A Study of the Identification and Validation of Competency-based Tasks for the Power and Transportation Area of Industrial Arts in the State of Virginia

Robert P. Quiqley
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A STUDY OF THE IDENTIFICATION AND
VALIDATION OF COMPETENCY-BASED TASKS
FOR THE POWER AND TRANSPORTATION AREA
OF INDUSTRIAL ARTS IN THE STATE OF VIRGINIA

A Research Paper
Presented to
the Faculty of the School of Education
Old Dominion University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Education

by
Robert P. Quigley
May 1979
This research paper was prepared under the direction of the instructor in Problems in Education, VIAE 636. It is submitted to the Graduate Program Director for Vocational and Industrial Arts Education in partial fulfillment of the requirements for the Degree of Master of Science in Education.

Approved May 1979

John M. Ritz, Ed.D.
Graduate Advisor
Graduate Program Director
Vocational and Industrial Arts Education
ACKNOWLEDGEMENTS

I wish to express my gratitude to Mr. Walter Deal, III, for his assistance in developing this paper. Also, a special thanks to Dr. John Ritz for his encouragement, patience, and valuable advice.
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Chapter 1

INTRODUCTION

The General Assembly of Virginia in recent legislation approved an educational plan which requires that local school divisions must develop minimum competencies for all their students. The major benefit of such a program would be to insure minimum levels of achievement through development of standardized curricula, elimination of subject overlap, and the possibility of employing professionals to help formulate curricula.

In compliance with the General Assembly's legislature directive the State Supervisor of Industrial Arts Education began a program to develop minimum competencies for the areas of Industrial Arts. It was established that these catalogs of minimum competencies would be implemented by June 30, 1982. This study was designed to aid in the identification and validation of competencies for the Power and Transportation area of Industrial Arts.

BACKGROUND

Following the state directive to develop consistency of curricula in educational programs, the competency-based instructional movement in Virginia began. "Competency-based instruction can be explained as a process of specifying what makes a person competent in a certain subject or field, and then the teaching of these competencies to the learner."1 Another definition of CBI states it is a means of education
based upon the identification and attainment of prespecified outcomes. Once these outcomes have been attained the student then graduates to another level of learning. Therefore, it is necessary that educators develop programs where competencies to be mastered are clearly stated.

In developing competencies for industrial arts, professionals are now designing programs of study concerning systems rather than individual and separate categories.

"Those concerned with curriculum development in subject fields which derive content from the technologies find their task becoming increasingly difficult. Practitioners in the field of general education and the industrial arts, concerned with long-term educational goals and technologically literate citizens, are searching for logical, yet flexible, structures and the means to attain agreement upon content."

STATEMENT OF THE PROBLEM

Since a directive has been issued and a deadline for implementation established, the wheels of the competency-based educational movement are now set in motion. The problem of this study was to identify and validate competencies for the area of Power and Transportation needed by Industrial Arts Teachers in Virginia.

LIMITATIONS OF THE STUDY

During the course of this study two limitations were recognized. They are listed as follows:

1. This study pertains to the curricula development in competency-based education for the State of Virginia only.

2. Only those professionals which respond to the questionnaire are included in the analysis of the findings.
IMPORTANCE OF THE STUDY

It is hoped that information gained in this study will aid in the development of a competency-based curriculum catalog in the Power and Transportation area of Industrial Arts Education. The major benefit of such a catalog would be to insure minimum levels of achievement through development of standardized curricula, elimination of subject overlap, and the possibility of employing professionals to help formulate curricula. As a system designed to develop certain knowledge, skills, and attitudes in students enrolled in industrial arts programs, competency-based instruction is one effort to improve education and increase accountability. It is therefore hoped this competency research will aid in insuring quality education in regards to accountability as an accepted method to improve education for the benefit of the student. This research will not only aid novice teachers in developing a Power and Transportation program, but it will also benefit veteran teachers as well.

DEFINITION OF TERMS

In order to clarify the researcher's use of terms which appear in this study and which may be unfamiliar to the reader, the following definitions are given.

1. **CBI/Competency-Based Instruction.** Competency-based instruction is a means of education based upon the identification and attainment of prespecified outcomes. To be competent implies that a learner be well qualified and possess certain abilities and qualities
within a specified content area. Competency-based instruction is a system designed to develop prespecified knowledge, skills, and attitudes in learners who are enrolled in an educational program.

2. **Area of Competence.** Identifies the industrial arts course for which the particular task was prepared.

3. **Content/Concept.** Identifies the sub-area which the particular task is associated.

4. **Task.** Is the knowledge, skills, or attitude which the learner should possess after instruction in the industrial arts class.

5. **CRM/Criterion Reference Measure.** Are means to identify if the learner can successfully perform the stated task.

6. **Performance Guides.** Are sub-tasks which lead to the development of the knowledge, skills, and attitudes identified in the tasks.
Competency-based education is a new trend that is sweeping this country. It is a movement in education that began less than ten years ago but has gained momentum and has captured the imagination of many educators throughout America.

For those new to this concept of education the question is asked: what is competency-based education? The term competency-based seems to be gaining in current literature, but by whatever name it is called, it is essentially a performance-based program. In other words, competency-based education is a systematic approach to instruction. Competency-based education reflects the basic needs of our American society with respect to its overall concern for doing, not just knowing how to do, and with continuing to do tasks which are to be effective in achieving objectives.

W. Robert Houston, Professor and Associate Dean of the College of Education, University of Houston, states:

"Competency-based emphasizes a minimum standard; it adds criterion levels, value orientations and quality to the definition of the movement. While competency advocates note three levels for criteria - cognitive, performance, and consequence - they press for the latter as the most significant measure of effectiveness. Performance advocates, also recognizing consequence as the ultimate test of an individual's effectiveness, point out that many intervening variables affect results (pupil ability, interest, motivation, availability of resources). They stress that our present understanding of these variables and our inability to control them adequately in field settings preclude consequence objectives as realistic requirements."
It has been thought by some that competency-based programs should be primarily involved with performance of curricula and consequence of behaviors that are a result of performance. Therefore, competencies identify a basic framework for curricula development and are different from behavioral objectives. These differences can be translated into more specific objectives for instructional purposes.

"Competencies differ from behavioral objectives in several ways. For example as these terms are typically used, competencies: (1) are logically derived from a role of conception; (2) are broader in scope; (3) define programs rather than instructional unit outcomes; (4) require multiple assessments to accommodate varied contexts, criteria and conditions; (5) emphasize performance and consequences of actions over cognitive outcomes (while behavioral objectives may relate equally well to anyone of these three); and (6) are oriented typically toward professional or vocational roles."

When discussing specific instructional objectives relating to competency-based education invariably the question appears, what is the basis behind competency-based education? Each human being is an individual and no two act or do or think in exactly the same way. Therefore it is safe to assume that each educator differs in his or her approach to teaching methods and philosophies. Thus curricula being offered by educators to the same grade and in the same area may differ substantially from instructor to instructor. The amount of time spent on different areas may vary also, even when the same material is being covered by the instructors. In the area of industrial arts as in other areas, many teachers develop their own programs, independently of others, which may or may not
provide adequate learning situations or be educationally sound. Thus individuality can and does lead to inconsistency in developing curricula. Some educators feel that these inconsistencies are a waste of students and instructor's time. Time is wasted in the teaching of overlapping material because instructors are unaware of what each student has previously been taught.

"The instructor's position is uncomfortable because he is probably the single originator of his curriculum. This curriculum is based heavily on his personal interpretation of the study distributed by the educational system the teacher is operating within; and the study guides are usually very flexible, making the number of curricula that can be generated from one of them practically unlimited."

Another important argument in favor of consistency in curricula concerns the beginning teacher. During the first year of teaching much time is spent in developing course outlines and identifying content. "The novice teacher is not the best prepared person to formulate curricula, nor should he be required to. The situation is not desirable because it will diversify content taught." 6

Then which individuals should formulate these consistencies in curricula? Veteran teachers as professionals should be used to develop workable courses in the particular areas of their concern. The results of professional curricula analysis would provide the basis for selecting educational competencies to be measured.

Generally it has been accepted that clearly defined goals and objectives are more easily understood by individuals than those goals or objectives which are unclear or ambiguous. "Research confirms the hypothesis that students who know the specific objectives of
instruction achieve more than those unaware of the objectives." To be effective, clearly defined goals and objectives must therefore be written in a form which can be understood and easily translated. The development of a system of organization to insure consistency of curricula at a minimum level is the basis for competency-based education. "The necessary knowledge and skills are determined by analyzing each task and listing the sequential steps to be followed in its performance." Consequently, certain questions must be considered to determine competencies. What minimum competencies need to be measured? What skills, knowledge and attitudes are required? How are competencies measured? Once these questions have been answered students achievement can be measured on acceptable performance and completion of designated tasks. "Acceptable performance of tasks requires that students possess certain skills and knowledge. More specifically, both knowing and doing are required."9

SUMMARY

Power and Transportation Technology as a curriculum has been implemented in Virginia schools over the past several years. As a vital study, this curriculum offers students needed insight into the principles and processes of how people and goods are transported within the framework of today's society. However, without some system of continuity the teaching of any Power and Transportation Curriculum is left up to the individual educator's interpretation of
the curriculum. The development of a task catalog is justified to aid in obtaining a basic curriculum guideline which in turn develops continuity.
Chapter 3

DESIGN OF THE STUDY

This study was designed to identify and validate knowledge, skills, and attitudes needed as content for structuring programs in Power and Transportation. This information was gathered directly from veteran teachers in the State of Virginia.

POPULATION OF THE STUDY

The population in this study consisted of an Advisory Committee whose members included the supervisor of the Virginia State Department of Education, two college level educators and four veteran high school educators from the State of Virginia.

DATA GATHERING INSTRUMENT

As an instrument to collect the necessary data for this study a validation survey of Comprehensive Catalog Development For Power and Transportation Technology was formulated. A copy of this survey is included in Appendix A. In an attempt to make it as concise as possible, only those questions which seemed relevant and necessary for the study were included. Before mailing, the questionnaire was analyzed by Walter Deal, III, (Associate Professor of Industrial Arts at Old Dominion University), who made helpful suggestions concerning changes in the listing, selecting, and phrasing of questions used in the questionnaire.
COLLECTION OF THE DATA

A questionnaire was sent to designated members of the advisory committee. The questionnaires were mailed with cover letters and a self-addressed, stamped envelope on November 15, 1978.

DATA ANALYSIS

A suitable method for comparison of the data will be utilized in the computation of the findings. The research questions will be analyzed by using percentages to study the results of the question statements.

SUMMARY

The gathering tool for the study consists of a survey questionnaire concerned with the validating of students completing identified industrial arts programs in the State of Virginia. A specially selected advisory committee was used to determine this information. In the following chapter the presentation and analysis of the data is determined.
Chapter 4

ANALYSIS OF THE DATA

For this study a survey questionnaire was developed which consists of 15 basic subject areas involving Power and Transportation Technology with a total of 42 questions. There were a total of 15 subject areas questioned. Each subject area contained three parts. The area of Competency, Content/Concept, and Task. The Area of Competence was Power and Transportation Technology. Since this did not change throughout the survey, it was only listed with the first subject area. The Content/Concept listed one of the 15 basic subject areas. The Task part included the actual survey questions. After each question the capital letters A U D appeared in the right side of the page. These letters were used to tabulate the questionnaire response. A - represented agree, U - undecided and D - disagree. The respondent was asked to circle the appropriate letter.

The survey was mailed with a stamped, self-addressed envelope to the seven members of the State Advising Committee. There was a 100% response to the questionnaire.

Table 1A lists the first twenty-one questions of the survey and how each of the seven advisory committee members responded. Each committee member was designated in the table with a capital letter (A through G). Table 1A also shows the percentage of favorable responses for each question. Table 1B is a duplicate of table 1A except that it list questions twenty-one through forty-two.
Table 2 charts the total responses and how each category (A, U, D) rated on a percentage level.

ANALYSIS SUMMARY

The results of the survey show that of the 294 responses, 261 or 88.8 percent were judged favorably by the advisory committee. Nine (9) responses or 3 percent were judged unfavorably; and 24 responses or 8.2 percent were judged with an undecided vote. Further analysis indicates that questions with five (5) or fewer favorable ("agree") responses should be reviewed to determine if those questions need revision. Of the forty-two questions listed in the survey, questions 4, 6, 7, 15, 24, 25, 29, 30, 40, and 42 had five or fewer favorable responses.
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A - Agree  
D - Disagree  
U - Undecided
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<tr>
<td>42</td>
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<td>4</td>
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</tbody>
</table>

**Responses**
- A - 261
- U - 24
- D - 9

**Percentage**
- A - 88.8%
- U - 8.2%
- D - 3%

**Total Responses**
- 294
Chapter 5

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

SUMMARY

It is hoped that the information gained from this study will aid in the development of a Competency-Based Curriculum Catalog in the Power and Transportation area of Industrial Arts Education in the State of Virginia. Such a catalog would insure to some extent that necessary levels of achievement would exist through the development of standardized curricula, the elimination of subject overlap, instructional continuity, and the possibility of employing professionals to help formulate curricula. It is also hoped that this competency research will aid in insuring quality education in regard to accountability as an accepted method to improve education for the benefit of the student.

CONCLUSIONS

The results of the questionnaire survey clearly shows that the majority of the questions surveyed met with a favorable response. Those questions which did not receive a 100% favorable were re-evaluated and rewritten. Therefore it can be concluded that the survey was a success in obtaining valuable information on the needed subject areas in the Power and Transportation Curriculum of Industrial Arts.

RECOMMENDATIONS

From the results of the study the first draft of the competency-based catalog in Power and Transportation Technology was created. (Appendix B).
However, it is recommended that the results from this study not be used as a total curriculum guide. On the contrary, the catalog which will be written as a direct result of the study is intended to be used as a reference guideline to aid Industrial Arts educators in developing Power and Transportation Curricula using the competency-based instruction format. It can be further stated that the results of this study relate just one of many methods of procuring information to establish a competency catalog.
Footnote Reference

1 Ritz, John M. and Joyner, David I. Instructions on Catalogs of Tasks for Competency-Based Instruction in Industrial Arts Education. Old Dominion University, Norfolk, Virginia (May, 1978) p. 3.


3 Houston, W.R. "Strategies and Resources for Developing a Competency-Based Teacher Education Program, New York State Education Department (1972).


6 Ibid. p. 36.

7 Houston and Warner (1977) p. 18.


9 Ibid p. 50.
BIBLIOGRAPHY


Ritz, John M. and Joyner, David I., "Final Report - Development of a Competency-Based Instruction Curriculum Plan." Department of Industrial Arts Education, Old Dominion University, Norfolk, Virginia (June, 1978).

Ritz, John M. and Joyner, David I., Instructions on Catalogs of Tasks for Competency-Based Instruction in Industrial Arts Education. Old Dominion University, Norfolk, Virginia (May, 1978).

VALIDATION SURVEY OF COMPREHENSIVE CATALOG DEVELOPMENT FOR POWER AND TRANSPORTATION TECHNOLOGY

This study is aimed at validating all students completing identified industrial arts programs in the State of Virginia. Circle the one response which most nearly describes your opinion of each statement. If you feel additional competencies need to be added to the competency list, please note them on the final page of the survey.

An example to show how the survey should be completed is provided:

Example:

AREA OF COMPETENCE: Industrial Crafts
CONTENT/CONCEPT: Leatherwork
TASK: Develop skill in useage of the swivel knife.

Key: A - Agree
     U - Undecided
     D - Disagree

Example:

AREA OF COMPETENCE: Power and Transportation Technology
CONTENT/CONCEPT: Introduction to Power and Transportation
TASK:

1. Define power.
2. List examples of mechanical power, fluid power, and electrical power.
3. Define transportation.
4. List examples from these areas of transportation: air, water, land, and space.
CONTENT/CONCEPT: Safety Practices

TASK:

5. List safety practices used in Power and Transportation.

CONTENT/CONCEPT: Occupational Opportunities

TASK:

6. List occupational opportunities pertaining to the area of Power Technology.

7. List occupational opportunities pertaining to the area of Transportation Technology.

CONTENT/CONCEPT: Applications of Power in Transportation Systems

TASK:

8. List and describe applications of power in transportation systems with emphasis on what, where, and how goods are transported.

CONTENT/CONCEPT: Heat Engines

TASK:

9. Identify and describe the internal combustion two stroke engine.

10. Identify and describe the diesel two stroke engine.

11. Identify and describe the internal combustion four stroke engine.

12. Identify and describe the four stroke diesel engine.

13. Identify and describe Wankel rotary internal combustion engines.
CONTENT/CONCEPT: External Combustion Engines

TASK:

14. Identify and describe the reciprocating external combustion engine.

15. Identify and describe the rotary external combustion engine.

CONTENT/CONCEPT: Applications of Heat Engines

TASK:

16. Describe the uses of heat engines in transportation systems.

CONTENT/CONCEPT: Natural Sources of Power

TASK:

17. Describe the uses of wind as a source of power.

18. Describe the uses of water as a source of power.

19. Describe the uses of solar energy as a source of power.

20. Describe muscle power and its uses as a source of power.

21. Describe the uses of tides as a source of power.

22. Describe the uses of the earth's own heat as a source of power (geothermal).

CONTENT/CONCEPT: The Nuclear Reaction as a Source of Power

TASK:

23. Describe the uses of nuclear reaction as a source of power.
CONTENT/CONCEPT: Career Opportunities Related to Natural Sources of Power.

TASK:
24. List and describe career opportunities in construction of water transportation. A U D
25. List and describe career opportunities in airborne technology. A U D

CONTENT/CONCEPT: Mechanical Power

TASK:
26. List and describe sources of mechanical power. A U D
27. Describe the transmission of mechanical power. A U D
28. Describe the control of mechanical power. A U D
29. Describe mechanical power output. A U D
30. Describe and list career opportunities in the mechanical power area. A U D

CONTENT/CONCEPT: Fluid Power

TASK:
31. Define fluid power. A U D
32. Define and describe the term hydraulic. A U D
33. Define hydrodynamics. A U D
34. Define hydrostatics. A U D
35. Identify and describe pneumatics. A U D

CONTENT/CONCEPT: Electrical Power

TASK:
36. List and describe sources of electrical power. A U D
37. Describe generators in electric power. 

38. Describe the transmission of electrical power. 

39. Describe control of electrical power. 

40. Describe power loads of electrical power. 

**CONTENT/CONCEPT:** Power in Transportation Systems

**TASK:**

41. Describe the utilization of power in transportation systems.

**CONTENT/CONCEPT:** Research and Development

42. Describe research and development in power and transportation systems.
Appendix B
TASK # 1

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Introduction to Power and Transportation

TASK: Define Power.

CRITERION REFERENCED MEASURE: Define power as the conversion of energy to perform useful work.

PERFORMANCE GUIDES:

1. Read assignments on power.
2. Teacher presentation.
3. Perform energy conversion experiments.
4. Identify the six basic forms of energy:
   a. Mechanical
   b. Electric
   c. Light
   d. Heat
   e. Nuclear
   f. Chemical

TASK # 2

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Introduction to Power and Transportation

TASK: Define Transportation.

CRITERION REFERENCED MEASURE: Define transportation as the movement of goods, people, and services from one point to another.

PERFORMANCE GUIDES:

1. Read assignments on transportation.
2. Teacher presentation.
3. View film on transportation and society.
4. Identify examples of the four general mediums of transportation:
   a. Land
   b. Sea
   c. Air
   d. Space
INTRODUCTION TO POWER AND TRANSPORTATION TECHNOLOGY

TASK # 3

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Introduction to Power and Transportation

TASK: Develop an Understanding of Safety Practices used in Power and Transportation Technology.

CRITERION REFERENCED MEASURE: Demonstrate knowledge and understanding of safety practices used in power and transportation technology.

PERFORMANCE GUIDES:

1. Teacher presentation on safety.
2. Class discussion.
3. Participate in class activities safely.

TASK # 4

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Introduction to Power and Transportation

TASK: List and Describe Occupational and Career Opportunities Pertaining to the Areas of Power and Transportation Technology.

CRITERION REFERENCED MEASURE: List and discuss four career and occupational opportunities related to the areas of power and transportation technology.

PERFORMANCE GUIDES:

1. Read assignments on career opportunities.
2. Bring in four "classified employment opportunity advertisements" from the local newspaper that reflect employment opportunities in power technology.
3. Identify and discuss the following:
   a. Training required
   b. Working conditions
   c. Type of physical stamina required
   d. Salary or wages that may be expected.
   e. Advancement opportunities
TASK # 5

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Introduction to Power and Transportation

TASK: Describe Research and Development in Power and Transportation Systems.

CRITERION REFERENCED MEASURE: Describe how the use of research and development in power and transportation systems may be used to provide economy, convenience, safety, and efficiency.

PERFORMANCE GUIDES:

1. Teacher presentation.
2. Field trip to closest controlled traffic intersection.
3. Observe auto traffic flow pattern.
4. Time and record data as to dominant traffic flow.
5. Analyze data as to direction for efficiency, economy of time, and safety.

TASK # 6

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Applications of Power in Transportation Systems

TASK: List and Describe Applications of Power in Transportation Systems with Emphasis on What, Where, and How Goods are Transported.

CRITERION REFERENCED MEASURE: Describe how power may be used to efficiently move goods, services, and how people may be moved efficiently.

PERFORMANCE GUIDES:

1. Teacher presentation.
2. View films on:
   a. Air terminals and travel
   b. Land: truck/auto travel
   c. Land: railroad travel
3. Construct model transportation terminal.
AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Applications

TASK: Describe the Uses of Control Systems Related to Power in Transportation Systems.

CRITERION REFERENCED MEASURE: Develop an understanding of the uses of control systems pertaining to power in transportation systems.

PERFORMANCE GUIDES:
1. Read assignments on control systems.
2. Teacher presentation.
3. Listen to guest speaker from air traffic control tower.
4. Establish role playing activity: air transport control tower.
5. Role playing: taxi cab radio dispatcher.

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Applications

TASK: Describe the Applications of Transportation Support Systems Pertaining to Power in Transportation Systems.

CRITERION REFERENCED MEASURE: Acquire a knowledge and understanding of how transportation support systems are used in power and transportation systems.

PERFORMANCE GUIDES:
1. Read assignments on transportation support systems.
2. Participate in class discussion.
3. Define roles and participate in role-playing activity.
**TASK # 9**

**AREA OF COMPETENCE:** Power and Transportation Technology

**CONTENT/CONCEPT:** Heat Engines/Internal Combustion

**TASK:** Identify and Describe the Operation of the Internal Combustion Two-Stroke Engine.

**CRITERION REFERENCED MEASURE:** Identify and describe the function of the internal combustion two-stroke engine.

**PERFORMANCE GUIDES:**
1. Read assignments on two-stroke IC engine.
2. Participate in class discussion.
3. Participate in small engine activity.

**TASK # 10**

**AREA OF COMPETENCE:** Power and Transportation Technology

**CONTENT/CONCEPT:** Heat Engines/Internal Combustion

**TASK:** Identify and Describe the Internal Combustion Four-Stroke Engine.

**CRITERION REFERENCED MEASURE:** Identify and demonstrate an understanding of the function of the four-stroke IC engine.

**PERFORMANCE GUIDES:**
1. Read assignments on four-stroke IC engine.
2. Participate in class discussion.
3. Participate in small engine activity.
TASK # 11

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Heat Engines/Internal Combustion

TASK: Identify the Concept and Describe the Operation of the Four-Stroke Diesel Engine.

CRITERION REFERENCED MEASURE: Describe the operation and major features of the diesel engine.

PERFORMANCE GUIDES:
1. Read assignments on diesel four-stroke engine.
2. Participate in class discussion.
3. Participate in laboratory experiences.

TASK # 12

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Heat Engines/Internal Combustion

TASK: Identify and Describe the Wankel Rotary Internal Combustion Engine.

CRITERION REFERENCED MEASURE: Identify and acquire an understanding of the function of the Wankel rotary internal combustion engine.

PERFORMANCE GUIDES:
1. Read assignments on Wankel Rotary IC engines.
2. Participate in class discussion.
3. Perform laboratory experiments with rotary engine.
TASK #13

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Heat Engines/Internal Combustion

TASK: Describe the Uses of Heat Engines in Transportation Systems.

CRITERION REFERENCED MEASURE: Describe and be able to discuss the application of heat engines in land, air, sea and space transportation systems.

PERFORMANCE GUIDES:
1. Read assignments on application of heat engines in transportation.
2. Participate in class discussion.

TASK #14

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Natural Sources

TASK: Describe the Use of Wind as a Source of Power.

CRITERION REFERENCED MEASURE: List and describe various uses of wind as a source of power.

PERFORMANCE GUIDES:
1. Read assignments on wind as a source of power.
2. Participate in class discussion.
3. List various uses of wind as a source of power.
4. Construct a model wind power generator.
**TASK # 15**

**AREA OF COMPETENCE:** Power and Transportation Technology

**CONTENT/CONCEPT:** Types of Power/Natural Sources

**TASK:** Describe Muscle Power and its Uses as a Source of Power.

**CRITERION REFERENCED MEASURE:** Describe how muscle power can be used as a source of power.

**PERFORMANCE GUIDES:**

1. Read assignments on muscle power as a source of power.
2. Participate in class discussion.

**TASK # 16**

**AREA OF COMPETENCE:** Power and Transportation Technology

**CONTENT/CONCEPT:** Types of Power/Natural Sources

**TASK:** Describe the Uses of Water as a Source of Power.

**CRITERION REFERENCED MEASURE:** Develop an understanding of the uses of water as a natural source of power.

**PERFORMANCE GUIDES:**

1. Read assignments on water as a source of power.
2. Participate in class discussion.
3. Teacher presentation.
**TASK # 17**

**AREA OF COMPETENCE:** Power and Transportation Technology

**CONTENT/CONCEPT:** Types of Power/Natural Sources

**TASK:** Describe the Use of Ocean Tides as a Source of Power.

**CRITERION REFERENCED MEASURE:** Explain the Principle of using ocean tides as a source of power.

**PERFORMANCE GUIDES:**
1. Read assignments on ocean tides as a source of power.
2. Participate in class discussion.
3. Teacher presentation.

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**TASK # 18**

**AREA OF COMPETENCE:** Power and Transportation Technology

**CONTENT/CONCEPT:** Types of Power/Natural Sources

**TASK:** Describe the Uses of Solar Energy as a Source of Power.

**CRITERION REFERENCED MEASURE:** Explain how solar energy may be used as a source of power.

**PERFORMANCE GUIDES:**
1. Read assignments on solar energy.
2. Participate in class discussion.
3. Teacher presentation.
4. Teacher demonstration using solar cells.
**TASK # 19**

**AREA OF COMPETENCE:** Power and Transportation Technology

**CONTENT/CONCEPT:** Types of Power/Natural Sources

**TASK:** Describe the Uses of Geothermal, the Earth's own heat as a Source of Power.

**CRITERION REFERENCED MEASURE:** Explain the principle of using the earth's own heat as a source of power.

**PERFORMANCE GUIDES:**
1. Read assignments on geothermal sources of power.
2. Participate in class discussion.
3. Teacher presentation.

**TASK # 20**

**AREA OF COMPETENCE:** Power and Transportation Technology

**CONTENT/CONCEPT:** Types of Power/Natural Sources

**TASK:** Compare and Contrast the Terms Finite, Replenishable, and Continuous Sources of Power.

**CRITERION REFERENCED MEASURE:** Demonstrate a knowledge of the terms finite, replenishable and continuous sources of power; and make a comparison of their meanings.

**PERFORMANCE GUIDES:**
1. Read assignments.
2. Participate in class discussion.
3. Teacher presentation.
TASK # 21

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Mechanical

TASK: Define the Term Mechanical Power.

CRITERION REFERENCED MEASURE: Develop an understanding of the meaning of the term mechanical power.

PERFORMANCE GUIDES:
1. Read assignments on mechanical power.
2. Participate in class discussion.
3. Teacher presentation.

TASK # 22

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Mechanical

TASK: List and Describe Sources of Mechanical Power.

CRITERION REFERENCED MEASURE: List various sources of mechanical power and demonstrate an understanding of how mechanical power is acquired from these sources.

PERFORMANCE GUIDES:
1. Read assignments on sources of mechanical power.
2. Participate in class discussion.
3. List sources of mechanical power.
TASK # 23

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Mechanical

TASK: Describe how Mechanical Power is Transmitted.

CRITERION REFERENCED MEASURE: Acquire a knowledge of how mechanical power is transmitted for use.

PERFORMANCE GUIDES:

1. Read assignments on the transmission of mechanical power.
2. Participate in class discussion.
3. Teacher presentation.

TASK # 24

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Mechanical

TASK: List and Describe Methods of Controlling Mechanical Power.

CRITERION REFERENCED MEASURE: List and describe various methods of controlling mechanical power.

PERFORMANCE GUIDES:

1. Read assignments on the control of mechanical power.
2. Participate in class discussion.
3. List methods of controlling mechanical power.
TASK # 25

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Mechanical

TASK: Describe Mechanical Power Output.

CRITERION REFERENCED MEASURE: Explain what is meant by mechanical power output.

PERFORMANCE GUIDES:
1. Read assignments on mechanical power output.
2. Participate in class discussion.
3. Teacher presentation.

TASK # 26

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Mechanical

TASK: Describe how Mechanical Power is Used in Transportation Systems.

CRITERION REFERENCED MEASURE: Develop an understanding of the utilization of mechanical power in transportation systems.

PERFORMANCE GUIDES:
1. Read assignments on the application of mechanical power in transportation.
2. Participate in class discussion.
3. Teacher presentation.
TASK # 27

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Fluid

TASK: Define Fluid Power.

CRITERION REFERENCED MEASURE: Define the term fluid power.

PERFORMANCE GUIDES:
1. Read assignments on fluid power.
2. Participate in class discussion.
3. Teacher presentation.

TASK # 28

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Fluid

TASK: Define the Term Hydraulic.

CRITERION REFERENCED MEASURE: Develop an understanding of the term hydraulic.

PERFORMANCE GUIDES:
1. Read assignments on hydraulics.
2. Participate in class discussions.
3. Teacher presentation.
4. Student activity in hydraulics.
TASK # 29

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Fluid

TASK: Define the Term Hydrodynamics.

CRITERION REFERENCED MEASURE: Acquire an understanding of the term hydrodynamics.

PERFORMANCE GUIDES:
1. Read assignments on hydrodynamics.
2. Participate in class discussion.
3. Teacher presentation.

TASK # 30

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Fluid

TASK: Define the Term Hydros: ics.

CRITERION REFERENCED MEASURE: Develop an understanding of the term hydrostatics.

PERFORMANCE GUIDES:
1. Read assignments on hydrostatics.
2. Participate in class discussion.
3. Teacher presentation.
TASK # 31

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Fluid

TASK: Define the Term Pneumatics.

CRITERION REFERENCED MEASURE: Develop an understanding of the term pneumatics.

PERFORMANCE GUIDES:

1. Read assignments on pneumatics.
2. Participate in class discussion.
3. Teacher presentation/demonstration on pneumatics.

TASK # 32

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Fluidics

TASK: Describe the Transmission of Fluid Power.

CRITERION REFERENCED MEASURE: Describe the process in which fluid power is transmitted for utilization.

PERFORMANCE GUIDES:

1. Read assignments on the transmission of fluid power.
2. Participate in class discussion.
3. Teacher presentation.
TASK # 33

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Fluidics

TASK: Describe the Uses of Fluid Power in Transportation Systems.

CRITERION REFERENCED MEASURE: Develop an understanding of the uses of fluid power in transportation systems.

PERFORMANCE GUIDES:

1. Read assignments on the utilization of fluid power in transportation.
2. Participate in class discussion.

TASK # 34

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Electrical

TASK: Define the Term Electrical Power.

CRITERION REFERENCED MEASURE: Define the term electrical power.

PERFORMANCE GUIDES:

1. Read assignments on electrical power.
2. Participate in class discussion.
3. Teacher presentation.
TASK # 35

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Electrical

TASK: List and Describe Sources of Electrical Power.

CRITERION REFERENCED MEASURE: Describe and list various sources of electrical power.

PERFORMANCE GUIDES:

1. Read assignments on sources of electrical power.
2. Participate in class discussion.
3. List sources of electrical power.

TASK # 36

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Electrical

TASK: Describe Generators and the Generation of Electric Power.

CRITERION REFERENCED MEASURE: Develop an understanding of generators and how they are used to generate electrical power.

PERFORMANCE GUIDES:

1. Read assignments on generators.
2. Participate in class discussions.
3. Teacher presentation.
TASK # 37

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Electrical

TASK: Describe the Transmission of Electrical Power.

CRITERION REFERENCED MEASURE: Acquire a knowledge of how electrical power is transmitted for utilization.

PERFORMANCE GUIDES:
1. Read assignments on the transmission of electrical power.
2. Participate in class discussion.

TASK # 38

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Electrical

TASK: List and Describe Methods of Controlling Electrical Power.

CRITERION REFERENCED MEASURE: List and describe several methods used in the control of electrical power.

PERFORMANCE GUIDES:
1. Read assignments on controlling electrical power.
2. Participate in class discussion.
3. List methods used in the control of electrical power.
TASK # 39

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Electrical

TASK: Compare and Contrast Power Loads and Electrical Power.

CRITERION REFERENCED MEASURE: Compare and contrast the terms power loads and electrical power.

PERFORMANCE GUIDES:
1. Read assignment on power loads.
2. Participate in class discussion.
3. Teacher presentation.

TASK # 40

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Electrical

TASK: Describe the Utilization of Electrical Power in Transportation Systems.

CRITERION REFERENCED MEASURE: Develop an understanding of how electrical power is utilized in transportation systems.

PERFORMANCE GUIDES:
1. Read assignments on the utilization of electrical power in transportation.
2. Participate in class discussions.
3. Teacher presentation.
TASK # 41

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Nuclear

TASK: Describe the Use of Nuclear Reaction as a Source of Power.

CRITERION REFERENCED MEASURE: Develop an understanding of the uses of nuclear as a source of power.

PERFORMANCE GUIDES:
1. Read assignments on nuclear power.
2. Participate in class discussion.
3. Teacher presentation.

TASK # 42

AREA OF COMPETENCE: Power and Transportation Technology

CONTENT/CONCEPT: Types of Power/Nuclear

TASK: Contrast the Utilization of Nuclear Power in Transportation Systems.

CRITERION REFERENCED MEASURE: Acquire a knowledge of the utilization of nuclear power in transportation systems.

PERFORMANCE GUIDES:
1. Read assignments on utilization of nuclear power in transportation.
2. Participate in class discussion.
3. Teacher presentation.