Using the Delphi Technique in EducationalTechnology Research

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Abstract

As educational technology practitioners and researchers engage in research in the field, a wide array of research methodologies are available to them. One such methodology is the Delphi Technique. Use of the Delphi Technique offers many benefits, including the ability to obtain expert opinion, build consensus, determine the suitability of the application of instructional interventions, forecast trends, and interact with research subjects without being limited by time and space. While the origin and early use of the Delphi Technique was in the business setting, it has been used in other environments over the years, including educational settings. The various intrinsic qualities of the methodology could be beneficial to the field of educational technology. This article examines the Delphi Technique, its benefits, and how it could benefit educational technology researchers.

Keywords: Delphi Technique, Research Methodology, Educational Technology Research, Technology use in Research, Futures and Decision-making Approach

Introduction

In consideration of the diverse roles of educational technologists and critical decisions required at different junctures in program development, instructional improvement, technology application, change management, and adoption of instructional and technological innovation, the Delphi Technique appears to hold promise for practitioners and researchers alike. In a time of unprecedented change and developments in technology and rapid exploration of applicable pedagogy, decision making on technology acquisition and application, introduction of new teaching and learning methodology, or determining issues that relate to the functions of educational technologists are possible areas that the Delphi Technique could be applied in educational technology research and practice. The Delphi Technique could be used to explore critical issues, predict the future, and equip those in leadership with information that could be vital in decision-making, policy formulation, or improvement of practices in the field. It has been used in research to set goals and to forecast the emerging roles of professionals (Bickel, 1998; Bornyas, 1995; Rines, 1988; Scarpa, 1998). The Delphi method has also been used in studies in educational settings and on roles and leadership issues. The Delphi Technique can be used to answer many research questions in the field of educational technology.

The Delphi Technique

The Delphi Technique is a research methodology that is used to elicit, distill, and determine the opinions of a panel of experts from a given field, seek consensus among the experts, and make predictions or decisions using the expert

opinions of the panelists involved in the study. The Delphi Technique also highlights areas of divergence of opinions. This research methodology is based on the premise that the collective opinions of expert panelists are of richer quality than the limited view of an individual. This research methodology was developed by Helmer and Dalkey at the Rand Corporation during the early 1950s to explore technology and science trends (Dalkey, 1967; Helmer, 1967; Linstone & Turoff, 1975). Linstone and Turoff (1975), describe the Delphi Technique as a "method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem" (p. 3). The Delphi Technique is one of the most beneficial forecasting procedures used by decision makers. While participants, usually referred to as expert panelists, in a Delphi study are separated by time and space, they can engage in the same process at their own pace and time, independent of each other and without the influence of the other expert panelists on their opinions. The Delphi process relies on the anonymity of the participants to minimize any influence on the opinion of expert panelists as they vote on issues.

The Process

A Delphi Technique study is an interactive and iterative process that can go from one to as many rounds as are necessary to yield a consensus (Cyphert & Gant, 1970; Lang, 1998; Rockart & Morton, 1975). The instruments used in the process are questionnaires that require feedback from the participants in a predetermined number of rounds. Typically, the first questionnaire draws the attention of the panelists to the issues, problems, or questions to be addressed and elicits responses or comments (Isaac & Michael, 1995; Ziglio, 1996). The responses that are received in round one are used to construct the questionnaire for round two. In subsequent rounds, panelists reconsider the responses they contributed in earlier rounds. Summaries are comprised of the statistical interpretations of the panelists' opinions, as well as their comments, usually derived from the open-ended questions in the questionnaires. The iterative nature of the processes undergone in the subsequent rounds of the Delphi study is essential for building consensus. After two or three rounds of obtaining the opinions of the expert panelists, a pattern of consensus will begin to emerge. In some instances, the panelists are asked to identify issues in their field, instead of responding to items on a questionnaire.

Identifying and Selecting Delphi Study Participants

Expert panelists who participate in a Delphi study are experienced professionals who can provide an informed view or expert opinion on issues in their given field. They are selected because of their knowledge of their field or the issue being investigated. Knowledge in a field, subject matter area, or expertise on the issue that is being investigated is an essential requirement for participation as an expert panelist in a Delphi study. The Delphi Technique relies on the opinion of these experts to determine the level of consensus, future directions, or to determine a course of action. The importance of the opinions of these experts makes the identification and selection of appropriate participants to serve as expert panelists one of the most important aspects of the Delphi Technique (Lang, 1998; Tersine & Riggs, 1976). Selecting the right panelists helps to maximize the quality of responses and reduce biases as well as build credibility into the results of the study.

Approaches that can be utilized to identify expert panelists include using listings from professional organizations, through word of mouth and recommendations from professional colleagues, or use of other sources that will ensure participation of the best-qualified panelists with knowledge of the issues being studied. Diversity in the make-up of the backgrounds of the panelists could be an asset as it helps to provide both depth and breadth of the multiple perspectives on the issues. Despite their individual experiences, the panelists for a Delphi study are not selected to form a broad representation of the population, as is the case in most research methodologies.

Opinions of researchers vary on whether Delphi studies should start with a large or small number of panelists. Starting with a large pool of panelists could be advantageous. The rationale for the initial selection of a large group of panelists is that it is difficult to know how many will be willing to participate in the study until it is completed. Attrition can be a major issue due to the time involvement. Some suggest that a Delphi study could begin with fewer than 50

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panelists. Researchers agree that 10 to 50 panelists can engage in a Delphi study (Delbecq, Van de Ven & Gustafson, 1975; Jones & Twiss 1978; Turoff, 1975. Okoli and Pawlowski 2004) recommends a panel of 10-18 experts. Under the right conditions even a group of four panelists can successfully participate in a Delphi study (Brockhoff, 1975).

Those who favor smaller sizes do so largely from a logistical perspective based on the practical matters related to coordination of Delphi study activities. Large samples in a Delphi study can present difficult logistical challenges resulting in a huge time investment by the panelists as well as by the researcher. Factors that influence number of Delphi study participants and the successful use of the methodology rests more on group dynamics than on statistical power.

Developing and Validating Delphi Study Instruments

An essential process of a Delphi study is the development of instruments to be used in the study. An instrument could be a questionnaire designed to collect demographic information and a blank page with one or more questions to which panelists could respond, or a questionnaire with multiple questions to which the panelists would respond based on their expertise. The questions could be generated from issues facing a field in general or from a particular academic program, professional organization, or business organization. In educational technology, it could include issues facing practitioners, technology or pedagogical issues, or other imminent problems. The questions could also result from issues identified during a literature review. Provision could be made on the instrument for the panelists to include written comments or questions that they deem pertinent.

While many Delphi studies start with a questionnaire, there are studies that have started with a blank page on which the panelists are asked to identify issues or challenges that confront the field, organization, group, or program with which they are familiar. Opinions vary about whether to start a Delphi study with blank pages or with questions to which the panelists will respond. The approach to use may be determined by the issues involved. Starting a Delphi study with a blank page that contains a question for the panelists enables them to generate relevant ideas from their wealth of knowledge. Developing a round-one questionnaire to have open-ended questions is consistent with the requirement in most Delphi method literature (Farmer, 1998; Murray, 1968). Using an open-ended format for the first round of a Delphi study reduces the chances of excluding items that the researcher may have omitted. However, generating a questionnaire for the panelists helps to identify possible issues that the panelists might forget. Providing a rating instrument such as a questionnaire with a Likert scale for panelists to rank their responses is an approach that is frequently used. It is possible to gain from the benefits of both of these methods by starting a Delphi study that combines both approaches for richer responses.

Achieving Consensus in a Delphi Study

Achieving consensus or stability is widely agreed to be the main purpose of a Delphi study (Armstrong, 1989; Murray & Hammons, 1995; Zemke & Kramlinger, 1982). The Delphi Technique is viewed as the most important among consensus-building methodologies because it allows the participating experts to reach consensus on the significant aspects of the issues in the study. Delphi researchers have different views on methods of determining consensus while using the Delphi methodology. Researchers who conduct Delphi studies define consensus and the criteria for determining when consensus is achieved. This is based on the purpose of their study, the number of expert panelists, and duration of the study. Two or more rounds of questionnaires can show a pattern of consensus in a Delphi study.

Consensus is achieved when a predetermined percentage of the participants come to agreement on issues being studied. Dajani, Sincoff, and Talley (1979), note that consensus "occurs when unanimity is achieved concerning any issue" (p. 85). Furthermore, Dajani et al. (1979) explain that, "In most Delphi studies, consensus is assumed to have been achieved when a certain percentage of the responses fall within a prescribed range for the value being estimated." (p. 83). Percentages can be used to describe rating patterns and determine acceptable levels of agreement among panelists in a Delphi study (Dajani et al., 1979; Zolingen & Klaassen, 2003; Murphy & Terry, 1998). Stability is related to consensus and it is also an important feature in Delphi studies. Stability is reached when no further shifting of the participants' responses is obtained in all the rounds (Scheibe, Skutsh, & Schofer, 1975). Dajani et al. (1979) explain stability as the "consistency of responses between successive rounds of a study" (p. 84). While consensus and stability are important and need to be obtained, the purpose of a Delphi study is to produce "critical examinations and discussions, not [to force] a quick compromise" (Turoff & Hiltz, 1996, p. 57).

Use of the Delphi Technique in Educational Technology Research

The Delphi Technique has been used in business and academic circles since its inception. According to Weaver (1971), the Delphi Technique appears to be a suitable approach for people in education to "think about the future in a more complex way than they ordinarily would" (p. 271). Researchers have used the Delphi Technique in educational settings to set future goals, forecast trends, explore the emerging roles of professionals, and answer different research questions (Bickel, 1998; Bornyas, 1995; Clarke & Coutts, 1970; Cyphert & Gant, 1970; Rines, 1988; Scarpa, 1998; Schieman, 1980).

The unique characteristics of the Delphi Technique make it useful in educational technology research for exploring critical issues, predicting the future of the field, defining roles of educational technologists as pedagogy and technologies change, predicting effective instructional interventions and strategies, determining areas of need in the instructional design and technology programs as the field grows, identifying problem areas in the field, equipping those in leadership with information that could be vital in decision-making or policy formulation, and in answering research questions in the field. Educational technologists can employ the Delphi Technique in their practice to determine effective methods of working with their constituencies; identify best practices in the profession and current skill sets; and to forecast emerging trends and technologies. The Delphi Techniques can be used to answer many educational technology research questions and yield results that will aid in decision-making by faculty, researchers, and administrators at various levels in the field.

Application of Delphi Studies to Educational Technology Settings: Issues and Problems

A look at different ways that the Delphi Technique has been used in other disciplines could suggest possible ways it could be applied to Educational Technology (ET). It may be pertinent to include in the discussion a few studies that have used the Delphi Technique in the field of education.

Studies in Identifying Roles and Responsibilities and Determining Competency Levels

The Delphi Technique could be used in research studies that explore the changing roles of educational technologists and professional competencies, particularly when those roles are being affected by fast-paced changes in technologies and teaching and learning processes. Similarly, it could be used to determine the compe-

tencies of educational technologists as change occurs in the field. Researchers in other fields have consistently engaged in studies to determine the roles and responsibilities of a position or the competencies of practitioners in their fields, thus helping to identify and define roles and competencies in their field or profession. A study that identifies roles can be of importance in determining the functions of practitioners or professionals in that field. For instance, Rines (1988) conducted a Delphi study to determine the competencies for administrators in the allied health programs in academia. The study served as an initial step in the process of establishing broad competencies that could serve as appropriate criteria for hiring, promoting, and developing directors of academic allied health programs in higher education. The results of the study by Kane and Colton (1990) showed that program directors must be particularly competent in their roles as fiscal officers, educators, program directors, group leaders, resource developers, and communicators. McLagan (1983) surveyed human resource professionals to determine the structure of the field and to identify core competencies that are essential for these practitioners to successfully engage in their roles. McLagan's study identified nine areas of practice for human resource professionals: human resource planning, organization and job design, organization development, personnel research, personnel research and information systems, employee assistance, union-labor relations, compensation and benefit, and selection and staffing. A study by Robeson (1983) identified 50 competencies and 10 functions of special education administrators. Similarly, Fulkert (1997) conducted a three-round Delphi study to determine the competencies required to be a trainer, gathering data from 35, 28, and 22 panelists for each round of the study. The study helped to determine the important competencies a trainer should have in order to be hired. The Delphi technique could be used for similar studies in educational technology.

Studies to Determine Areas of Practice and Importance

The Delphi Technique could be used to determine areas of practice and areas of increasing importance in the ET field. Using a two-round

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Delphi methodology, Dufour (2003) conducted a research study to identify areas of practice, responsibilities, and tasks of continuing higher educators, which led to the description of areas of practice for the field of continuing higher education. The findings of the Delphi study by O'Neill, Scott, and Conboy (2009) to investigate the factors that influence collaborative learning in distance education identified seventeen most important factors. The factors include, among others, course rationale and design, instructor characteristics, training, group dynamics, the development of a learning community and technology.

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Studies in Leadership

The Delphi Technique has been used in research studies that have examined leadership issues (Bornyas, 1995; Cetron, 1969; Dalkey, 1967; Judd, 1972). Schieman (1980) used the Delphi methodology to determine if media directors in Canadian universities perceived themselves as agents of change or if they were just holding maintenance-oriented positions, and to obtain information on the importance the directors placed on the tasks they performed. Scarpa (1998) used the Delphi Technique to investigate the leadership practices and technology competencies needed by administrators to implement technology in their institutions. The study used a modified three-round Delphi method to gain consensus from a panel of experts. In another study, Murry and Hammons (1995) used the Delphi Technique to determine the effectiveness of the criteria used for administrative personnel assessment.

Studies in Technology Use

The Delphi Technique could be used to investigate issues relating to emergence of new technologies, changes within higher education, educational reform initiatives, adoption of instructional innovation, and the need to provide faculty and students with the necessary technological skills and access to technologies. Holden and Wedman (1993) conducted a Delphi study to determine which computer-mediated communications could be used in higher education.

Predicting Futures

One of the attributes of the Delphi Technique is its strength in futures forecasting. This feature could be used to advantage in forecasting the future and predicting trends in the ET field. Other professional fields engage in the practice of futures forecasting to help guide practice, prepare graduates for future employment, and develop curriculum to keep the field current and relevant. In a study to identify essential functions for registered nurse educators, Bickel (1998) used the Delphi Technique with 32 nurse educators who participated as expert panelists. The three rounds of the Delphi in that study resulted in consensus (97%) on 67 of 69 functions identified by the panelists, although a small proportion of the panelists were in disagreement, and the identification of 18 essential functions in registered nurse education. The research findings provided a research basis for the development of lists of essential functions by nursing programs. In a Delphi study by Rice (2009) which examined multiple perspectives on policy, practice, and research, the panelists identified specific priority areas to be addressed by those engaged in all facets of for K–12 distance education over the next five years.

Challenges in the Use of the Delphi Technique

While the Delphi Technique has many benefits, it also has problems and challenges associated with its use. Opinions of researchers vary on the use of the Delphi Technique in any setting. While some laud the qualities of the Delphi Technique, there are experts who have leveled criticisms on the methodology. Two of those criticisms include the lengthy time involved and the experience of the panelists.

Lengthy Process

The use of the Delphi Technique requires multiple rounds of iteration and feedback. This process could be lengthy and thereby result in participant attrition. Even in cases where there is interest in the outcome, the panelists could be overwhelmed if the study lasts too long. Researchers in a protracted study might be tempted to force a consensus. However, measures can be taken to keep panelists in a Delphi study, one of which involves providing incentives. The incentives could be such that will not influence the opinion of the expert panelists. A related problem is slow or non response to the questionnaire. To minimize non-response, Hsu and Sandford (2007) recommends the initial contacts introduce both the researcher and the topic of research other potential participants.

Experience of the Panelists

Some critics have expressed concern about the level of experience of the expert panelists.

A number of assumptions are made about the experience of panelists participating in a Delphi study; the first being that the panelists have a thorough understanding of the issues that are identified and rated in a study or that they have an in depth knowledge a field, while it is obvious that their level of experience and expertise might not be the same. It is assumed that contextual issues, personal biases, and personal conceptions will not influence the responses of the panelists. There is also the challenge of how reliable panelists will be in self-reporting on their experiences and knowledge.

Furthermore, it is assumed that since the panelists are experts on the issues being discussed that they would be interested in a study that relates to their field, and that the interest would motivate them to participate and sustain them all through the study.

These issues and challenges should not deter from the use of the Delphi Technique, as other research methodologies also have some issues and concerns. With thorough knowledge of the methodology and careful planning, it is possible to minimize or overcome the challenges.

Conclusion

The Delphi methodology is designed to both obtain and identify areas of consensus and divergence of opinion. The Delphi methodology is an effective approach in cases that involve a problem for which the use of analytical techniques cannot be easily applied, but which can gain from subjective judgment. The Delphi Technique can be useful when investigating problems with multiple issues and which requires the judgments of expert panelists. This research approach is based on the notion that the collective viewpoints of expert panelists can yield better results than the limited view of an individual. It can be a beneficial tool in the field of educational technology.

This article has discussed the Delphi Technique, the process involved in its use, and the ways it has been used in various disciplines. The provided examples of Delphi use in different fields and organizations did not exhaust the possibilities in the use of Delphi Technique. Researchers in the field of educational technology could apply the Delphi Technique creatively in other areas. The uses and attributes of the Delphi present an alternative methodology for educational technology researchers and graduate students who might be interested in conducting research studies. With developments in information technology, innovations in teaching and learning processes, and changes in the field of educational technology, the Delphi Technique could be used in studies that will help to identify new directions for the field, competencies, roles and responsibilities, best practices, changes in the field, technology applications, leadership and policy issues, and more, in an effort to continue to improve practices in the field.

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