AN IDENTIFICATION OF ELECTRICAL COMPETENCIES WITH OPINIONS ON EDUCATIONAL ORDER AND NOTE OF IMPORTANCE BY ELECTRICAL CONTRACTORS AND INSTRUCTORS

By

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CHAPTER I

INTRODUCTION

In a time when only 20 percent of all jobs require a college education, the importance of vocational preparation for the "world of work" is obvious. There are many factors that require consideration during the planning of a course of study for an employment-oriented vocational program. Decisions on questions such as what to teach, what to order should it be presented and how much time should be spent on each topic have to be based on the future employment opportunities of the students.

According to Melvin L. Barlow (1) "course content must be determined upon the basis of an analysis of the occupation or family of occupations" (p. 412). Analyzing the occupation will provide a list of competencies required of people currently working in the trade. Reproducing these competencies in a vocational program will provide job-oriented experiences for students planning to enter the trade.

After the competencies have been determined, an order for presentation and the note of importance must be established. The order in which these competencies are presented is determined by their relationship to each other. Often the ability to perform one competency is contingent on mastery of another.

The note of importance for each competency will have to be determined by people currently associated with the occupation. The note of

importance will then reflect the significance each competency has to people currently in the occupation.

Statement of the Problem

As the electrical trades become more diverse in their occupational practices, the need for more research-directed educational activities becomes eminent. Careful planning is needed to insure that the competencies taught in electrical trades programs are occupationally oriented.

The competencies learned by vocational electrical trades students must parallel the job requirements of the occupation. This matching of competencies is needed for successful assimilation into the electrical trades.

The problem of deciding what competencies to teach, what order to present them and how important they are to the occupation is a major concern to most vocational educators. Educational objectives should be planned and developed according to needs derived from a study of current occupational practices.

Purpose of the Study

The purpose of this study was to develop a list of occupational competencies from the electrical trades area and have tradesmen assign a rank order for educational presentation and place a note of importance on them. This provided information that could be used for the construction of a course of study that is employment-oriented.

Objectives of the Study

To accomplish the purpose of this study, the following objectives were formulated:

1. Search the literature and list the most frequently occurring competencies in the electrical trades.

2. Establish an order for the educational presentation of these competencies in the electrical trades.

3. Establish an order that will give a note of importance for these competencies.

Assumptions of the Study

For the purpose of this study, the following assumptions were accepted:

1. That tradesmen used in this study were representative of Oklahoma's electrical trades.

2. That the tradesmen used in this study were qualified to analyze the competencies for an electrical trades program.

3. That the instrument developed for gathering data was suitable for the purpose intended.

Scope

This research included the opinions of 12 secondary electrical trades instructors and 20 cooperating contractors from across the state. The opinionnaire used in this study was hand delivered to each individual.

Definitions of Terms

The following definitions of terms are furnished to provide, as nearly as possible, clear and concise meanings of the terms as used in this study.

Electrical contractor is a person currently owning or operating a business involved in electrical installations.

Competency refers to a specific block of knowledge and skill. It has a definite stopping point, but can be a part of a larger job.

Tradesmen refers to skilled workers.

CHAPTER II

REVIEW OF LITERATURE

The importance of planning is obvious in the development of a course of study for a vocational program. The experiences that the student has must aid him in achieving his occupational objectives. As Gordon G. McMahon (2) states: "Curriculum must meet the needs of the student rather than the desires of the developer" (p. 2).

If a student in a job-oriented vocational program is to achieve success in his chosen occupational area, he must be trained in current practices. His trade competencies must match the needs of the occupational job market. The curriculum, then, for job-oriented vocational programs must have input from people who have had experiences in the occupation. McMahon (2) supports this philosophy in this statement: "Vocational curriculum must be developed by those who know the fields of study involved through work experience" (p. 2).

Preparation for effective teaching has a definite starting point. Verne C. Fryklund (3) states: "In order to teach an occupation or a subject or an activity, there first must be an inventory of the elements to be taught" (p. 1). McMahon (2) makes this statement: "The first step is preparation of an instructional list of items which the teacher feels are important enough to be taught" (p. 79). Though stated slightly different, both author's thoughts run parallel. They both agree that deciding on the elements to be covered is the first step in developing a course of study.

Instrument Planning

The first objective of this study was to prepare a list of competencies suitable for use in a vocational electrical trades class. This researcher used electrical wiring texts to develop a concensus list of competencies. The following authors' texts were used: H. P. Reichter (4), Henry A. Miller (5) (6), Elmer W. Jones (7), Kennard C. Graham (8) and Walter N. Alerich (9). Seventeen competencies were selected on a frequency of occurrence bases from these texts. These seventeen competencies were incorporated into an opinionnaire in order to achieve the purpose of this research.

McMahon (2) describes our second objective in this statement: "The next step involves a reorganization of the entire list into a sequence which seems logical in terms of the complexity of the occupation itself" (p. 82). This researcher used electrical contractors and electrical trades instructors to arrange the list in its educational order. A column on the right hand side of the opinionnaire was left for these people to designate their educational order.

McMahon (2) describes another need in this statement: "With the sequential outline established, the teacher must turn to consideration of the amount of time needed to present each item to an average class" (p. 84). This researcher felt that a note of importance would aid instructors in planning their time allocations. A column was left on the left hand side of the opinionnaire for the electrical contractors and instructors to designate a note of importance for each competency.

Pitfalls and Summary

In beginning this research, a few pitfalls or obstacles were encountered. One of these was the variation in terminology. It was a difficult task to arrange the skills under a concensus competency title.

This research is current, yet it covers only the traditional skills and has no intent on trying to place order to all electrical areas.

Hopefully, this research will be used (if the desired concensuses arise) in many electrical trades classes. Hopefully, tomorrow's students will receive an education related directly to the employment opportunities in their future.

We are all aware of the very real connection between the lives we lead and careers we pursue. Students, likewise, are concerned about their possibilities, limitations, and sources of reliable information. They deserve every opportunity to make decisions, try things, and become the individuals they want to be.

According to W. James Popham and Eva L. Baker (10): "There are three major sources from which objectives may be constructed: the learner, the society, and the subject matter" (p 49). This research used that portion of society which is currently involved with the occupation. The competencies or subject matter were derived from electrical texts. The individual instructors will have to find the students' objectives.

CHAPTER III

METHODOLOGY

The major purpose of this study was to establish a list of electrical trade competencies and give them an educational order and note of importance. This chapter is a description of the methods used to achieve that purpose.

Population

The population was composed of 12 Oklahoma secondary vocational electricity instructors and electrical contractors they recommended for the study. Each instructor was asked to supply the names of four electrical contractors whom they felt would assist in the study. If an instructor could not supply the names of four contractors, then the number he could recommend was contacted. If a contractor did not wish to participate, no substitutions were made. This researcher felt that only interested people should be used.

Methods

A list of competencies for the opinionnaire was established by a frequency tabulation of their appearance in eight electrical texts. Seventeen competencies were listed and given to a panel of four electrical contractors for evaluation and revision as suggested. The names and addresses of these consulting contractors are listed in the appendix.

The opinionnaires were individually given to the electrical trades instructors with directions for completing them. An explanation was also given for the purpose of this research. The instructors were then asked to recommend four area contractors who would assist in this research. The individual opinionnaires were given to the contractors with the same directions that the instructors received.

The opinionnaires required the surveyed population to rank the list of competencies twice. The first time they ranked the competencies, they were asked to number them in the space provided from one to seventeen. This ranking indicated the importance that each competency had in their daily work.

In the second ranking, the instructors and contractors expressed their opinions on the order for presentation of the competencies. The contractor's educational order was believed to be valuable because of their current involvement with the occupation.

It was hoped that the resulting data would have natural breaks form in it so as to facilitate the final assigning of the competencies in an educational order and to designate their note of importance.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This chapter consists of presentation and analysis of the data obtained from opinionnaires received from the vocational electricity instructors and selected contractors.

Of the twelve instructors in the state, only five could list the requested four contractors. The large percentage of new programs and instructor turnover made it difficult for these people to come up with the requested number of contractors. Of the forty-five opinionnaires, 32, or 71.11 percent, were returned.

The opinionnaire was designed to retrieve two classes of data; (1) an educational rank, and (2) an industrial note of importance.

Analysis of Educational Rank Data

An opinionnaire of this type has many areas that seem related or similar because of their job interdependency. This caused the majority of the rankings to fall on two or more rank positions. Two positions may have received eighty percent of the rankings with neither actually receiving fifty percent. Because of this quality, most of the competencies were ranked within groups of four. Individual ranking inside the groups are given according to the total percentage of rankings received by each competency that fell in that group. By analyzing the electrical safety competency data separately, this researcher was left

with four groups of four. They are (2-5), (6-9), (10-13) and (14-17) respectively.

Analysis of Safety Competency Data

Electrical safety is analyzed in Table I and will have the assigned rank of one (illustrated as (1) on table) both in educational order and note of importance classifications. Table I has the data for the safety competency expressed with individual percentages of rankings by contractors and instructors as well as total percent for each ranking between one and seventeen. Under "Educational Rank" safety received 92 percent of the instructors' ranks and 100 percent of the contractors' ranks for the number (1) position. The only rank for safety that did not fall in the number (1) position fell in the ten through thirteen group. The lower half of Table I deals with the note of importance. Safety received 100 percent of the instructors' ranks and 70 percent of the contractors' ranks for the (1) position.

Table I has five considerations for the safety data. They are educational rank and note of importance, percent of instructors, percent of contractors and percent of total. Safety has the educational rank of number one. Safety received 100 percent of the contractor number one rankings and 92 percent of the instructors. The total percent figures come from combining the total rankings made for number one and divided by the total rankings made for the area of safety. The only rank not received by the number one slot fell in the group composed of ranks ten through thirteen. The second half of this Table I deals with the note of importance ranking. The data in this half is interpreted in the same manner as was done for the educational rank.

TABLE I

EDUCATIONAL RANK AND NOTE OF IMPORTANCE FOR ELECTRICAL SAFETY COMPETENCY

Educational Rank	Percent of Instructors	Percent of Contractors	Percent of Total
(1)	91.67	100	96
(2-5)	0	0	0
(6-9)	0	0	0
(10-13)	8.33	0	4
(14-17)	0	0	0
Note of Importance			
(1)	100	70.59	82.14
(2-5)	0	11.76	7.14
(6-9)	0	5.88	3.57
(10-13)	0	5.88	3.57
(14-17)	0	5.88	3.57

Analysis of Educational Order Data

Table II shows the competencies that fell in the two through five (2-5) group for educational rankings. The first competency on this table is basic switching situations. Looking under "Percent of Rankings in Group" it is seen that 100 percent of the instructors' rankings fell

in this group. It is also seen that 88.24 percent of the contractors' rankings fell within this group.

TABLE II

EDUCATIONAL RANK FOR COMPETENCIES WITH PERCENTAGE FIGURES FOR GROUP (2-5)

Competency	Percent of Rankings in Group Instructors	Contractors	Percent of Total	Individual Rank
Basic Electrical Theory	100	88.24	92.30	2
Basic Switching Situations	63.64	52.94	57.14	3
Tools	58.33	47.06	51.72	4
Testing Equipment	75	35.29	50	5

Table II is a good example of how frequency distribution broke the data down into groups. There seldom were enough rankings on exactly one numeric position to make it clearly identifiable. In Table II, for instance, 57.14 percent of the population sampled felt the basic switching competency fell in the two through five group. While this is evidence that the majority of the people felt it should be taught early in relation to other competencies, it was a frequency

distribution within the group that gave it the individual rank of three. In the group, only 9 percent of the instructors and 18 percent of the contractors had actually ranked it specifically as an educational rank of three.

The higher the total percentages, the higher a competency was ranked in Table II and Table III. The higher frequency of early individual rankings indicated a more prevalent opinion that the competency should be taught sooner than one with a lower percentage in the same group. Both tables list the competencies in their data assigned order. Both tables list total percentages as well as the percentages of both instructors' and contractors' rankings that were received in the group.

TABLE III

EDUCATIONAL RANK FOR COMPETENCIES WITH PERCENTAGE FIGURES FOR GROUP (6-9)

Competencies	Percent of Rankings in Group Instructors	Contractors	Percent of Total	Individual Rank
Boxes and Fittings	75	76.47	75.86	6
Making Up Conductors	50	58.82	53.33	7
Cables and Wires	33.33	52.94	48.15	8
Wiring 3-Way and 4-Way Switches	41.67	47.06	44.83	9

Tables IV and V are ranked just opposite of Tables II and III. The higher percentages in these two tables are the lowest ranking. The higher the percentage, the more prevalent the opinion that this competency should be taught later.

TABLE IV

EDUCATIONAL RANK FOR COMPETENCIES WITH PERCENTAGE FIGURES FOR GROUP (10-13)

Competency	Percent of Rankings in Group Instructors	Contractors	Percent of Total	Individual Rank
Installing Devices	41.67	23.53	31.03	10
Box Location and Placement	33.33	47.06	41.38	11
Overcurrent Devices	66.67	29.41	44.82	12
Service Installations	58.33	47.06	51.72	13

Table V contains the third and fourth highest total percentage received by competencies in this research. These percentages correspond with the flourescent lighting and electric motor competencies, ranking them 16 and 17 respectively. Almost all of the population sampled felt these elements should be covered at the end of the educational process.

TABLE V

EDUCATIONAL RANK FOR COMPETENCIES WITH PERCENTAGE FIGURES FOR GROUP (14-17)

Competency	Percent of Rankings in Group Instructors	Contractors	Percent of Total	Individual Rank
Panels and Overcurrent Protection Enclosures	45.45	58.81	50	14
Conduit Bending	83.33	52.94	63.33	15
Flourescent Lighting	91.67	88.13	89.65	16
Electric Motors	100	82.35	89.65	17

Table VI is a composite of Tables I, II, III, IV, and V with the competencies and their descriptions arranged according to the analysis of data.

Analysis of Note of Importance Data

The note of importance rankings reflects how important each of these competencies are to a tradesman in everyday activities. The data and resulting rank order for note of importance of each competency will emphasize the need for more expertise in the higher ranking competencies than in the lower ranking ones.

The data for note of importance ranking was evaluated at a midpoint break. Since the number one note of importance has already been

TABLE VI

COMPETENCIES WITH ASSIGNED EDUCATIONAL ORDER

Educational Rank	Competencies and Descriptions
1	Electrical safety--including methods of removing victims from live wires, types of fire extinguishers, tagging of equipment while servicing and disconnecting equipment.
2	Basic electrical theory--Ohm's Law, other basic math, terminology, series and parallel circuits and checking for current.
3	Basic switching situations--wiring a single pole switch to control a light, color codes, code rules and terminology.
4	Tools--types, care and usage.
5	Testing equipment--ampmeters, VOM, their uses and application.
6	Boxes and fittings--understanding box fill, making common boxes and fittings as well as demonstrate their application.
7	Making up conductors--all types of junction box and lighting outlet make-up.
8	Cables and wires--identification of various type cables and wires and know their uses.
9	Wiring 3-way and 4-way switches--legal and illegal methods, 4-ways to feed supply wires.
10	Installing devices--installing devices, identifying terminals, code rules and terminology.
11	Box location and placement--finding center points of rooms, counter space requirements, calculating heights, code book requirements, etc.
12	Service installations--required sizes and calculations, heights, parts identification and code facts on grounding, etc.
13	Panels and overcurrent protection enclosures--installation, types and special applications.
14	Over-current devices--fuse, breakers, code requirements, etc.
15	Conduit bending--degrees allowed per run, saddles, offsets, stubs, cutting and reaming.
16	Flourescent lighting--terminology, parts, operation of various types of flourescent lighting.
17	Electric Motors--identification of types, interpreting plates, selection factors, light maintenance and repair.

assigned to safety, then the remaining sixteen competencies can be broken into two groups. In one group, the higher frequency distribution of rankings is between two and ten, while in the other group, the higher frequency of rankings occurs between eleven and seventeen. This form of evaluation was used because of the break that occurred in the data and also, because of a lack of concensus rankings on individual positions.

In Table VII, rank positions were assigned to the competencies according to the percentages of rankings they received in that group. The higher the percentage, the higher the rank an individual competency received with the group. The cables and wires competency received the highest total percentage and was ranked two in Table VII.

TABLE VII

ASSIGNED RANKINGS FOR NOTE OF IMPORTANCE OF COMPETENCIES (2-10) GROUP

Competency	Percent of Rankings in Group Instructors	Contractors	Percent of Total	Individual Rank
Cables and Wires	81.81	86.66	84.61	2
Installing Devices	90.90	75.00	82.14	3
Making Up Conductors	72.72	82.35	81.48	4
Basic Switching Situations	90.90	76.47	81.48	5
Wiring 3-way and 4-way switches	72.72	70.58	72.41	6

TABLE VII (Continued)

Competency	Percent of Rankings in Group Instructors	Contractors	Percent of Total	Individual Rank
Overcurrent Devices	63.63	76.47	71.42	7
Service Installations	63.63	68.75	64.28	8
Tools	63.63	53.33	57.69	9
Box Location and Placement	36.36	68.75	53.57	10

Table VIII contains the competencies whose data had higher frequencies of rankings in the eleven to seventeen classification. Their interpretation is just opposite of Table VII. In Table VIII, the higher ranking percentages are the least important competencies. The lower percentages, in this group, are ranked highest. Basic theory had 52 percent of its total rankings fall within the eleven through seventeen group. This means that 42 percent of the basic theory rankings were in the (2-11) group. It is then considered more important than the flourescent lighting competency which only received seven percent in the (2-11) group.

TABLE VIII

ASSIGNED RANKINGS FOR NOTE OF IMPORTANCE
OF COMPETENCIES (11-17) GROUP

Competency	Percent of Rankings in Group Instructors	Contractors	Percent of Total	Individual Rank
Boxes and Fittings	27.27	50	40.74	11
Basic Theory	9.09	23.52	44.44	12
Panels and Overcurrent Protection Enclosures	63.63	47.05	46.42	13
Testing Equipment	34.54	64.70	60.71	14
Conduit Bending	72.72	70.58	71.42	15
Flourescent Lighting	100	82.35	89.28	16
Electric Motors	100	82.35	89.28	17

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter includes a summary of the study with the major findings. Also presented are conclusions and recommendations based on the analysis and presentation of data collected.

Summary

The major purpose of this study was to develop a list of electrical trade competencies and have tradesmen give them an educational order and express an opinion on a note of importance. To perform this purpose, objectives for this study were: (1) to search the literature and list the most frequently occurring competencies in the electrical trades, (2) to establish an order for the educational presentation of the competencies in the electrical trades, (3) to establish an order that will give a note of importance for these competencies in the electrical trades.

The list of competencies for the opinionnaire was established by a frequency tabulation of their appearances in electrical trades textbooks. The list of competencies was checked and approved by a consulting board of electrical contractors.

The competencies were placed on an opinionnaire which provided space for the tradesmen to assign an educational rank and note of importance.

Twelve secondary Oklahoma vocational electrical trades instructors and 20 electrical contractors made up the group of tradesmen. The researcher hand delivered the opinionnaire to each tradesman.

An opinionnaire of this type has many areas that seem related or similar because of their job interdependency. This caused the data to form natural breaks at quarter groups in the educational order data. The note of importance data break was at midpoint in the list of competencies for the electrical trades.

Conclusions

The following conclusions were based on the outcomes of this study:

1. Most tradesmen feel that safety is the most important competency in the electrical trades.

2. Based on the responses given, those surveyed felt safety should be taught first to electrical trades students.

3. The importance which a competency has to the occupation has little or no effect on when it should be presented in an educational situation.

4. There is general agreement among tradesmen on the educational order that should be used in the presentation of electrical trade competencies to students.

5. The job interdependency between the competencies made it difficult to achieve a concensus rank.

Recommendations

Based on the findings of this study, the following recommendations are made.

1. That independent studies be made by vocational electricity instructors to determine how well their curriculums are meeting student needs.

2. That further study be conducted to see if an occupational note of importance can be used to allocate a duration of study for electrical trades competencies.

3. That further study be conducted which would support the use of occupationally oriented educational objectives.

4. That all curriculum development should be based on an analysis of current occupational practices.

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APPENDIXES

CONSULTING CONTRACTORS

Bill Stites - Alva Electric Supply
Alva, Oklahoma

Bob Pettyjohn - Eddy Electric Supply
Shawnee, Oklahoma

Darrel Kline - Northwest Electric
Alva, Oklahoma

Frank Sanders - Northwest Electric
Alva, Oklahoma

Below is a list of electrical competencies. First, I would like you to read through the competencies and place them in order from 1-17 in column "A" according to the importance this task has in your work. Then I would like you to place them in order in column "B" according to how you would teach an apprentice these facts.

A		B
_____	Electrical safety--including methods of removing victims from live wires, types of fire extinguishers, tagging of equipment while servicing and disconnecting of equipment.	_____
_____	Basic electrical theory--Ohms Law, other basic math, terminology, series and parallel circuits and checking for current.	_____
_____	Basic switching situations--wiring a single pole switch to control a light, color codes, code rules, and terminology.	_____
_____	Installing devices--installing devices identifying terminals, code rules and terminology.	_____
_____	Wiring 3-way and 4-way switches--legal and illegal methods, 4-ways to feed wires.	_____
_____	Making up conductors--all types of junction box and lighting outlet make-ups.	_____
_____	Over-current devices--fuse, breakers, code requirements, etc.	_____
_____	Box location and placement--finding center points of rooms, counter space requirements, calculating heights, code book requirements, etc.	_____
_____	Flourescent lighting--terminology, parts, operation of various types of flourescent lighting.	_____
_____	Service Installations--required sizes and calculations, heights, parts identification and code facts on grouding, etc.	_____
_____	Electric Motors--identification of types, interpreting plates, selection factors, light maintenance and repair	_____
_____	Conduit Bending--degrees allowed per run, saddles, off-sets, stubs, cutting and reaming.	_____
_____	Cables and wires--identification of various types of cables and wires and know their uses	_____

_____	Boxes and fittings--understanding box fill, making common boxes and fittings as well as demonstrate their application.	_____
_____	Panels and overcurrent protection enclosures--installation, types and special applications.	_____
_____	Testing equipment--ampmeters, VOM, their uses and application.	_____
_____	Tools--types, care and usage	_____

Other (specify)

VITA

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Master of Science

Thesis: AN IDENTIFICATION OF ELECTRICAL COMPETENCIES WITH OPINIONS ON EDUCATIONAL ORDER AND NOTE OF IMPORTANCE BY ELECTRICAL CONTRACTORS AND INSTRUCTORS

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Professional Organization: American Vocational Association, Oklahoma Vocational Association, National Education Association, Oklahoma Education Association, Iota Lambda Sigma Fraternity.