Enhancing the Collection Process for the Delphi Technique

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Abstract - The purpose of this manuscript is to describe a process that enhances the data collection process for the Delphi technique for descriptive research. The approach consists of online platforms to expedite the process and reinforce the validity of data collection. 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, Collection Process

INTRODUCTION

One significant problem that is usually encountered in Delphi research has to do with the rigors involved in maintaining focus when collecting data over long periods of time. Beyond problems of 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 collection process by utilizing new and efficient data collection software. The online collection process for the Delphi Technique was designed to minimize the time for data collection.

CONTEXT AND PURPOSE OF THE STUDY

The context of the study was to identify quality indicators of visual-based learning material in technology education for grades 7-12; however, the purpose of this article is to describe and illustrate the process of using the enhanced data collection procedure through an actual study. The specific question that provided focus for the study was, what indicators must visual-based learning material in technology education for grades 7-12 have to be effective in transmitting information?

The Delphi technique exists in two basic forms: (1) The Paper-and-Pencil Version (Conventional Delphi), and (2) The Delphi Conference. The Conventional Delphi includes questions being sent to a group and, based on their response, a new questionnaire is developed and disseminated to the same group. This continues through several rounds, providing the group the opportunity to reevaluate their own answers based upon examination of the group response. The Delphi Conference uses a computer program to compile and distribute the group results. The main advantage of this method is that there is no delay in summarizing feedback from each round and returning the group responses. In this paper we will discuss the advantages the Delphi conference technique and introduce new software used to enhance the collection process at a greater level.

The computer-based Delphi method has a number of advantages over paper-and-pencil Delphi: (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, 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; (6) A structure for the dynamic contribution of knowledge over time can be provided [Turner & Turner, 2].

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PROCEDURES AND METHODOLOGY

A sample of 21 experts from selected technology education associations and organizations was asked to verify and rate the relative importance of a set of identified quality indicators. The research goal was to obtain consensus regarding which indicators are important during the selection process of a visual-based learning material for technology education programs in grades 7-12. A descriptive research design was utilized to achieve this objective since the panel members under investigation were attempting to describe what knowledge, skills, and abilities are associated with visual-based learning. It was determined that educators and authors of visual-based learning material from different regions of the country would provide some breadth of insight. Each round presented an instrument to panel members who completed and returned it to the researcher. The responses were analyzed and compiled to build the next round's instrument. For each item, several nonparametric statistics were used to show correlation and median scores were calculated. The combination of these indices was used to determine the degree of importance and consensus for each item.

INSTRUMENT DESIGN AND IMPLEMENTATION

Round I
The instrument for Round I was developed from information found in the review of literature. Example quality indicators were provided to the panel to serve as paradigms for format and structure.

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 sent to the review panel for verification. The indicators were presented in random order.

Round III
The purpose of Round III was to develop consensus among expert panel members. The form consisted of the final indicators with electronic textboxes next to them that provided the rank, mean, and median of each indicator. The panel member was asked to accept or reject the indicators from the final list.

DESCRIPTION OF THE COLLECTION PROCESS

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, 2]. 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, 1].

The World Wide Web spans the globe, and geographical boundaries are becoming less of an issue in communication. Because of advanced online capability, the cost of survey administration for educational research is becoming cheaper 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, 3]. 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 [Nesbary, 1].

This study involved three rounds to achieve consensus among the group of experts. The unique component of this study was the collection process and the software used to achieve the task. All data were gathered electronically through a website created to host the study and the World Wide Web as a primary mode of communication using Web-based instruments. The advantage of using electronic mail for this research was that it greatly reduced the time that would have been needed to send regular mail across the United States. The steps of the collection process were: a) the creation of the website to host the questionnaires; b) the creation of the questionnaires using electronic forms; c) the creation of a platform that provided access to the panel of experts and also protected the data from outsiders; d) the creation of a platform that collected all submitted data and turned it in to a readable form to be used for statistical instruments.

The creation of the website to host the questionnaires for the study was the first step of the collection process. Using Dreamweaver ™ software the researcher created a website (see Figure 1) that introduced the panelist to the study and also provided essential information related to the collection process. The collection process information also included important dates for each round of the study, instructions on how to access the questionnaires and also links to each step of the process. To protect the data of the study and also to collect demographic information on each panelist, each step of the process was protected through a password. To gain access to any of the rounds each panelist was required to login using a username and password provided in a letter prior to the beginning of the study. Once correct password and username was used, the panelist had full accesses to the questionnaires and was able to complete them at any given time.

The second step of the collection process was the creation of the questionnaires for each round. Using the electronic form feature of the Dreamweaver ™software the researcher was able to create interactive questionnaires that allowed the panelist to make selection by clicking on specific buttons or to add new information by typing it in to a textbox (see Figure 2). Each form included the name of the study, Visual Material Assessment in Technology Education (VisMATE), ™ on the top, a set of instructions for the panelist and the quality indicators or questions related to the study and written from the researcher. Having the instruments in to an electronic format that allowed the researcher to make quick changes if necessary, change color and size of the fonts to make the document more attractive and pleasant to the panelist. Once the questionnaires were completed, all the panelist had to do to send the data to the researcher was to click on the submit button at the end of the questionnaire.

For the information to travel through the web from the hands of the panelist to the hands of the researcher a platform was necessary to allow the task. Using InForm™, a collection software available at most bookstores, the researcher was able to link the documents of the website to the server of the university and then to an email account that was appointed to collect the results and transform them in to an excel format spreadsheet. Having this luxury the researcher was able to access the data anywhere at any time. This allowed the researcher to collect the data within one month timeframe. The time advantage allowed the researcher to start processing the data and proceed to the next stages without wasting time. Another advantage of the enchased collection process was the cut of cost into the minimum. By avoiding the use of post stamps, envelopes and paper the study was completed with a small budget.

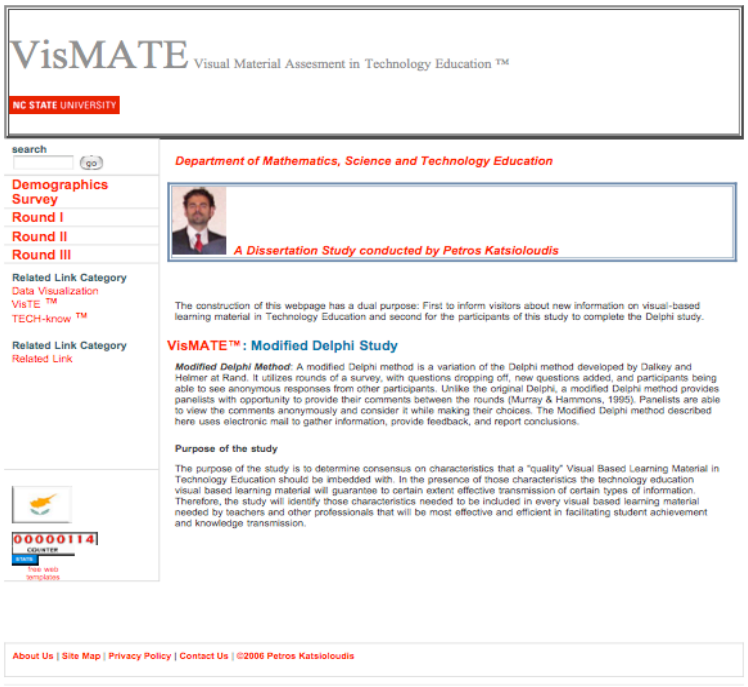
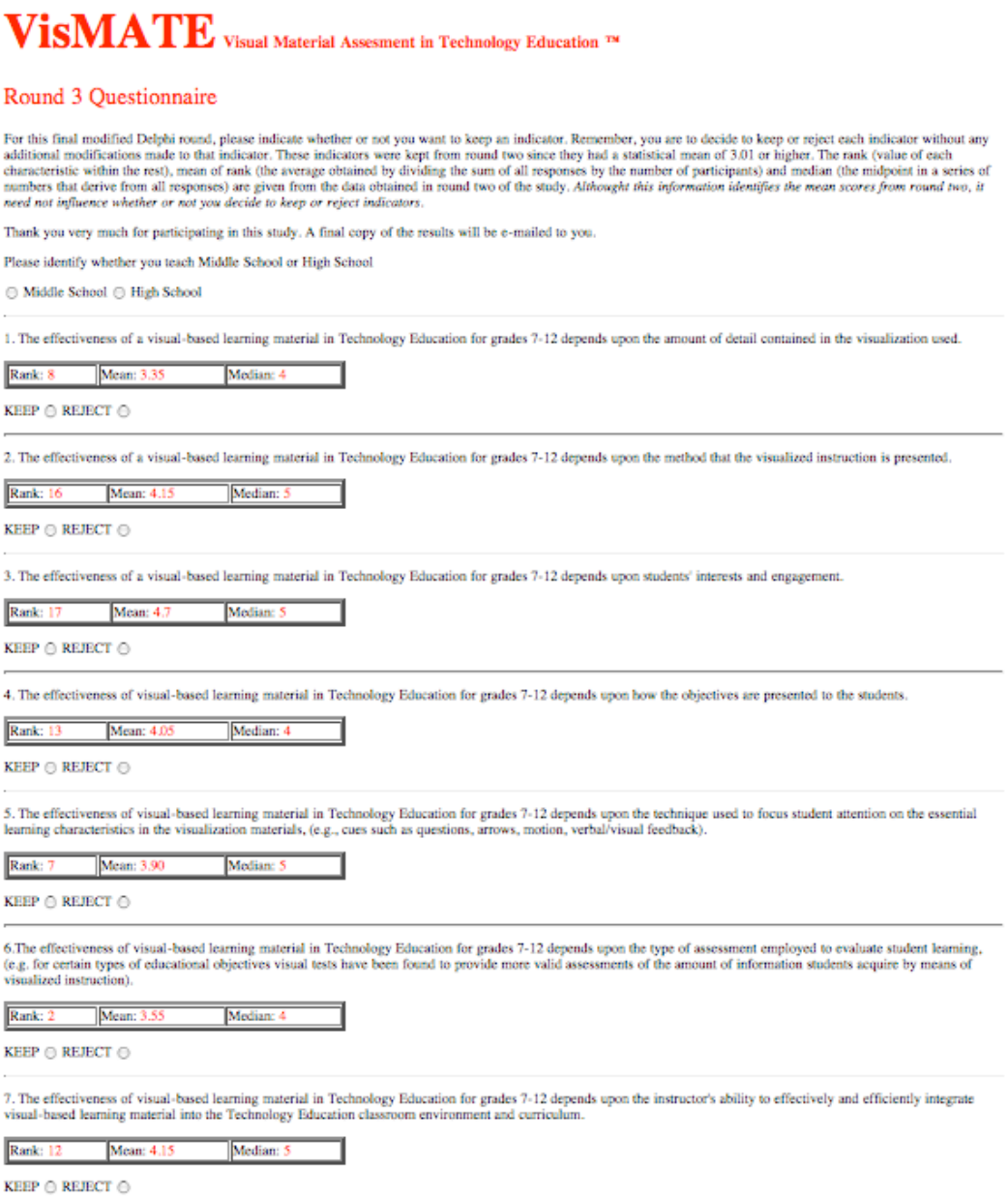


Figure 1. FrontPage of Data Collection Website.



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. *Although 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 ○

Figure 2. Round III Questionnaire.

DISCUSSION

Table 1 describes and compares different components associated with Delphi studies of similar type cases. From personal experience conducting both a conventional and enhanced collection process Delphi studies it was found that the average time spent to collect data from the first round to the third using a conventional collection process was 4-6 months versus 1 month.

Table 1. Comparison between conventional and enchanted collection process

	Conventional Collection Process	**Enhanced Collection Process**
Time	4-6 months	1 month
Cost	$200-$300	$20.00
Simplicity	Check squares or write answer on paper	Easy to complete questions by clicking on buttons and texting in to a text box
Response Rate	80%-100%	93%-100%
Mobility	Need to be at specific location	Can be access anywhere with internet access
Accessibility	Open to anyone that can attain a copy of the survey	Accessible only to individuals with username and password

Note: All measures represent similar type cases and were obtained through literature review conducted from the author of this paper.

The cost associated with the two types of collection is also significant since the conventional collection process requires postage, envelops and paper, where the enhanced process does not. An estimated of two to three hundred dollars cost was calculated for similar type studies that use the conventional type collection process versus twenty dollars for the enhanced. The simplicity of the instruments for the panel members is also an important discrepancy factor between the two types of collection. Using electronic based instruments it was indicated from the panel members to the researcher that process was easier. The use of color, several types of fonts, text buttons and other animation tools made it easier to the panel members to complete the instruments. During a prior Delphi study that the researcher conducted the panel members complaint that the completion of the instruments using conventional types of collection (writing in the answer, or checking boxes) was at some cases confusing and didn't allow much flexibility. In cases where the panel member changed decision about the outcome of a question and wanted to rewrite the answer the process got more difficult especially when ink pen was used.

The mobility that the enhanced collection process offers to the researcher and the panel member is also important. From the researcher's side, being able to access the data results at remote locations where internet access was provided made a significant difference. Not having to be at the institution at all times, and being able to retrieve information from home or conference sites promoted the completion of the study. This flexibility it also contributed to better analysis of the results since the researcher was able to retrieve the results at different meeting locations and share them with other experts at no time. From the panel members' side, being able to complete the questionnaires using the web it promoted the completion of the instruments on time, from different locations at convenient times. Given the fact that most of the experts were full time employees, working every day, this factor was significant.

Access to the instruments from the individuals intended to do so was significantly important. Using the username and password feature of the electronic form the possibility of outsiders skewing the results was minimal.

Even thought someone can argue that the enhanced collection process is not perfect and different disadvantages may occur, the author of this paper supports that the advantages overweight the disadvantages.

CONCLUSIONS

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 (95.2%) and in general the study was completed with no major technical issues. Comparing the time frames for specific tasks using the enchased collection process in the Delphi study versus the conventional type of collection 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.