be sent. The person conducting this study is:

Rod Slater  
40 Beach Road  
Waterman 6020

Yours sincerely,

Joe Hegney

Industrial Arts Dept.  
WACAE, Nedlands.

N.B. If there is only one Industrial Arts Teacher at your school, please return the other questionnaire uncompleted.
THE DESIGN PROCESS

What do we intend to design and make?

This is often called the design brief. It states very clearly what the problem is that you have to solve.

Research and ideas

The next step is to find out as much as possible about the problem. Then you can start to sketch your ideas and begin to think about suitable materials to use.

Development of chosen ideas

Select your best idea, writing down your reasons for choosing it. You must now think about the materials in more detail and decide which ones will be most suitable. You may then need to improve or develop your idea further. Making a model may well be necessary at this stage, to enable you to see what your idea will look like in three dimensions.

A working drawing and planning procedure

At this stage you will need to make your working drawings. They contain all the information needed to produce your finished design. Careful planning is also vital at this stage and will help to prevent you from making mistakes and wasting valuable materials.

Making

This stage is sometimes called realisation. Your final design, once drawn accurately and carefully planned, should not be very difficult to make. Making is really only a small part of the design process.

Evaluating

Evaluating and testing is one of the most important parts of the design process. At this stage you must be very critical about your work. Find out whether it works or not and decide if it has solved the problem.
APPENDIX C

DESIGN EDUCATION QUESTIONNAIRE

Instructions: This questionnaire is designed to identify trends. There are alternative answers provided for each question, with most questions requiring you to place the number corresponding to the answer of your choice, in the place provided. Others require you to simply place a tick next to your choice(s). Several questions require a short answer. When choosing from the alternative answers, select the alternative that is closest to your ideal reply.

1. Do you teach in a .......(circle).
   DISTRICT HIGH SCHOOL....1
   SENIOR HIGH SCHOOL......2
   HIGH SCHOOL.............3

2. Do you teach the design process in lower secondary school units?
   ALL THE TIME.............1
   SOMETIMES..............2 ANSWER ...
   SELDOM.................3
   NEVER.................4

3. Is the design process taught to ....
   YEAR 8
   YEAR 9
   YEAR 10
   ALL
   NONE

4. Compared with the model provided, how do you present the design process?
   IN THE SAME FORM........1
   IN A SIMILAR FORM.......2 ANSWER ...
   IN A DIFFERENT FORM.....3
   NOT APPLICABLE........4

5. If a different model is used, what stage is different? (tick)
   DESIGN BRIEF
   RESEARCH AND IDEAS ...
   DEVELOPMENT OF CHOSEN IDEAS ...
   WORKING DRAWING AND PLANNING ...
   MAKING (MANUFACTURE) ...
   EVALUATING ...
6. At what stage of a unit is the design process introduced?
   THE BEGINNING.........1
   THE MIDDLE............2
   THE END..............3  ANSWER ...
   VARIES.............4
   NOT AT ALL...........5

7. The design process is taught by ....teachers.
   ALL....................1
   MOST...................2  ANSWER ...
   A FEW.................3
   NO.....................4

8. If a programme includes the design process is it........?
   YOUR OWN.............1
   YOUR SCHOOLS.........2
   SOMEBODY ELSES.......3  ANSWER ...
   NOT APPLICABLE........4

9. Are there specific resources provided by the Ministry to aid in the teaching of the design process in lower secondary school? (tick)
   YES ...
   NO ...

10. Have you been given specific objectives for design education? (tick)
    YES ...
    NO ...

11. Have you received resources for design education from any source other than the Ministry? (tick)
    YES ...
    NO ...

12. If yes, was this source.......  
    ANOTHER EDUCATION SYSTEM...1
    INDUSTRY...............2
    ANOTHER GOVERNMENT BODY...3  ANSWER ...
    NOT APPLICABLE..........4
13. Do you think more emphasis on the design process would enhance the subject area of Industrial Arts?
   DEFINITELY ............ 1
   POSSIBLY ............ 2
   DOUBTFUL ............ 3
   NO .................. 4

14. Do you think it possible to include the design process in your current lower school units?
   NO .................. 1
   WITH MAJOR ALTERATIONS .... 2
   WITH MINOR ALTERATIONS .... 3
   YES .................. 4

15. Could the design process be taught in your present workshop set-up?
   YES .................. 1
   WITH MINOR ALTERATIONS .... 2
   WITH MAJOR ALTERATIONS .... 3
   NO .................. 4

16. The design process includes drawing, planning, making, and student evaluation. Would this be difficult to assess?
   NO .................. 1
   SLIGHTLY .............. 2
   A FAIR DEGREE ........ 3
   YES .................. 4

17. Would combining 'drawing' and 'making' create an organizational problem?
   NO .................. 1
   A MINOR PROBLEM ....... 2
   A SIGNIFICANT PROBLEM .... 3
   DEFINITELY ............ 4

Briefly outline any reasons

................................................
................................................
................................................
18. What do you think would be the amount of preparation required, compared with your current units?
   NO INCREASE ...........1
   MINOR INCREASE ..........2
   MODERATE INCREASE ......3  ANSWER ...
   MAJOR INCREASE ..........4

19. What do you think student response might be towards conducting minor research in their own time?
   ENTHUSIASM .............1
   INDIFFERENCE ............2  ANSWER ...
   RELUCTANCE ............3
   REFUSAL ............4

20. Could you identify three elements that you would consider barriers to the introduction of design education.
   i] ............................................. .
   ii] ........................................... .
   iii] .......................................... .

21. Where did you do your teacher training (tick).
   CURTIN (WA)
   WACAE (NEDLANDS)
   OTHER (Name) ....................... .

22. What was the duration of your training? (tick)
   2 YEARS ..................
   3 YEARS ..................
   4 YEARS ..................
   OTHER (Name) ....................... .

23. During teacher training, did you receive instruction on teaching the design process?
   YES, A LARGE AMOUNT .......1
   YES, A MODERATE AMOUNT ....2  ANSWER...
   YES, A SMALL AMOUNT .......3
   NO ......................4

24. Have you ever received in service training which included instruction on the design process? (tick)
   YES ...
   NO ...
25. Do you think you would benefit from specialized in service training in design education?
   DEFINITELY.............1
   POSSIBLY..............2
   DOUBTFUL...............3 ANSWER ...
   NO.....................4

26. Is there any comment you would like to make about design education and its use in lower secondary school Industrial Arts units?
Senior Teacher of Industrial Arts,
xxxxxxx Senior High School.

A brief reminder that the questionnaires on Design Education are now due. The response to date has been excellent but there are some replies still to be returned. The return of those questionnaires will ensure maximum input by Industrial Arts teachers, and will assist the study to fulfil its aims. I fully understand the strain other teachers are experiencing at present and greatly appreciate your participation in this study.

Any comment or query about the questionnaire, or Design Education in general, is most welcome. I can be contacted on 448 5804, and Joe Hegney can be contacted on 386 0253.

Yours sincerely,

Rod Slater
APPENDIX E

QUESTIONS FOR THE FOLLOW-UP INTERVIEW ON DESIGN EDUCATION

(I) RESPONDENT'S OPINIONS.

What are your general comments on the questionnaire?

(II) IS DESIGN TAUGHT IN LOWER SCHOOL INDUSTRIAL ARTS UNITS?

(a) Do you teach design?
(b) Who do you teach it to?

year 8
year 8 & 9
year 9
year 9 & 10
year 10
All
Not at all

(c) Do other teachers in your school include design in their units, and in what form?
(III) HOW DO YOU TEACH DESIGN?
(a) Do you teach the whole design process?
   (i.e. design brief; research and ideas;
   concepts; drawing and planning; making;
   evaluating).
(b) If you do teach the design process, do you
    teach it to all students in a group?
(c) If you don’t teach the whole design process
    how do you incorporate design in lower
    school units?

(IV) THE INFLUENCE OF TEACHER TRAINING ON THE
     USE OF DESIGN EDUCATION.
(a) What type of teacher training did you
    undergo, and what is your classification?
    (2, 3, or 4 year trained)
(b) Did you do many design process activities
    during your teacher training?
(c) Did your training include how to teach
    design?
(d) Did your teacher training influence your
    use of design education?
THE INFLUENCE OF TEACHER PERCEPTIONS ON THE USE OF DESIGN EDUCATION.

[ perception = insight, understanding, awareness ]

(a) What is the general level of student ability in your lower secondary school units?

(b) If there is a concentration of one particular student type in lower secondary units, what do you think the reason for this is?

(c) Does the unit curriculum affect the implementation of design education?

(d) Why? [ elaborate ]

(e) Would it be possible to effectively teach the theory and drawing components in your current workshop/s.
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