Using the Delphi Method to Identify Technical Workshop Topics

Jon R. Jones, Pittsburg State University, United States
Greg Belcher, Pittsburg State University, United States

The IAFOR International Conference on Education – Hawaii 2020
Official Conference Proceedings

Abstract
This research utilized the Delphi method to collect data from a selected panel to both identify and rank the importance of technical workshop topics in one of the sixteen Career and Technical Education (CTE) Pathways. The primary reason for selecting this research method was based on past research where it was utilized in gaining consensus on curricular items. Other reasons for selecting this research methodology included the diversity of the panel members being located in different areas of the United States, and the limited past research in this area. Also, items that were later rank ordered in round two and three were originally unknown in round one. The design of this Delphi study allowed researchers to gather information from 12 panel members. Diversity, within this panel, was utilized to ensure that input was provided from all aspects of this technical area. The final panel was comprised of four of the participants being employed by or owners of a related business and industry, four participants being graduates of a related CTE area within the previous four years and employed in a related occupational area, and four participants being educators teaching in a related pathway. The three round Delphi method accomplished the outcome sought, to identify and rank order a list of proposed workshop topics. It was also determined that the Delphi method had both advantages and disadvantages in developing this list. The researchers would propose to share the identified advantages and disadvantages.

Keywords: Career and Technical Education, Delphi Method, Technical Workshops, CTE Teacher Workshops

Introduction

The Kansas Center for Career and Technical Education (KCCTE) was developed through a legislative grant to support teacher professional development for those teaching in Career and Technical Education (CTE) programs and pathways in the State of Kansas. One of the main objectives of the KCCTE was to help enhance the technical skills of CTE teachers/instructors and thereby improving the experience of their students. Although there are 16 different pathway in CTE, this study was designed to identify the needed skills for Career and Technical Education instructors who teach in the Architecture and Construction pathway/program.

The Delphi technique was chosen as research method because it is regarded as a reasonable strategy for achieving consensus on additions to and deletions from current curriculum (Thaangaratinam and Redman, 2005). Deciding what constitutes good practice is essential to establishing competencies for curriculum development. To reduce bias, it is critical to maintain the diversity of the panel of experts. This would require careful consideration of differing views and opinions based upon industry input rather than solely on educational input. Within this study, the Delphi technique was used to obtain and identify both differences of opinion and build consensus from the selected panel of experts. The Delphi study is best used where there is a problem that can be addressed with subjective judgement that can be given by expert panel members. This is based on the notion that "the collective viewpoints of expert panelists can yield better results than the limited view of an individual" (Nworie, 2011, p.29). Nworie (2011) also contends that the Delphi method is best used in studies where the goal is to identify new directions in a field, new or emerging competencies, best practices, changes, technology applications, and policy issues in order to improve what is happening in the field, making the Delphi a good fit for this study.

Typical surveys attempt to identify "what is," whereas the Delphi technique is used to address "what could or should be" (Miller, 2006). This allows the researchers to arrive at a conclusion of what the future curriculum needs to include. The Delphi Method is very useful for predicting the future and for making policy and planning decisions (Williamson, 2002).

The number of rounds used in a Delphi study is variable and depends upon the purpose of the research. Bammer, McDonald & Deane (2013) suggest a two or three round Delphi is sufficient for most research. If the purpose of the study is to reach group consensus and the sample is relatively dissimilar, then three or more rounds may be required. As the number of rounds increases, so does the effort required by Delphi participants. This often leads to a fall in the response rate (Alexander, 2004; Rosenbaum, 1985; Thomson, 1985).

Typical Delphi Process

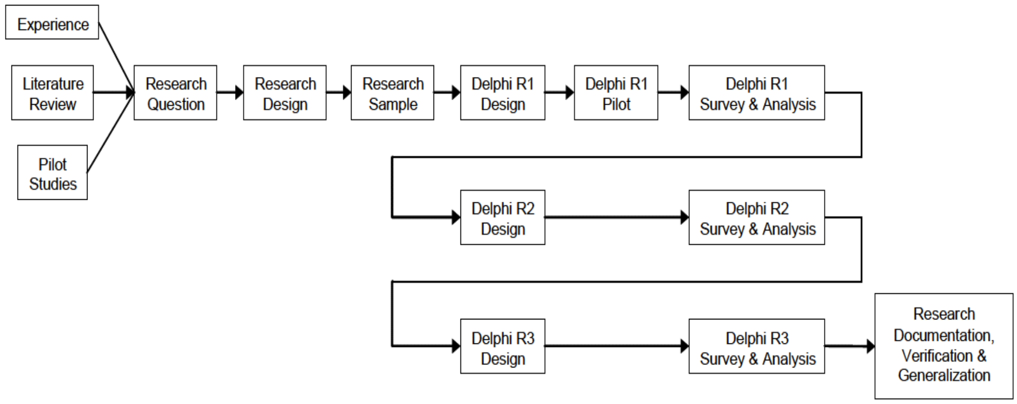

Figure 1: Three Round Delphi Process
Skulmoski, Harman and Krahn (2007)

Past researchers suggest (Judd, 1972; Taylor & Judd, 1989; Jacobs, 1996) choosing appropriate subjects for the expert panel is the most important step in the entire process of conducting a Delphi study because it directly reflects the quality of the results. Diversity in the background of panel members can be advantageous as it adds a broader and deeper understanding of the issue by having multiple individual perspectives on the same issue (Nworie, 2011). Delphi panel experts should be competent within the area of knowledge surrounding the target topic and should demonstrate knowledge that members of society at large and recognized professions would see as being of expert quality (Hallowell & Gambatese, 2009).

Rowe and Wright (1999) determined a Delphi panel may consist of as few as three members or as many as 80 on the high side. Most studies, they found, used a panel of between eight and 16 members so they suggest a minimum of eight although no direct correlation between the number of panel members and their effectiveness was cited.

Delphi panelists should meet four requirements in order to be considered an "expert": "i) knowledge and experience with the issues under investigation; ii) capacity and willingness to participate; iii) sufficient time to participate in the Delphi; and iv) effective communication skills" (Adler & Ziglio, 1996, p. 14). Each panel member's commitment to participate in a multi-round Delphi can be determined by the response rate in each successive round (Keil, Tiwana & Bush, 2002). Often, true experts in a field have great insight, yet are usually very busy and may not be able to fully engage.

Body

For the purpose of this study, the researchers chose a panel of 12 members. Four of these members were from areas in business directly related to the architecture and construction industries from companies, unions, or entities deemed progressive and upstanding via personal reputation and represented their own industrial entity during the study. Four of the members were from education. These four were chosen from both secondary and post-secondary institutions to participate based upon having been recognized as outstanding educators and stated so by their peers. The remaining four panel members were recent graduates from a secondary or post-secondary architecture and construction program who were currently employed in the architecture and construction field. These four members were recommended to participate by their previous instructors. All panel members resided and were employed in the state of Kansas.

Gender did not factor into the screening process. Several individuals and entities were sought out to participate in the study some of whom were females. All of the females and several other individuals chose not to respond to the solicitation email; thus, all 12 identified members of the original panel were male.

Among the 12 panelists chosen for the study, age did not factor into the screening process, but reflected a diverse group of participants with one-third (33.3%) reporting an age range of 20-30, less than one-fifth (16.7%) reporting an age range of 31-40, one-quarter (25%) reporting an age range of 41-50, and one-quarter (25%) of panel members reporting an age range of 51 or older. The amount of education was not a consideration in screening panel members but did reflect a diverse group. One participant (8.3%) reported no higher education degree. Two panelists reported receiving trade or technical training resulting in 16.7% of the total. Five panel members (41.7%) reported having attained a Bachelor's degree and four panel members (33.3%) reported having attained a Master's degree.

Email solicitations were sent beginning in February to qualified persons who fit the criteria of educators, business and industry personnel and recent graduates and who were recommended to participate. The study concluded with the results of the third-round survey in the month of November.

In round one, 23 technical competencies were identified by the panel. Within round two, the panelists were asked to rate each of the items using a 5-point Likert scale (1 = completely unimportant, 2= not very important, 3= important, 4= very important and 5= extremely important). Within the round 3, each panel member was sent the results of round 2 (means and SD) of each Likert item and were asked if they wanted to change their ranking of this to be closer to the mean.

It was determined the Delphi method had both advantages and disadvantages in developing this list. Some of the topics that were identified in round one were considered non-technical in nature. Still other topics were considered to be duplications of those identified by other panelists. The non-technical topics and those that were considered to be duplications were eliminated. A third party helped to identify the topics that were eliminated. All of the topics identified by round one were previously unknown to the researchers, thus accomplishing one of the main advantages of the Delphi which is to identify things that are previously unknown.

Twelve panel members were sent the round one survey. Of the 12, only eight panel members responded before the data was compiled and round two was sent out. The responses of the eight participants yielded a response rate of 66.6%. The goal of the first round was to identify what educators teaching in an architecture and construction program in either a secondary or postsecondary institution, industry personnel specifically in architecture and construction and recent graduates of an architecture and construction program perceived to be the areas where there were skill gaps or what the future competencies would be in the field of architecture and construction. Each individual was asked to identify up to five topics to be considered by the members of the Delphi panel. The only restraint placed on these individuals was that the topics contrived had to be technical in nature.

The responses from the eight participants who completed and returned the round one survey were compiled and analyzed by the researcher and a colleague separately and examined for duplication, clarity and the technical nature of the topic. The researcher and colleague compared the generated lists of topics and selected those which were deemed technical in nature. Responses that were duplications or considered to be non-technical were eliminated for the development of the round two survey. It was determined that five topics identified by the participants were non-technical in nature. The topics deemed non-technical in nature included: Verbal communication, responsibility for self, time management, professional practice and document control. Computer skills, fundamental construction skills, and layout techniques were each identified twice by different participants. Industry specific software and design/build were identified three times by different participants. Plan and print reading and verbal communication were identified four times by different participants.

From the edited list of responses, 23 technical competencies are needed by those entering the architecture and construction field in the future were identified and condensed for inclusion in round two. The identified technical competencies were: Industry specific software, 4D schedules, plan/print reading, computer skills, control of a set of drawings, design/build, professional/technical writing, civil plan reading, scheduling, fundamental construction skills, graphic skills, coping style trim work, textures and drywall finishes, stick framing, window and door installation, concrete finishing, OSHA safety, technical drafting skills, design development process, layout techniques, welding and metal fabrication, mechanical trades, and building codes and state statutes.

Those who did not complete the round one survey were not included in round two data collection, therefore, eight participants were sent the survey for the second round. Of those eight participants who were sent the round two survey, seven completed the survey and sent it back. The responses of the remaining seven participants yielded a response rate of 87.5% which is much higher than the 66.6% response rate from round one.

As described in the previous section, responses from the eight participants who completed and returned the round one survey were identified, edited for clarity and duplication, verified the topic was technical in nature and condensed for inclusion in round two. Given the list of identified and edited topics from round one, participants were asked to rate the topics on a five-point Likert scale as to their perceived level of importance in rounds two and three (Allen & Seaman, 2007). A rating of "5" on the scale would mean the topic was perceived to be extremely important, a rating of "4" would mean the topic was perceived to be very important, a rating of "3" would indicate the topics was perceived to be important, a rating of "2" would indicate that the topic was perceived to be not very important, while a rating of "1" would mean the topic was perceived to be completely unimportant.

Table 1 presents a numeric representation of the responses of the seven participants who completed and returned the round two survey. The individual response of each participant is included along with the mean and standard deviation of the responses from this group of participants.

	Mean	SD	#1	#2	#3	#4	#5	#6	#7
OSHA	4.43	.787	5	5	3	4	5	4	5
Plan and print reading	4.29	.756	4	5	3	5	5	4	4
Software	4.14	.900	4	5	3	5	5	3	4
Computer skills	4.14	.900	5	5	3	4	5	3	4
Design/build	4.14	.900	3	3	4	5	5	4	5
Prof/tech writing	4.14	.690	4	3	4	5	5	4	4
Control of drawings	4.00	1.000	3	5	3	5	4	3	5
Scheduling	4.00	.816	3	5	4	3	5	4	4
Construction skills	3.71	1.113	5	5	2	3	4	4	3
Drafting	3.57	1.272	4	2	3	5	5	4	2
Civil plan reading	3.57	.787	3	5	3	3	4	4	3
Mechanical trades	3.57	.976	3	2	4	4	3	5	4
Building codes and statutes	3.57	1.272	2	2	4	5	4	5	3
Layout techniques	3.43	.976	2	3	4	3	4	5	3
Design processes	3.43	.787	3	2	4	4	4	3	4
Concrete finishing	3.00	1.000	3	5	3	3	2	3	2
Window/door installation	3.00	.577	3	2	3	3	4	3	3
Stick framing	3.00	.577	3	2	3	3	4	3	3
Graphic skills	3.00	1.155	4	2	2	5	3	3	2
Welding and fab	2.71	1.113	2	2	3	3	2	5	2
4D Schedules	2.43	.976	2	2	4	1	3	3	2
Drywall finishes	2.00	.816	3	1	2	1	2	3	2
Trim work	2.00	.816	3	1	2	1	2	3	2

Table 1. *Round 2 survey results and individual ratings*

The responses from the seven participants who completed the round two survey were analyzed and the mean and standard deviation for each topic was calculated. Only the top 15 topics with the highest perceived rated Mean were included in the round three survey. The top 15 topics with the highest perceived level of importance included: Industry specific software, plan/print reading, computer skills, control a set of drawings, design/build, professional/technical writing, civil plan reading, scheduling, fundamental construction skills, OSHA safety, technical drafting skills, design development process, layout techniques, mechanical trades, and building codes and statutes.

Of the seven participants who responded to the round two survey and were included in round three, seven responded yielding a response rate of 100% from round two to round three, but only a 58.3% response rate from the original 12 selected panel members. The 15 top ranked technical competencies were included in the round three survey and the participants had the opportunity to compare their rating with that of the group Mean and either confirm or change their initial rating (Skulmoski et al., 2007). Table 2 presents a numeric representation of the responses of the seven participants who completed and returned the round three survey. The individual response of each participant is included along with the Mean and Standard Deviation of the responses from this group of participants.

	Mean	SD	#1	#2	#3	#4	#5	#6	#7
Plan and print reading	4.43	.787	4	5	3	5	4	3	5
OSHA	4.29	.756	4	5	3	5	5	4	5
Design/build	4.29	.756	5	5	4	4	4	3	4
Scheduling	4.14	.690	4	5	3	4	3	3	5
Prof/tech writing	4.14	.690	4	3	4	5	5	4	5
Computer skills	4.14	.690	4	3	4	4	5	4	5
Software	4.14	.900	3	5	3	4	4	4	4
Control of drawings	3.86	.900	3	5	4	4	5	4	4
Construction skills	3.86	1.069	5	5	2	3	4	4	4
Civil plan reading	3.86	.690	5	5	3	4	4	4	5
Layout techniques	3.71	.756	4	2	3	4	4	4	3
Mechanical trades	3.57	.976	3	2	4	4	4	3	4
Design processes	3.43	.787	3	3	4	4	4	5	3
Drafting	3.43	.787	3	2	4	4	3	5	4
Building codes and statutes	3.29	.951	3	2	3	4	3	5	3

Table 2. *Round 3 survey results and individual ratings*

The responses from the seven participants who completed Round Three were analyzed and placed in order of perceived importance per the group mean from the third-round survey. All of the 15 technical competencies were deemed “important”, “very important”, or “extremely important” by the group having received an importance rating of above 3.0 as a group Mean. Plan/print reading was deemed by the group to be the most important technical competency of the 15 that were included in the third-round survey with a group Mean rating of importance at 4.43. OSHA and design/build were a close second with a group Mean rating of importance of 4.29. Scheduling, professional/technical writing, computer skills and industry specific software were all tied for the third level of importance with a group mean rating of 4.14. These seven topics were deemed by the Delphi panel to be the dominant technical competencies to effectively teach architecture and construction at the secondary and post-secondary level.

Control of drawings, construction skills and civil plan reading were in a three-way tie for the next rated level of importance with a group Mean rating of 3.86. Layout techniques received a group Mean rating of 3.71. Mechanical trades were rated at 3.57. Design processes and drafting both received a group Mean rating of 3.43, and building codes and statutes received a perceived importance group Mean rating of 3.29. Each of the 15 technical competencies were deemed “important”, “very important”, or “extremely important” by the group having received an importance rating of above “3.0” as a group mean.

For the purpose of this research, similarities and differences in perceived levels of importance between groups was analyzed. Of the seven participants who responded to all three rounds of the survey, only one was an instructor at an educational institution. This accounts for the Standard Deviation in the Education column being zero.The areas of most agreement between groups were the following: The use of industry specific software was rated at 4.25, 4.0 and 4 by members of business, recent graduates and the instructor, respectively. This accounts for only a .25 difference in perceived level of importance across groups. Likewise, the control of a set of drawings also had only a .25 difference in perceived level of importance across groups. Plan and print reading, design/build, professional/technical writing, and design processes all showed only a .5 difference in level of perceived importance across groups.

Computer skills were rated "extremely important" by the educator at 5. The business participants rated computer skills just above "very important" at 4.25, while recent graduates rated computer skills just above "important" at 3.50, thus, there was a difference of 1.5 points of level of perceived importance between the groups. Scheduling was rated at 4.5 by members of business, 4.00 by recent graduates and 3 by the educator. This also accounts for a 1.5 point difference of level of perceived importance between groups. Basic construction skills were rated at 3.5 by members of business, 4.00 by recent graduates and 5 by the educator resulting in a difference of 1.5 points on the level of perceived importance between groups. Mechanical trades were rated 3.25 by members of business, 4.5 by recent graduates and 3 by the educator, resulting in a 1.5-point difference in level of perceived importance between groups. The participant from education rated computer skills very high as opposed to the rating by recent graduates. The educator also rated basic construction skill very high as opposed to the perceived level of importance by members of business. However, recent graduates rated mechanical trades much more important than either members of business or the educator, and members of business rated scheduling much more important than the educator (See Table 3).

	Business		Recent Graduates		Education	
	Mean	SD	Mean	SD	Mean	SD
Software	4.25	.957	4.00	1.414	4	0
Plan and print reading	4.50	1.000	4.50	.707	4	0
Computer skills	4.25	.500	3.50	.707	5	0
Control of drawings	3.75	.957	4.00	1.414	4	0
Design/build	4.25	.957	4.50	.707	4	0
Prof/tech writing	4.00	.816	4.50	.707	4	0
Civil plan reading	4.00	.816	4.00	.000	3	0
Scheduling	4.50	.577	4.00	.000	3	0
Construction skills	3.50	1.291	4.00	.000	5	0
OSHA	4.00	.816	4.50	.707	5	0
Drafting	3.25	.957	3.50	.707	4	0
Design processes	3.50	1.000	3.50	.707	3	0
Layout techniques	3.75	.500	4.00	1.414	3	0
Mechanical trades	3.25	.957	4.50	.707	3	0
Building codes and statutes	3.00	.816	4.00	1.414	3	0

Table 3. *Mean between groups and Standard Deviation within groups*

Conclusions

The purpose of this study was to identify the future technical competencies for architecture and construction educators so technical workshops could be designed to fit those needs. This study provided a framework for further identification of technical competencies within the architecture and construction areas of CTE as well as any other CTE areas where a need exists to identify future technical competencies. Based on the information in Table 3, the educator rated three items at a much higher level of importance than the other groups. These items included: Computer skills, basic construction skills and OSHA Safety. From the standpoint of an educator, these items were perceived to be extremely important whereas industry personnel and recent graduates may not see them as being quite so important. On the contrary, business and industry personnel tended to rate plan/print reading and scheduling higher in level of importance than the educator while recent graduates closely agreed on the importance of these items. Recent graduates rated mechanical trades much higher in level of importance than members of business and industry or the educator, indicating their perception of a skill that is greatly lacking from their point of view, while other technical competencies were rated similar to the other groups. The findings presented in Table 2 point to a lack of technological expertise. Six of the seven highest rated technical competencies could be considered to be directly related to technology. This finding falls directly in line with the views of Laczkowski, et al. (2018), as they determined technological advancements, innovation and adoption of the latest technology in the construction industry had been lacking accounting for an approximate 30 percent gap in production across the construction industry. OSHA safety was tied for second place in Mean ratings which indicates the participants all deemed safety was a priority. A majority of the responsibility for safety instruction lies with the CTE instructor. "Students must receive an endless amount of general and specific safety education" (Threeton & Walter, 2013, p. 66-67).

Research has suggested properly identifying professional development needs which are in high demand is a crucial part of developing effective teachers (Layfield & Dobbins, 2002). Technological advancements, innovation and adoption of the latest technology in the Construction Industry have been lacking (Laczkowski, Padhi, Rajagopal & Sandrone, 2018). Part of this slow-moving adoption of new technology may have been due to the roadblocks put in place which hindered professional development of teachers (Drage, 2010).

The implications for practice of this study represent a basis on which the KCCTE can design, coordinate and support relevant and needed technical workshops to help architecture and construction educators stay current in the technical skills of their field. While the findings of a Delphi study only reflect the opinions of a small number of people at one particular point in time, this study determined there is a need for technical training for educators on several future competencies. The KCCTE will begin to work through the list of most important perceived technical competencies identified in this study and offer workshops to address those competencies.

Plan and print reading had the highest rated Mean score which makes this competency the most likely choice to begin designing a technical workshop around. Referring to the list of highest Mean rated competencies from Table 2, six of the seven competencies that had a Mean rating of above 4.0 could be deemed technological in nature. This may actually allow for some combination of topics into single workshops rather than having separate workshops designed around each competency. Computer skills and industry specific software are two technical competencies which would fall into this category. Design/Build and Scheduling are two identified technical competencies which could possibly be combined into one technical workshop with the possibility of offering more advanced levels of this topic in the future. OSHA Safety was a top-rated competency which would be considered technical but not technology based. Safety should always be a major priority for CTE classrooms and labs. Instructors must "focus on their own professional development by attending technical update workshops that provide occupational specific information on new safety practices" (Threeton

& Walter, 2013, p. 67). OSHA Safety is a topic that a technical workshop should be designed for to meet the needs of CTE teachers. Professional/technical writing was a competency rated high in importance by participants and could be incorporated into each technical workshop to help meet the gap in this area. Based upon the findings that suggest a theme of graphics and visualization among the identified technical competencies, workshop presenters should be sure to incorporate activities in each of their workshops to increase competence related to these skillsets. Looking back at the findings from the round two survey, it is recommend that the lower Mean rated technical competencies not be considered priorities for technical workshops. These competencies include: 4D scheduling, trim work, drywall finishes, and welding and fabrication. While these competencies may still be important skillsets to possess, they were not seen by participants to be areas where a large amount of concentration was needed.

Putting the panel of experts together and getting individuals to agree to participate may seem like an easy task. It is not. This was undoubtedly the most time-consuming part of the Delphi process, which came as a surprise to the researchers. Another surprise was, of the 12 panelists who agreed to participate, only seven members of the panel completed all three rounds of the survey within the allotted amount of time An assumption was held that panel members involved in the education field would be more likely to participate fully. This was in error as only one of the educators completed all of the surveys in the timeframe allotted.

Given the limitations of this study and the findings, further research is recommended. Future studies could investigate any or all of the CTE areas in the state to identify different technical competencies where training is needed to meet the demands of their respective industries. This study could be easily replicated in other states and be similarly implemented on a national or international level to identify different technical competencies where training is needed to meet the demands of industry. A recommendation would be to include ample time to gather a sufficient number of panel members so the number of actual participants involved in the study yields the appropriate amount of data to maintain a solid foundation and premise of need. Another recommendation would be to start with a larger panel of 20–24 people evenly spread between the groups of educators, recent graduates and business and industry personnel. This could alleviate the challenges associated with the low numbers in some groups due to attrition. If the study were replicated, the researcher recommends the participants making up the panel of experts have equal representation in each of the current occupational areas. It would be interesting to send the round three survey, listing the 15 top rated competencies to a larger number of individuals from each of the occupational groups represented and compare the results of their ratings with those found in this study to determine to what extent the results agree with and differ from what was found in this Delphi study.

This Delphi study had its share of limitations and disadvantages. Since only seven members of the panel completed all three survey rounds, the results of the study had to be based solely on those results. This study was also limited to the state of Kansas.

The researchers did have two panel members who completed and returned surveys after the deadline. These were not included in the research because of the missed schedule. It is recommended that more time to complete the rounds of the study may increase participation rates.

References

Adler, M. & Ziglio. E. (1996). *Gazing into the oracle: The Delphi Method and its application to social policy and public health*. London: Jessica Kingsley Publishers.

Alexander, D. C. (2004). A Delphi study of the trends or events that will influence the future of California charter schools. *Digital Abstracts International*, *65* (10), 3629. (UMI No. 3150304).

Allen, I. E., & Seaman, C. A. (2007). Likert scales and data analyses. *Quality Progress*, *40*(7), 64.

Bammer, G., McDonald, D., & Deane, P. (2013). *Research integration using dialogue methods* (p. 165). ANU Press.

Drage, K. (2010). Professional Development: Implications for Illinois Career and Technical Education Teachers. *Journal of Career and Technical Education*, *25*(2), 24-37.

Hallowell, M. R., & Gambatese, J. A. (2009). Qualitative research: Application of the Delphi method to CEM research. *Journal of Construction Engineering and Management*, *136*(1), 99-107.

Jacobs, J. M. (1996). *Essential assessment criteria for physical education teacher education programs: A Delphi study*. Unpublished doctoral dissertation, West Virginia University, Morgantown.

Judd, R. C. (1972). Use of Delphi methods in higher education. *Technological Forecasting and Social Change, 4* (2), 173-186.

Keil, M., Tiwana, A. & Bush, A. (2002). Reconciling user and project manager perceptions of IT project risk: A Delphi study. *Information Systems Journal, 12*(2), 103 - 119.

Laczkowski, K., Padhi, A., Rajagopal, N & Sandrone, P. (March 2018). Re: How OEMs can seize the high-tech future in agriculture and construction [Online forum McKinsey & Company]. Retrieved from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/how-oems-can-seize-the-high-tech-future-in-agriculture-and-construction?cid=eml-app

Layfield, K. D., & Dobbins, T. R. (2002). In-service needs and perceived competencies of South Carolina agricultural educators. *Journal of Agricultural Education*, *43*(4), 46-55.

Miller, L. E. (2006, October). Determining what could/should be: The Delphi technique and its application. In *meeting of the 2006 annual meeting of the Mid-Western Educational Research Association, Columbus, Ohio*.

Nworie, J. (2011). Using the Delphi technique in educational technology research. *TechTrends*, *55*(5), 24.

Rosenbaum, J. (1985). A College and University Curriculum Designed to Prepare Students For Careers in Non-Broadcast Private Telecommunications: A Delphi Method Survey of

Professional Video Communicators. *Digital Abstracts International*, *46* (09), 2548. (UMI No. 8525512).

Rowe, G., & Wright, G. (1999). The Delphi technique as a forecasting tool: issues and analysis. *International Journal of Forecasting*, *15*(4), 353-375.

Skulmoski, G. J., Hartman, F. T., & Krahn, J. (2007). The Delphi method for graduate research. *Journal of Information Technology Education: Research*, *6*, 1-21.

Taylor, R. E., & Judd, L. L. (1989). Delphi method applied to tourism. In S. Witt, & L. Moutinho, (Eds.). *Tourism Marketing and Management Handbook*. New York: Prentice Hall.

Thangaratinam, S., & Redman, C. (2005). The delphi technique. *The Obstetrician & Gynaecologist*, *7*(2), 120-125.

Thomson, B. (1985). Appropriate and inappropriate uses of humor in psychotherapy as perceived by certified reality therapists: A Delphi study (Delphi Method). *Digital Abstracts International*, *47* (01), 90. (UMI No. 8606095).

Threeton, M. D., & Walter, R. A. (2013). Managing technical programs and facilities.
Williamson, K. (2002). Research methods for students, academics and professionals: Information management and systems. Elsevier.

Contact email: jon.jones@pittstate.edu
gbelcher@pittstate.edu