107th Mississippi Valley Technology Teacher Education Conference and the 58th Southeastern Technology Education Conference
Nashville, TN

SESSION VI: MVTTEC – Related Research

Curriculum Development Using the Delphi method for competency-based education courses.

Dr. Dominick O. Manusos
Millersville University
November 19th, 2021

The Introduction

At a previous combined conference, a dissertation topic was proposed during a STEC presentation. This proposed dissertation was on identifying course objectives for a "tiny house" course related to construction. The reason for this proposal was due to the increase of tiny houses being built by high schools, community colleges, and universities. I heard of programs doing this for various reasons, including; saving costs and build space compared to full-scale construction, to incorporate consistent educational experiences between cohorts of students, as a way to raise funds (after sale of the structure), as a way to provide service to community or non-profits, and also because it was hip and trendy. When the time came for a proposal to my graduate committee, they recommended sharing this proposal with this group of educators to glean what could not be gleaned from a single committee alone. A presentation was given, advise was provided, and copious notes were scrawled by a dear colleague. This crucible helped to refine and define the direction of this dissertation, and for that I wish to convey my sincerest thanks.

This conference paper is an executive summary of a dissertation submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the degree of Doctor of Education. It is this researcher's intent to share the reasoning, justification, methods, data, findings, and conclusions of this dissertation.

The Need and Justification

Tiny house construction has been a part, albeit a small one of modern construction practices for some years now; the longevity of this movement is yet to be determined. As the cost of this type of project is much smaller than constructing a 1:1 scale house, tiny house construction has been included in some construction courses; however, while the fundamentals are similar, there are some specific details that are different than traditional home construction. If these differences are specific to tiny home construction, should the courses being taught not also include specific objectives to discuss these differences and prepare students to construct these houses using best practices for tiny home construction?

Very little research has been contributed to the area of identifying what the program level objectives should be in a tiny home construction course. This study will be one component to help develop curriculum to address the specifics of tiny home construction. More research will be needed to organize, and develop course outcomes, student learning objectives, course content and assessments. The research question posed for this dissertation was:

- What are the educational objectives to be included in a post-secondary, competency-

based education course that focuses on construction and builds a tiny house as the project for the students?

The Literature Review

To begin the process of answering this question, a literature review was part (Chapter 2) of the dissertation. The full dissertation can be found at the North Carolina State University Libraries Institutional Repository:

https://www.lib.ncsu.edu/resolver/1840.20/39113

The literature review briefly covered the history of Career and Technical Education, starting with the European model of apprenticeship, the incorporation of manual training in American public education, and how that evolved over the course of American history (American Vocational Association, 1976a; American Vocational Association, 1976b; American Vocational Association, 1976c; American Vocational Association, 1976d; Gordon & Schultz, 2020). This understanding of where Career and Technical Education came from and how it was incorporated into the American public education system helped to define where construction courses came from, how they were implemented, and what their purpose was. A review of modern and not-so-modern construction curriculum showed that commercially available textbooks on traditional residential construction or carpentry included the traditional methods, with limited inclusion of alternative construction methods (Industrial Arts Curriculum Project, 1970; Kicklighter, Kicklighter, & Baird, 1995; Pierce & Karwatka, 2005; Wright & Brown, 2012). Comparing this review of literature with modern trends it was evident that there was a growing use of tiny houses in construction courses, but no validated educational objectives (EOs) from which to base a tiny house curriculum. But how does one choose EOs to be included in a curriculum, and furthermore, what process is used to validate those EOs? Experts in tiny house construction were identified by other experts in the field. Using a combination of the CTETE Directory, trade show contacts, and a national list of tiny house companies, experts in the tiny house construction field were identified and nominated by other experts. Those nominees were then solicited for their participation in a conventional four-round Delphi study. Expertise was represented by high school teachers, trade school faculty, university faculty, and industry professionals. All of these experts had experience with designing or building tiny houses. Thirteen experts provided input for the rounds, and three experts were part of the review panel to limit bias throughout the process. The goal of the research was to identify EOs as defined by Krathwohl & Anderson (2001), and then to validate these EOs through subsequent rounds of the Delphi process. Qualtrics was used to disseminate the survey/questionnaire. Data were stored in a secure online cloud-based storage system, behind dual authentication, and were de-identified.

The Methodology

Demographics and Examples

The first portion of the research involved collecting pertinent demographic data, as well as providing some examples of EOs.

Round 1

The first round of the Delphi used the EO examples provided (Table 1) and allowed the participants to accept, modify, reject the examples. Participants were then also allowed to provide their own EOs related to tiny house construction. They were also allowed to provide

feedback on the examples provided. The EOs from round 1 can be found on Table 2.

Round 2

The second round had the experts **rate** all of the EOs from the first round with a Likert Scale from 1 (low importance) to 5 (high importance). The mean and standard deviation were then calculated (Table 3), and any EO with a mean score above the statistical mean of 3.0 were retained for the next round (Clark, 1997).

Round 3

The third round had the experts **rank** the remaining EOs in order from 1 (highest priority) to 57 (lowest priority). These rankings were analyzed in two ways, the first determined a correlation coefficient of the ***means***, and the second determined a correlation coefficient of the ***ranks*** (Clark, 1997). Both analyses were done as a Spearman's Rho to determine the correlation of the scores. Finally, any EOs ranked in the top 50^{th} percentile were retained for the next round (Clark, 1997). These data can be found on Table 4.

Round 4

The fourth round had the experts provide final acceptance or rejection of the now remaining EOs. A Chi Squared goodness of fit test was conducted on the acceptance versus rejection rate. Any EOs found to have statistical significance were retained (Table 5).

Post Delphi

Participants were then sent the final list (Table 6) of EOs that had advanced through all four rounds of the Delphi. Participants will be given access to the completed study and full dissertation once a link to the NCSU Libraries Institutional Repository becomes available (See link above).

The Data

The data on subsequent pages represents the collected and analyzed data from all 4 rounds of the Delphi study. Some rounds will prove additional explanations of the analysis as it relates to how the data was analyzed and retained.

Table 1

List of Example Educational Objectives Provided for Round 1

List of Example Educational Objectives
Upon completion of this course, students will be able to:
Safely use hand tools and power tools
Understand the process of (residential) construction
Interpret a set of construction plans (Blueprints)
Design a tiny house
Design a structure to meet building codes
Build a structure to meet building codes
Plan for storage during construction and for use of structure after construction
Understand subfloor construction
Apply wall framing procedures
Implement roof and truss design
Apply stair layout and building procedures
Apply foundation procedures
Apply roof framing procedures
Apply roofing applications
Apply thermal and moisture protection
Apply exterior door and window installation
Apply exterior finishing
Apply interior finishes, hardware, and trim
Apply electrical installation procedures
Apply plumbing installation procedures
Apply HVAC installation procedures
Design an energy efficient structure
Design a space efficient structure
Design an environmentally friendly structure
Design a structure that is sustainable

Table 2

Round 1 Educational Objective List Returned from Experts

Round 1 Educational Objectives (N=13)
Upon completion of this course, students will be able to:
Understand and Apply the safe use of hand tools and power tools.
Understand the process of residential construction.
Differentiate between full-scale and small-scale construction.
Create a set of plans for construction.
Interpret a set of plans for construction.
Design a tiny house.
Build a tiny house.
Design a structure to meet acceptable codes (building, safety, municipal, etc.)
Build a structure to meet acceptable codes. (building, safety, municipal, etc.)
Understand the process for designating and securing a worksite for tiny home construction.
Plan for storage during construction.
Plan for use of structure after construction.
Plan for transportation of structure.
Understand and Apply floor framing procedures.
Understand and Apply finished flooring installation procedures.
Differentiate between types, materials, and finishes for finished floors.
Understand and Apply wall framing procedures.
Understand and Apply roof framing procedures.
Differentiate between framed and truss roofs.
Understand and Apply stair construction procedures.
Design stairs that meet code and/or can be used safely.
Build stairs that meet code and/or can be used safely.
Understand and Apply foundation construction procedures.
Differentiate between permanent and temporary foundations.
Understand and Apply roofing procedures.
Differentiate between roofing products/materials.
Understand and Apply moisture protection procedures
Understand and Apply thermal protection procedures.
Understand and Apply exterior door and window construction procedures.
Understand and Apply exterior finishing procedures.
Differentiate between exterior finishing products/materials.
Understand and Apply interior finishing procedures.
Differentiate between interior finishing products/materials.
Understand and Apply electrical installation procedures.
Differentiate between electrical components, fixtures, and finishes.
Understand and Apply plumbing installation procedures.
Differentiate between plumbing components, fixtures, and finishes.
Understand and Apply HVAC installation procedures.
Differentiate between HVAC components, fixtures, and finishes.
Design an energy efficient structure.
Design a space efficient structure.
Design an environmentally friendly structure.
Understand the environmental impact of the structure.
Design a structure that can apply principles of sustainability.

Table 2 (continued).

Build a structure that can apply principles of sustainability.
Design a structure within client specifications.
Build a structure within client specifications.
Communicate with city and municipal officials effectively.
Consider budgetary restrictions.
Understand and Apply specialty utility connection procedures (campsite, RV, mobile home, ADU).
Understand and Apply winterizing techniques.
Understand and Apply certification and inspection processes for registration/insurance/title work.
Understand and Apply cabinetry and millwork installation procedures.
Differentiate between types and materials of cabinetry and millwork.
Design interior lofted spaces.
Build interior lofted spaces.
Understand and Apply appliance installation procedures.
Differentiate between types, and finishes of appliances.
Apply principles of site factors including daylight, views, wind, vegetation, etc. into a structure.

Table 3

Round 2 Educational Objectives by Average Rating

Round 2 Objectives by Average Rating (Mean) N=13	Mean	SD
Upon completion of this course, students will be able to:		
Interpret a set of plans for construction.	4.917	0.29
Understand and Apply the safe use of hand tools and power tools.	4.833	0.39
Understand and Apply roof framing procedures.	4.667	0.65
Understand and Apply wall framing procedures.	4.583	0.67
Understand and Apply exterior door and window construction procedures.	4.583	0.67
Understand and Apply floor framing procedures.	4.5	0.80
Understand and Apply roofing procedures.	4.5	0.67
Consider budgetary restrictions.	4.5	0.67
Understand and Apply exterior finishing procedures.	4.417	0.67
Understand and Apply thermal protection procedures.	4.333	0.78
Differentiate between roofing products/materials.	4.25	0.62
Understand and Apply moisture protection procedures	4.25	0.75
Build a structure to meet acceptable codes. (building, safety, municipal, etc.)	4.167	1.40
Understand and Apply finished flooring installation procedures.	4.167	0.72
Communicate with city and municipal officials effectively.	4.167	1.19
Build stairs that meet code and/or can be used safely.	4.083	1.31
Build a structure within client specifications.	4.083	1.00
Build a tiny house.	4	1.13
Understand and Apply stair construction procedures.	4	1.13
Differentiate between exterior finishing products/materials.	4	0.85
Understand and Apply interior finishing procedures.	4	0.95
Design a space efficient structure.	4	0.95
Understand and Apply certification and inspection processes for registration/insurance/title work.	4	1.13
Apply principles of site factors including daylight, views, wind, vegetation, etc. into a structure.	4	0.60
Understand the process of residential construction.	3.917	1.00
Create a set of plans for construction.	3.917	1.16
Differentiate between electrical components, fixtures, and finishes.	3.917	1.00
Differentiate between plumbing components, fixtures, and finishes.	3.917	1.00
Design stairs that meet code and/or can be used safely.	3.833	1.27
Understand and Apply specialty utility connection procedures (campsite, RV, mobile home, ADU).	3.833	1.34
Understand and Apply winterizing techniques.	3.833	1.27
Design a structure to meet acceptable codes (building, safety, municipal, etc.)	3.75	1.42
Plan for transportation of structure.	3.75	0.97
Differentiate between types, materials, and finishes for finished floors.	3.75	0.75
Understand and Apply electrical installation procedures.	3.75	1.36
Understand and Apply plumbing installation procedures.	3.75	1.36
Understand the environmental impact of the structure.	3.75	1.14

Table 3 (continued).

Plan for use of structure after construction.	3.667	1.30
Differentiate between interior finishing products/materials.	3.667	0.89
Differentiate between HVAC components, fixtures, and finishes.	3.667	0.98
Design a structure within client specifications.	3.667	0.89
Differentiate between framed and truss roofs.	3.583	0.90
Build a structure that can apply principles of sustainability.	3.583	1.08
Understand and Apply cabinetry and millwork installation procedures.	3.583	0.90
Plan for storage during construction.	3.5	1.17
Differentiate between types and materials of cabinetry and millwork.	3.5	1.00
Understand and Apply appliance installation procedures.	3.5	1.09
Design a tiny house.	3.417	1.00
Understand the process for designating and securing a worksite for tiny home construction.	3.417	1.16
Understand and Apply foundation construction procedures.	3.417	0.79
Design an environmentally friendly structure.	3.417	1.08
Design a structure that can apply principles of sustainability.	3.417	1.08
Design an energy efficient structure.	3.333	1.15
Differentiate between types, and finishes of appliances.	3.333	0.89
Understand and Apply HVAC installation procedures.	3.25	1.22
Differentiate between permanent and temporary foundations.	3.167	1.03
Build interior lofted spaces.	3.083	1.38
Objectives Below Statistical Mean (3.0)		
Design interior lofted spaces.	2.667	1.15
Differentiate between full-scale and small-scale construction.	2.083	0.79
Across All Average Scores	**4.199**	**0.306**

Table 4

Round 3 Educational Objectives by Median Rank Order

Round 3 Educational Objectives by Median Rank Order (N=12)	R2 Mean	R3 Median	R3 Median Rankings
Upon completion of this course, students will be able to:			
100th Percentile			
Understand the process of residential construction.	3.92	2.0	1.0
Build a tiny house.	4.00	5.5	2.0
Design a tiny house.	3.42	7.5	3.0
Interpret a set of plans for construction.	4.92	8.0	4.5
Build a structure to meet acceptable codes. (building, safety, municipal, etc.)	4.17	8.0	4.5
Create a set of plans for construction.	3.92	9.0	6.0
Design a structure to meet acceptable codes. (building, safety, municipal, etc.)	3.75	11.5	7.0
Understand and Apply the safe use of hand tools and power tools.	4.83	14.5	8.0
Understand and Apply wall framing procedures.	4.58	17.0	9.0
Differentiate between framed and truss roofs.	3.58	18.0	10.0
Understand and Apply roof framing procedures.	4.67	18.5	11.0
Understand and Apply floor framing procedures.	4.50	20.5	12.0
Design a space efficient structure.	4.00	21.5	13.0
Differentiate between types, materials, and finishes for finished floors.	3.75	22.5	14.0
75th Percentile			
Consider budgetary restrictions.	4.50	23.0	15.0
Understand the process for designating and securing a worksite for tiny home construction.	3.42	23.5	16.0
Plan for transportation of structure.	3.75	24.0	17.0
Understand and Apply finished flooring installation procedures.	4.17	24.5	18.0
Build stairs that meet code and/or can be used safely.	4.08	25.0	19.0
Communicate with city and municipal officials effectively.	4.17	25.5	20.0
Understand and Apply roofing procedures.	4.50	26.0	21.0
Understand and Apply moisture protection procedures	4.25	26.5	22.0
Understand and Apply foundation construction procedures.	3.42	27.5	23.0
Differentiate between roofing products/materials.	4.25	28.0	24.5
Understand and Apply thermal protection procedures.	4.33	28.0	24.5
Plan for use of structure after construction.	3.67	28.5	26.0
Understand and Apply exterior finishing procedures.	4.42	29.0	27.0
Understand and Apply exterior door and window construction procedures.	4.58	29.5	28.0
50th Percentile			
Understand and Apply stair construction procedures.	4.00	30.0	29.5
Understand and Apply certification and inspection processes for registration/insurance/title work.	4.00	30.0	29.5
Understand and Apply interior finishing procedures.	4.00	31.0	31.0
Design stairs that meet code and/or can be used safely.	3.83	32.0	32.0
Differentiate between permanent and temporary foundations.	3.17	34.0	33.5
Understand and Apply electrical installation procedures.	3.75	34.0	33.5
Plan for storage during construction.	3.50	34.5	35.0
Differentiate between exterior finishing products/materials.	4.00	35.5	36.5
Design an energy efficient structure.	3.33	35.5	36.5
Understand and Apply plumbing installation procedures.	3.75	36.5	38.0
Differentiate between electrical components, fixtures, and finishes.	3.92	37.0	40.0
Design a structure within client specifications.	3.67	37.0	40.0

Table 4 (continued).

Understand and Apply specialty utility connection procedures (campsite, RV, mobile home, ADU).	3.83	37.0	40.0
Apply principles of site factors including daylight, views, wind, vegetation, etc. into a structure.	4.00	37.5	42.0
25th Percentile			
Understand and Apply HVAC installation procedures.	3.25	38.0	43.5
Differentiate between HVAC components, fixtures, and finishes.	3.67	38.0	43.5
Differentiate between plumbing components, fixtures, and finishes.	3.92	38.5	45.0
Understand the environmental impact of the structure.	3.75	39.0	46.5
Build a structure within client specifications.	4.08	39.0	46.5
Differentiate between interior finishing products/materials.	3.67	40.0	48.0
Design an environmentally friendly structure.	3.42	41.0	49.0
Design a structure that can apply principles of sustainability.	3.42	43.0	50.0
Build a structure that can apply principles of sustainability.	3.58	45.5	51.0
Build interior lofted spaces.	3.08	46.0	52.0
Understand and Apply winterizing techniques.	3.83	46.5	53.5
Understand and Apply cabinetry and millwork installation procedures.	3.58	46.5	53.5
Understand and Apply appliance installation procedures.	3.50	50.5	55.0
Differentiate between types and materials of cabinetry and millwork.	3.50	51.5	56.0
Differentiate between types and finishes of appliances.	3.33	52.5	57.0

Analysis of Variance Findings Round 3

A Spearman Correlation Coefficient (Spearman Rho) was done comparing the mean data from Round 2 (averaged "importance" scores) to the mean data from Round 3 (average of returned rankings). A second Spearman Correlation Coefficient was done comparing ranked data from Round 2 (ranking the means) and from Round 3 (taking the median scores and ranking them).

When comparing the mean data from Round 2 and Round 3, round 2 data was Likert data (more important being a higher number than less important) and Round 3 data was ranked data (higher rank is shown as a lower number). When Spearman's Rho correlation was calculated for the mean data from Round 2 and Round 3, perfect correlation would have been shown as -1. Spearman Rho mean correlation coefficient was -0.5423 where $p < .001$, indicating a significant moderate negative correlation.

When comparing the ranked data from Round 2 and Round 3, Round 2 means were ranked in order from greatest (1) to least (57). Round 3 ranked data was determined by ranking the calculated median scores of each objective. When Spearman's Rho correlation was calculated for the ranked data from Round 2 and Round 3, perfect correlation would have been shown as 1. Spearman Rho rank correlation coefficient was 0.5129 where $p < .001$, indicating a significant moderate positive correlation.

To gain consensus, of the remaining 57 objectives, those scoring with median rankings above the 50th percentile were retained (Clark, 1997).

Table 5

Round 4 Educational Objectives by Acceptance Rate

Round 4 Educational Objectives by Acceptance Rate (N=12)	Acc.	A%	Rej.	R%	Chi Square	p Value
Upon completion of this course, students will be able to:						
Build a tiny house.	12	100.0%	0	0.0%	12.00	< 0.001
Interpret a set of plans for construction.	12	100.0%	0	0.0%	12.00	< 0.001
Understand and Apply exterior door and window construction procedures.	12	100.0%	0	0.0%	12.00	< 0.001
Understand and Apply floor framing procedures.	12	100.0%	0	0.0%	12.00	< 0.001
Understand and Apply moisture protection procedures	12	100.0%	0	0.0%	12.00	< 0.001
Understand and Apply roof framing procedures.	12	100.0%	0	0.0%	12.00	< 0.001
Understand and Apply roofing procedures.	12	100.0%	0	0.0%	12.00	< 0.001
Understand and Apply the safe use of hand tools and power tools.	12	100.0%	0	0.0%	12.00	< 0.001
Understand and Apply wall framing procedures.	12	100.0%	0	0.0%	12.00	< 0.001
Build stairs that meet code and/or can be used safely.	11	91.7%	1	8.3%	8.33	< 0.01
Consider budgetary restrictions.	11	91.7%	1	8.3%	8.33	< 0.01
Create a set of plans for construction.	11	91.7%	1	8.3%	8.33	< 0.01
Design a space efficient structure.	11	91.7%	1	8.3%	8.33	< 0.01
Design a tiny house.	11	91.7%	1	8.3%	8.33	< 0.01
Understand and Apply exterior finishing procedures.	11	91.7%	1	8.3%	8.33	< 0.01
Understand and Apply foundation construction procedures.	11	91.7%	1	8.3%	8.33	< 0.01
Understand and Apply thermal protection procedures.	11	91.7%	1	8.3%	8.33	< 0.01
Understand the process of residential construction.	11	91.7%	1	8.3%	8.33	< 0.01
Build a structure to meet acceptable codes. (building, safety, municipal, etc.)	10	83.3%	2	16.7%	5.33	< 0.05
Design a structure to meet acceptable codes. (building, safety, municipal, etc.)	10	83.3%	2	16.7%	5.33	< 0.05
Differentiate between framed and truss roofs.	10	83.3%	2	16.7%	5.33	< 0.05
Differentiate between roofing products/materials.	10	83.3%	2	16.7%	5.33	< 0.05
Differentiate between types, materials, and finishes for finished floors.	10	83.3%	2	16.7%	5.33	< 0.05
Understand and Apply finished flooring installation procedures.	10	83.3%	2	16.7%	5.33	< 0.05

Table 5 (continued).

p value greater than .05 (Rejected)						
Understand the process for designating and securing a worksite for tiny home construction.	9	75.0%	3	25.0%	3.00	> 0.05
Communicate with city and municipal officials effectively.	8	66.7%	4	33.3%	1.33	> 0.05
Plan for transportation of structure.	8	66.7%	4	33.3%	1.33	> 0.05
Plan for use of structure after construction.	7	58.3%	5	41.7%	0.33	> 0.05

Table 7

Final Educational Objective List

Final Educational Objective List (Organized by construction process order)
Upon completion of this course, students will be able to:
Understand the process of residential construction.
Design a structure to meet acceptable codes. (building, safety, municipal, etc.)
Design a space efficient structure.
Consider budgetary restrictions.
Create a set of plans for construction.
Design a tiny house.
Interpret a set of plans for construction.
Understand and Apply the safe use of hand tools and power tools.
Build a structure to meet acceptable codes. (building, safety, municipal, etc.)
Understand and Apply foundation construction procedures.
Understand and Apply floor framing procedures.
Understand and Apply wall framing procedures.
Build stairs that meet code and/or can be used safely.
Differentiate between framed and truss roofs.
Understand and Apply roof framing procedures.
Understand and Apply moisture protection procedures
Understand and Apply exterior door and window construction procedures.
Understand and Apply thermal protection procedures.
Understand and Apply exterior finishing procedures.
Differentiate between roofing products/materials.
Understand and Apply roofing procedures.
Differentiate between types, materials, and finishes for finished floors.
Understand and Apply finished flooring installation procedures.
Build a tiny house.

The Conclusions

The findings from this research can be categorized into two areas: the research process and the research product. The process of using the Delphi Methodology and combining teacher and industry expertise allows for curriculum to be developed and relevant to current industry needs. This process can be done at a distance so save cost and can be the source of validated educational objectives to be used in curriculum development. Using statistical analysis to gain consensus allows for every identified expert to provide input while allowing them to provide that input unhindered from other experts. The remote nature of the approach from this study, would allow experts to work at their own pace, and with access to their own resources. This allows for experts to provide as much or as little input as they see fit.

Some methods of curriculum development center around one expert, one teacher, or one vendor. While this can be convenient, it is also limiting. According to Lewy, curriculum decision makers need expert input because no one individual as all the expertise to cover the integration of many competencies (1977). This method of bringing teachers and industry experts together to develop educational objectives also aligns with higher education accreditation requirements; such that programs seeking accreditation need to show alignment between instruction and industry need (ATMAE, 2021). Other examples of curriculum development may include groups of teachers in a particular content area that are hired by a state agency to identify educational objectives and instructional objectives (NCDPI, 2015). These types of curricula, known as blueprints, were used to provide examples to the experts in Round 1 of the Delphi. This specific example of "Core and Sustainable Construction" was developed by 14 secondary educators, one industry representative, and the state education consultant. No notes were found that contained insight as to the process that was used, but the experts in this example were largely comprised of teachers, with only one industry expert represented. In contrast, the Delphi performed in this research had a more equal mix of secondary educators, post-secondary educators, and industry professionals.

Additionally, this process was applied to a specific career cluster (Architecture & Construction), and a specific career pathway (Construction Pathway). Advance CTE has many other career clusters, and pathways where this research process could be applied. National or state agencies looking to review or revise their existing curricula could use a similar process to aid in identifying educational objectives that are either not already identified, or were too new for identification when the curricula were developed. Other career clusters may include Agriculture, Food and Natural Resources; Manufacturing; Science, Technology, Engineering, and Mathematics. Many of the CTE career clusters include competencies that students are expected to learn (Advance CTE, 2020b).

The full dissertation can be found at the North Carolina State University Libraries Institutional Repository:

https://www.lib.ncsu.edu/resolver/1840.20/39113

The References

Advance CTE. (2020b). Career Clusters. Retrieved September 4, 2018, from https://careertech.org/career-clusters

American Vocational Association (1976a). The Awakening 1776-1826. *American Vocational Journal, 51*(1), 23-28. Retrieved from https://www.acteonline.org/wp-content/uploads/2018/02/The-Awakening_1776-1826.pdf

American Vocational Association (1976b). Independent action 1826-1876. *American Vocational Journal, 51*(1), 31-40. Retrieved from https://www.acteonline.org/wp-content/uploads/2018/02/Independent-Action_1826-1876.pdf

American Vocational Association (1976c). The vocational age emerges 1876-1926. *American Vocational Journal, 51*(1), 46-58. Retrieved from https://www.acteonline.org/wp-content/uploads/2018/02/Vocational-Age-Emerges_1876-1926.pdf

American Vocational Association (1976d). Coming of age 1926-1976. *American Vocational Journal, 51*(1), 63-88. Retrieved from https://www.acteonline.org/wp-content/uploads/2018/02/Coming_of_Age_1926-1976.pdf

ATMAE (2021). *2021 Accreditation handbook.* Retrieved August 31, 2021 from https://cdn.ymaws.com/www.atmae.org/resource/resmgr/accred_2018/2021_accreditation_handbook_.pdf

Clark, AC. (1997). *Identification of quality characteristics for technology education programs in North Carolina* [Unpublished doctoral dissertation]. North Carolina State University.

Gordon, H. R. D., Schultz, D. (2020). *The history and growth of career and technical education in America (*5th ed.). Waveland Press.

Industrial Arts Curriculum Project (1970). *The world of construction.* (4th ed.). McKnight & McKnight Publishing Company.

Kicklighter, C. E., Kicklighter, J. C., & Baird, R. J. (1995). *Architecture: Residential drawing and design.* (7th ed.). The Goodheart-Wilcox Company, Inc.

Krathwohl, D. R., & Anderson, L. W. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman.

Lewy, A. (Ed.). (1977). *Handbook of curriculum evaluation.* Longman.

Livingston, W. (2018, May 18). *Getting high school students interested in architecture careers.* The National Council of Architectural Registration Boards (NCARB). https://www.ncarb.org/blog/getting-high-school-students-interested-architecture-careers.

North Carolina Department of Public Instruction (2015). VoCATS Blueprints. *IC00 Core and Sustainable Construction.* Retrieved from https://sites.google.com/a/dpsnc.net/dps-central/cte/course-blueprints

Pierce, A. J. & Karwatka, D. (2005). *Introduction to technology* (3rd ed.). Glencoe/McGraw-Hill.

Wright, T. R. & Brown, R. A. (2012). *Exploring design, technology, and engineering.* (3rd ed.). The Goodheart-Wilcox Company, Inc.

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