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John Brocato (Ed.)

Original Publication Citation
Katsioloudis, P. (2009). Enhancing the collection process for the Delphi technique. In John Brocato (Ed.), *American Society for Engineering Education, Southeastern Section Conference Proceedings, 2009* (Article 057, pp. 1-9). American Society for Engineering Education. https://sites.asee.org/se/wp-content/uploads/sites/56/2021/05/2009ASEESE057.pdf

Enhancing the Collection Process for the Delphi Technique

Petros Katsioloudis[1]

Abstract - The purpose of this manuscript is to describe a process that enhances the data collection process for a Delphi technique. The approach consists of online platforms to expedite the process and reinforce the validity of the Delphi technique. The context of the study was the identification of quality indicators for visual-based learning material development for Technology Education programs for grades 7-12.

Keywords: Visual-based learning, Conventional Delphi technique, Hybrid Environments.

One significant problem that is usually encountered in Delphi studies has to do with the rigors involved in maintaining focus when collecting data over long periods of time. Beyond problems maintaining sufficient levels of concentration, large periods of wait time can promote confusion and anxiety to the researcher. This article reports on a research study that employed an additional modification to the Delphi technique. The online collection process for the Delphi Technique was designed to minimize the time for data collection through the use of data collection software.

CONTEXT AND PURPOSE OF THE STUDY

In educating environments the visual elements of courses, lessons, and presentations play an important role in learning. Well-conceived and rendered visuals help any audience understand and retain information [Wileman, 2], and the use of visual technology enhances learning by providing a better understanding of the topic as well as motivating students [Clark & Mathews, 3]. One can see that visualization methods are widely credited for simplifying the presentation of difficult subjects as well as aiding cognition; their use in the power engineering industry and education is enjoying significant growth [Idowu, Brinton, Hartamn, Nehard, Abraham, & Boyer, 4].

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Even though the success by which content visualization facilitates the learner's acquisition of information it is related to the individual's level of perceptual and associative learning in the content area. The individual must have sufficient experience and maturity to realize that using visualization is merely an attempt to represent reality vicariously [Dwyer, 5]. Much of intended visual communication or self-expression is not perceived, or often misunderstood, especially if it is complex [Lantz, 6]. In addition to the individual's experience, the visualization itself plays an important role in the learning process.

If all visual-based learning materials were equally effective in facilitating student achievement of all kinds of educational objectives, there would virtually be no problem associated with this type of instruction [Dwyer, 5]. However, this is not the case since there are many different types of visuals, differing in the amount of realistic detail they contain. For example, at the present time, educators, when faced with a choice of selecting one type of visualization from an array of available materials, have no way of knowing whether one type of visual is any more effective than another in transmitting certain types of information [Dwyer, 5]. The lack of quantifiable measures of quality and benchmarks will undermine information visualization advances, especially their evaluation and selection [Chaomei, 7]. The importance of knowing how to select the best type of visual-based learning materials is recognized throughout higher education; however, with the exception of some descriptive literature, few studies have been conducted to identify the essential indicators of visual-based learning materials used in technology education courses for the middle school and high school grades. The purpose of this study was to identify the quality indicators of visual-based learning materials in technology courses for grades 7-12.

DATA COLLECTION PROCESS

The computer-based Delphi method has a number of advantages over paper-and-pencil Delphi [Turner & Turner, 8]. These include: (1) asynchronous interaction used in Delphi procedures is more easily accomplished; (2) contributors can have continuous access to the emerging database by contributors without prior summarization and possible introduction of bias by the investigators; (3) participants can update themselves frequently about the discussion before contributing, enabling a more informed contribution and less duplication of responses; (4) responses can be screened more easily prior to distribution and record keeping, data processing, and statistical analyses are facilitated; (5) communication among participants is faster and less costly; participants who are geographically distanced can be included and (6) A structure for the dynamic contribution of knowledge over time can be provided (p. 127).

Traditional methods of survey distribution and collection that utilize the US postal system are slow and provide low rates of return. Internet technology provides a medium to decrease the amount of response time and provides easy follow-up using electronic mail [Turner & Turner, 8]. Many existing research studies in the area of information technology are utilizing the Internet and the World Wide Web as media to collect consensus data [Nesbary, 9].

The World Wide Web spans the globe, and geographical boundaries are becoming less of an issue in communication. Because of advanced online capabilities, the cost of survey administration for educational research is becoming less expensive and the amount of work required in survey distribution, collection, and analysis is greatly reduced. Although studies remain to be done, the validity of web-based survey research is likely to be strongest for researchers who target specific population samples [Watt, 10]. Early methods of Internet-based data collection typically embedded the instrument directly in the body of an e-mail message and requested the response to be replied to as an attachment or modification of the original message. However, researchers are increasingly directing participants to complete instruments that have been published as web pages (White & Dailey, 2001). Reading the supporting data and trying to approach this problem in a timely, efficient way the researcher decided to use the online modified Delphi technique to conduct this study.

PROCEDURES AND METHODOLOGY

The procedures for this research study began with a proposal for conducting the study and a review of literature to acquire information related to the subject and subject matter. The study used a modified Delphi method for identifying the quality indicators of supplemental technology education visual-based learning material for the middle and high school grades.

The approach used in this study to achieve its purposes was the online modified Delphi methodology with the use of data collection software called Inform ™. Many existing research studies in the area of information technology utilize the Internet and the World Wide Web as media to collect consensus data [Nesbary, 10].

This study involved three rounds to achieve consensus among a group of experts in visual-based learning material who were experienced technology teachers involved in pilot and field-testing for visual-based learning material grants. The number of rounds depended on reaching consensus among panel members. Most Delphi studies find that more than three rounds do not add significant value [Clayton, 11]. All data were gathered via a web site (see Figure 1) created to host the study and the World Wide Web as a primary mode of communication using Web-based instruments. Upon completion of the modified Delphi method, the indicators of visual-based learning material for middle and high school technology education courses were identified.

A review committee of three individuals who represented the background areas of the expert panel also was randomly selected to review all material and modifications made by the researcher before being sent to the experts for the different rounds, as suggested by Delbecg, Van de Van, and Gustafson [12]. Having the review panel also helped to prevent bias by the researcher during the editing and modifications made to the instruments between rounds. The review panel also participated as a test-piloting group to ensure the instrument being used for a given round was reader-friendly and easily understood.

Figure 1.

FrontPage of Data Collection Website

INSTRUMENT DESIGN AND IMPLEMENTATION

Round I

The instrument for Round I was developed from information found in the review of literature. Using Dreamwaver ™ the researcher created electronic pages that hosted the data and then using InForm ™ a data collection software, the pages were uploaded to the Web and were accessible to the panel within seconds. This allowed the panel of experts to complete the instrument the same day and send it back to the researcher.

Examples of quality indicators were established and placed in a survey instrument to indicate the actual format in which the indicators were written. The next step was to receive the approval from the review panel. Instruments were sent to the review panel for review and approval of the example indicators. Once the review panel approved the Round I instrument, it was accessible to the expert panel through the study's web site. Each member from the panel group received an email containing instructions on how to access the instrument and including the username and password of the electronic page. An email also was sent to the expert panel members after two weeks to remind them to reply. The Round I instrument for this study consisted of examples of indicators provided to the expert panel to help them understand better the type of information and writing style the study was identifying. Those examples were derived from the literature review that the researcher conducted prior the instrument design. However, the main component of Round I was the collection of a new set of indicators suggested from the experts rather than the modification and acceptance or rejection of given indicators. To achieve this task the Round I questionnaire included a large textbox for the members to write new indicators.

After completion of the Round I instrument by the panel of experts, the researcher received the new data through an email account. Inform ™ was set to automatically email all the data to the researcher and that of course saved an enormous amount of time for the researcher. All new suggested indicators were added to the instrument for Round II and changes were made to pre-existing given indicators. The newly created instrument for Round II then was sent to the review panel for approval. Once Round I instrument was completed the experts panel members were able to submit the form by clicking on a submit button on the page and all data was automatically transferred to the researcher's email account. Upon receiving Round I suggestions, all changes were made and instrument for Round II was created.

Round II

Round II of the modified Delphi method included the rating and ranking of those indicators from Round I. The instrument was developed and emailed to the review panel for verification. The indicators were presented in random order. During this round, a rating process was established for evaluating the ideas expressed during the pervious round. According to Linstone and Turoff [13], a rating system must be established for such items as the relative importance, desirability, confidence and feasibility of various policies and issues. Furthermore, these scales must be carefully defined so that there is some reasonable degree of assurance that the individual respondents make compatible distinctions between concepts (p. 89).

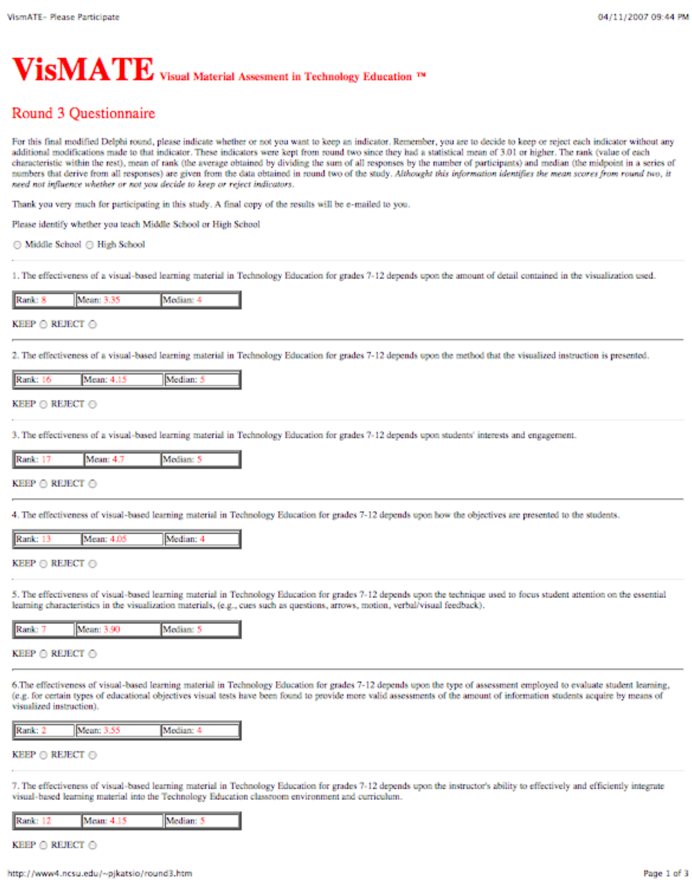
Round II was used to rate the responses given in Round I on a Likert scale with one to five with one being strongly disagree and five being strongly agree. Using Dreamweaver ™ electronic forms with radio buttons were created. The expert panel members were able to click on specific buttons representing the scale number selected. Upon receiving this information, the mean, median, and standard deviation were developed for each item. Only the indicators with a mean of 3.01 or higher were represented on Round III. Those indicators with a statistical mean of less than 3.00 were eliminated as not being within consensus and those indicators with a score of 3.01 or higher were kept for Round III [Mayer & Booker,14].

The second step in Round II was the ranking of the indicators received from Round I where participants reviewed the indicators kept after analyzing Round I and ranked each one in order of importance [Wicklein, 1993; Meyer & Booker, 16]. Each indicator kept from Round I was placed randomly in a list with a textbox provided underneath for ranking from most to least important. Also, the expert panel was given a final chance to add any new indicators or edit any of the existing ones. To accomplish this, a text box was created at the end of the second round instrument that allowed experts to type the new or edited indicator. Within the textbox it was stated that any new indicators that were added had to be ranked and rated also. Once the Round II instrument was completed the experts panel members were able to submit the form by clicking on a submit button on the page, all data were automatically transferred to the researcher's email account.

Round III

The purpose of Round III was to develop consensus among expert panel members. This was accomplished by making the suggested modifications from the review panel to the upper 51 percent of indicators that were kept from Round II (Clark, 1997). Again an electronic form was created using Dreamweaver ™. The form consisted of the final indicators with textboxes next to them that provided the rank, mean, and median of each indicator. The user now had the opportunity to keep or reject the indicator by filling in the appropriate button. See Figure 2 for more details.

Reviewers suggested changes including rewriting the instructions and rephrasing some of the indicators for better understanding and to eliminate ambiguity. In the Round III instrument members were asked to accept or reject only the final selections from Round II. In addition, participants were provided with the statistical analysis results from Round II: the median, mean and ranking of responses on each item. Experts were asked to check each characteristic and state whether it should be accepted or rejected. Upon completion of Round III instrument the participants were able to submit the instrument just by clicking on the submit button contained on the electronic page. Researcher received all the data instantly with no significant technical problems.


VismATE- Please Participate 04/11/2007 09:44 PM

VisMATE Visual Material Assesment in Technology Education ™

Round 3 Questionnaire

For this final modified Delphi round, please indicate whether or not you want to keep an indicator. Remember, you are to decide to keep or reject each indicator without any additional modifications made to that indicator. These indicators were kept from round two since they had a statistical mean of 3.01 or higher. The rank (value of each characteristic within the rest), mean of rank (the average obtained by dividing the sum of all responses by the number of participants) and median (the midpoint in a series of numbers that derive from all responses) are given from the data obtained in round two of the study. *Althought this information identifies the mean scores from round two, it need not influence whether or not you decide to keep or reject indicators.*

Thank you very much for participating in this study. A final copy of the results will be e-mailed to you.

Please identify whether you teach Middle School or High School

○ Middle School ○ High School

1. The effectiveness of a visual-based learning material in Technology Education for grades 7-12 depends upon the amount of detail contained in the visualization used.

Rank: 8	Mean: 3.35	Median: 4

KEEP ○ REJECT ○

2. The effectiveness of a visual-based learning material in Technology Education for grades 7-12 depends upon the method that the visualized instruction is presented.

Rank: 16	Mean: 4.15	Median: 5

KEEP ○ REJECT ○

3. The effectiveness of a visual-based learning material in Technology Education for grades 7-12 depends upon students' interests and engagement.

Rank: 17	Mean: 4.7	Median: 5

KEEP ○ REJECT ○

4. The effectiveness of visual-based learning material in Technology Education for grades 7-12 depends upon how the objectives are presented to the students.

Rank: 13	Mean: 4.05	Median: 4

KEEP ○ REJECT ○

5. The effectiveness of visual-based learning material in Technology Education for grades 7-12 depends upon the technique used to focus student attention on the essential learning characteristics in the visualization materials, (e.g., cues such as questions, arrows, motion, verbal/visual feedback).

Rank: 7	Mean: 3.90	Median: 5

KEEP ○ REJECT ○

6.The effectiveness of visual-based learning material in Technology Education for grades 7-12 depends upon the type of assessment employed to evaluate student learning, (e.g. for certain types of educational objectives visual tests have been found to provide more valid assessments of the amount of information students acquire by means of visualized instruction).

Rank: 2	Mean: 3.55	Median: 4

KEEP ○ REJECT ○

7. The effectiveness of visual-based learning material in Technology Education for grades 7-12 depends upon the instructor's ability to effectively and efficiently integrate visual-based learning material into the Technology Education classroom environment and curriculum.

Rank: 12	Mean: 4.15	Median: 5

KEEP ○ REJECT ○

http://www4.ncsu.edu/~pjkatsio/round3.htm Page 1 of 3

Figure 2.

Round III questionnarie

DISCUSSION

Using different types of software made it feasible for the study to be completed within a short amount of time. The response rate was high and in general the study was completed with no major technical issues. Comparing the time frames for specific tasks using the hybrid version of a Delphi study versus the conventional the difference was significant. More research however is needed to perfect this collection process so that it will be suitable in more alternative environments.

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Petros Katsioloudis was born and raised in Cyprus. He was educated in the United States where he received a Bachelors of Science degree in Science and Technology and a Masters of Education in Technology Education from California University of Pennsylvania. He earned a Doctoral Degree in Technology Education from North Carolina State University. Currently he is employed at Old Dominion University where he serves as an Assistant Professor and teaches various technology education courses. Petros is also serving as the Ambassador of Cyprus to the International Technology Education Association.