

Using the Internet to Improve HRD Research: The case of the web-based Delphi research technique to achieve content validity of an HRD-oriented measurement.

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Using the Internet to Improve International HRD Research: The case of the web-based Delphi research technique to achieve content validity of an HRD-oriented measurement.

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Abstract

A Web-based Delphi process can be used to answer difficult questions, compile a body of knowledge from diverse and geographically dispersed experts, or solve a problem in HRD. Of importance to HRD researchers a Delphi can also be used to establish content validity of a measurement. Because of its more qualitative online discussion environment, a Web-based Delphi procedure has the potential to offer a more rigorous content validation than traditional paper-based Delphi procedures and is applicable to HRD research and practice.

Introduction

This study used the Delphi research method to develop and validate the *Online Adult Learning Inventory*, an instrument to apply the principles of adult learning (andragogy) to Web-based instruction and training (Colton and Hatcher, 2004; Colton, 2002). A pioneering feature of this study was conducting the Delphi process on the Internet rather than employing more traditional paper and pencil techniques common to content validation of a Human Resource Development (HRD)-related research instrument. A Web site was constructed with a threaded discussion forum for discussions related to developing content and validity, Web forms for voting purposes to determine the level of expert consensus, a calendar to keep the panel on task, and as an archive to hold draft versions of the instrument and the text of previous discussions available for review at any time by the experts and the researchers. The experts were assigned pennames for anonymity. Ample time was allotted for expert panel members to reflect on the content validity of the draft instrument and to add additional commentary to the discussion forum any time and from any place. The specific research questions this study addressed are:

1. To what extent can a valid instrument be developed by a diverse Delphi expert panel that measures the application of adult learning principles to fully-mediated Web-based training?
2. How does a web-based Delphi assist a group of diverse and geographically dispersed subject matter experts in establishing a content valid measurement of instructional methods and techniques that demonstrate the application of adult learning principles to fully-mediated Web-based training?¹
3. To what extent can a Delphi process be established as a web-based method to validate research measures?

¹ This study is based in part on doctoral research conducted by Dr Colton (Colton, 2002)

The purpose of this paper is to highlight the results of the online Delphi research project; in particular the procedures used to establish an online and innovative process of content validation and obtaining 'rich' and descriptive information using the internet and current e-learning technologies. The online Delphi was proven to be an excellent tool in establishing content validity for an HRD-related construct, e.g., adult learning principles. A review of related literature revealed no existing research that used a web-based Delphi technique to validate measurements used in training and development (T&D) or HRD.

Rationale for and Significance of the study

This study illustrated online Delphi as a potentially effective and efficient tool for researchers and practitioners in HRD and related disciplines. There are several reasons why Delphi is an especially applicable research and evaluation tool for HRD research and practice. First, the multidisciplinary nature of HRD lends itself to practices and methods such as Delphi that offer flexibility and the capability to be easily implemented using the internet. Next, Delphi 'fits' HRD research in particular over other related disciplines due to its dependence upon expert opinion. The reliance on expert opinion is a common method in HRD, for example, subject matter experts (SME) are used to establish valid tasks and competence standards. Finally, as an applied discipline, HRD has been criticized for not bridging the gap between research and practice. Unlike other evaluation or research methods such as statistical processes that require significant training, skills and knowledge Delphi is a relatively simple process to learn and use. And like other methods requiring expert skills it produces valid results if implemented in a rigorous manner.

Delphi procedures have until the late 1990's to early 2000's been paper-based with some early research conducted on a mainframe computer or network (Turoff & Hiltz, 1995). The original purposes in constructing the Delphi Research site for this study on the internet was (1) convenience, (2) elimination of paperwork and mailings, (3) an attempt to utilize current technology, a topic of the research, into the research process, and (4) to develop an innovative and 'modern' process of content validity for HRD scholars and practitioners using the Delphi process. The result was the sheer volume of rich discussion and the "anytime, anywhere" give-and-take and anonymous communications amongst expert panel members leading to content validation of an HRD/adult education instrument. Delphi procedures have had some limited qualitative aspects to the otherwise quantitative voting procedures and consensus building of previous Delphi usage. This study demonstrated the potential of the internet to expand the qualitative aspects of the Delphi procedures beyond typical forecasting or concept development (Okoli & Pawlowski, 2004), and resulting in a richer content validation process and outcomes than common synchronous and paper-intensive procedures. It also suggests that as researchers and scholar-practitioners become better versed in the use of the internet the Delphi process described in this study has the potential to greatly improve the usability of Delphi as a means to achieve valid measurements used in HRD and training on a global basis.

This paper identifies a web-based Delphi process and includes a brief review of the Delphi-related literature and literature on content validation procedures as background for the study, a description of the web-based Delphi procedures used in developing and validating an instrument to assess adult learning principles in online training, and conclusions and implications for HRD and training and development (T&D) research and practice.

Delphi Method & Content Validity: A Brief Review of Two Literatures

This section describes a brief review of literatures for the Delphi method and content validity of measures used in HRD and training and development (T&D) and related disciplines. Each of these processes has a rich history of publications, thus the following is simply an attempt to support the research questions of the present study.

Delphi method

Computer-based Delphi procedures have been used since the 1970s on mainframe computers or networks (Turoff & Hiltz, 1995). Today, however, the technology is available to conduct an anonymous asynchronous threaded discussion easily on the Web "...where the merger of the Delphi process and the computer presents a unique opportunity for dealing with situations of unusual complexity" (Turoff & Hiltz, 1995 p.9). This is especially pertinent for HRD, a technology-rich discipline. Research indicates this combination opens the possibility for greater performance from the Delphi panel of subject matter experts than could be achieved from any individual, something that rarely happens in face-to-face groups (Turoff & Hiltz, 1995, p.8, p.11). Recent uses of web-based Delphi include its use as a research tool (Okoli, Pawlowski, 2004), as a forecasting tool (Chou, 2002), and research in educational technology (Pollard & Pollard, 2005). Additionally, Delphi is a conventional method used in HRD, training & development, and related disciplines (McGuire & Cseh, 2006; Chiang & Chen-Liang, 2006; Smeltzer & Davey, 1988; Miller & Trehan, 2004; Pollard & Pollard, 2004-2005; Cabaniss, 2002).

Delphi panel of experts

Delphi panelists are typically selected, not for demographic representativeness, but for the perceived subject matter expertise that they can contribute to the topic. In order to obtain the desired valid results, Scheele (1975) suggested the panel must be selected from stakeholders who will be directly affected, experts with relevant knowledge and experience, and facilitators in the field under study. Spencer-Cooke (1989) suggested that the composition of the panel relate to the validity of the results of the research. Criticisms of the use of experts include difficulties in identifying expert criterion and whether responses from experts are significantly different from non-experts (Mullen, 2003).

As research becomes more international in scope the need for subject matter experts (SME) that are geographically dispersed are becoming more common in HRD. Experts that represent different cultures and ethnicities are also becoming more common in training-oriented research. Additionally, as research in general becomes more complex and diversity-related research continues to be topical it is crucial that cross-cultural HRD and training research be expanded. Thus, cost effectiveness, timeliness and usability of research is a critical concern. This study is an initial step in establishing a method to conduct research in HRD and T&D using technology that may overcome some of the previous obstacles to implementing global research. It has the potential to bring together any number of experts to establish validity and other research and/or evaluation objectives in a timely and scientifically rigorous manner. But even with the availability of technology the number of participants is still an issue in conducting a Delphi study.

The literature suggests that Delphi panel sizes range from a few to fifty or more participants. In Brockhoff's study of Delphi performance (1975), he suggested that for forecasting questions, groups with eleven participants were more accurate in their predictions

than larger groups. For fact-finding questions groups with seven participants had a higher performance in his controlled study. Other studies have found that error decreases with larger Delphi panels (Linstone & Turoff, 1975), however, large panels have more difficulty achieving agreement and are more difficult to administer. Linstone (1978) remarked that accuracy improved very slowly with large numbers and that a suitable size is seven. Dalkey (1975) commented that, "...under favorable conditions, the group response can be more accurate than any member of the group" (p. 257).

Delphi process and procedures

The present study used a technology-rich environment, yet historically the paper and pencil process can last for 30 to 45 days (Barnes, 1987) or longer. For that reason, Scheele (1975) stated that attractive and stimulating peers provide the most powerful incentive to participate. Turoff and Hiltz noted: "Motivation for the expert is often lacking because results are often delayed or are not intended to benefit the expert" (1995, p.9). The response rates of the experts for paper-based Delphi method dissertations include, 92% overall with less than a ten percent drop-out rate (Dobbins, 1999), and similar results with the one Web-based Delphi discussed in this article (Colton, 2002). The time requirement for the Delphi process can last for 30 to 45 days (Barnes, 1987) but in the present study, due to the complexity of the research questions it took several months. The participants were offered the opportunity to participate in the discussion with other panel members of equal merit, to participate in producing and validating an evaluative knowledge-based tool, and to experience what was at the time a 'state-of-the-art' Internet-based Delphi process.

In the related literature Delphi procedures typically consist of three or more rounds. Each round consists of answering questions posed and is ended by a vote. This typically is conducted

with paper and pencil. There is usually a decrease in response rates for the second round of a paper-based Delphi, particularly when using volunteers, as they may lose interest (Jillson, 1975).

The present study had response rate better than with a paper and pencil procedure.

Computer-based techniques are far better than paper and pencil in constructing a flexible approach and, in fact, the traditional round structure may disappear, replaced by a continuous feedback process (Colton & Hatcher, 200x; Linstone & Turoff, 1975). The Delphi method became less structured and permitted greater freedom of discussion after the use of computer conferencing began. Adding the computer capability allowed for a shorter turn-around time, allowing for more immediate and on-going interaction and more material discussed (Price, 1975). This is especially true with new web based instructional management and e-learning platforms common in HRD.

The characteristics or benefits of conducting the Delphi process via computer over a face-to-face or paper-pencil discussion as summarized from Price (1975) and as discovered in the present study included:

1. When the communication process must be structured.
2. When the problem is so broad that many more individuals are needed than can easily interact face-to-face.
3. When severe disagreement among participants occurs, the process must be refereed, and anonymity must be assured.
4. When time is scarce and/or geographic distances are great, limiting group meetings.
5. When an easier more flexible way to access and exchange human experience is required.
6. When increases of the size of the information space to infinity is desirable.

7. When raising the probability of developing latent consensus is desirable.
8. When a written record is desirable.

However, there are potential problems with the contemporary computer-based Delphi method described herein. The historical Delphi model follows a sequential, paper-based structure with the facilitator acting to summarize the round. The computer discussion method can prolong the procedure and discussion can assume parallel tracks. Turoff (1991) suggested the timely use of voting to integrate the problem solving process with the group process. Turloff (1991) summarizes the use of computers in the process as, “The merger of Delphi and Computer Mediated Communications offers far more than the sum of the two methods” (p.11), by which he implies that by introducing computer-based discussion into the Delphi process to replace paper and pen, the Delphi process was strengthened. This was supported in the present study. Turoff, in recommending using the Internet for discussion, emphasizes that the most important criterion to Delphi process design is flexibility in allowing any panel member to “choose the sequence in which to examine and contribute to the problem solving process” (p. 2). A concern brought forward in the present study is language and cultural aspects of written communication that may confound understanding and comprehension among participants from different cultures and ethnicities. On the other hand, due to translation software, the web may actually enhance and expedite the communication and comprehension process within the Delphi process.

There are many reasons for the use of anonymity in the Delphi process. The reasons include: an expert making a commitment to a stand then being reluctant to change it, the different academic and professional standings of the participants, not losing face, and elimination of the usual biases found in today’s society such as gender, racial, ethnic and age biases and power differences. Anonymity of responses allows consensus to take place without the undue

influence of rank, power, personality or persuasive speaking which is common to [face-to-face] group meetings (Westbrook, 1997). Hiltz, Turoff, and Johnson (1989) suggest the use of pen names when using computer-based communications. A forum, discussion or electronic bulletin board enables this technique as e-mail addresses are not used for communications, thus anonymity can be assured. Pen names, although anonymous, allow for a sense of identification within the community of experts and were used for the present study (Colton and Hatcher 2004; Colton 2002).

Since the results of a Delphi are produced by structured interaction, the final product can be said to constitute a “reality construct for the group” (Scheele, 1975, p. 44). The results of a Delphi can be seen as “the product of a carefully designed and managed interaction and not answers to a set of abstract questions that are obtained by following prescribed methods” (p. 38). This is especially important for practitioners and applied researches in HRD who are developing measurements that require validity.

“People incorporate each others’ perspective and information into their thinking and arrive at a fairly accurate understanding of the critical issues to consider in their decision making process” (M. T. Corporation, 1983). This ‘depth’ of understanding and commitment to validity is not possible using more traditional methods. Thus, HRD may benefit from its use to content validate its instruments and measures. Panelists may change their previous votes at any time (Turoff & Hiltz, 1995). If consensus was not achieved on an item, that item may be dismissed for the present, subject to a later revision. The web makes it possible for these items to be easily revisited if necessary. Brockhoff (1975) states that variance reduction, or consensus, almost always occurs in Delphi groups between the first and fifth rounds but the best results, as a rule, are already known by the third round. Thus, any additional discussion may not be necessary.

Content validity

The second review of literature is about Content validity. It is one form of validity applicable to psychological, educational and social science measurement. It is also critical when developing valid measures for workplace tests and other personnel assessments and training measures. In psychometrics, content validity is the extent that a measure or item in a survey or other instrument represents a specific concept. A survey that is intended to measure worker attitudes toward training may not be content valid if it measures only a portion of the concept that is being measured. For example, if developers wanted to achieve an attitude measure that includes both affect and behavior, and the attitude survey measures only the affective dimension of attitude but ignores the behavioral dimension then the overall measure would not be considered valid. It is important to understand that “validation must consider the appropriateness of test content in relation to the purpose of the testing” (Sireci, 1998, p. 87). In developing a valid measure the Educational Research Association’s *Standards for Educational and Psychological Testing* (1999) Standard 1.6 suggests that it be “justified in reference to the construct the test [or measurement] is intended to measure or the domain it is intended to represent” (p. 18). Sireci (1998) added: “Content validity is the degree to which the test measures the content domain it purports to measure” (p. 2).

While some psychometricians insist that validity must be developed through statistical procedures, the large majority of test developers believe that there is no easy way to determine content validity aside from expert opinion. “The concept of validity applies to all measures used in the social sciences” (Sireci, 1998, p. 84). Content validity based on the opinion of experts has been a part of instrument development as early as the 1950’s when scholars indicated that

content should be validated through assessment of expert judgment and is still an accepted procedure for content validity in training and development and HRD.

Panels of experts in content validation

Content validity is determined at least in part by the judgment of subject matter experts (Gay, Mills & Airasian, 2005; Aiken, 2003). Crocker, Miller, and Franks (1989) reviewed judgmental methods for evaluating test content. All methods reviewed provided an index reflecting the degree to which the content of the test held up under the scrutiny of SMEs. Two commonalities existed among the different content indices reviewed. First, each procedure provided at least one quantitative summary of judgmental data gathered from SMEs. Second, the SMEs used in each procedure rated each test item in terms of its relevance and/or match to specified test objectives. Karoulis, Demetriadis, & Pombortsis (2004) also found that expert evaluations were as valid as empirical methods.

The use of subject matter experts is a requirement to establish content validity for most kinds of tests and measurements used in management and social science and is a common method used in T&D to establish training content. Methods used by SME's include relevance ratings and item-objective congruence ratings. "An inherent weakness in using relevance or item-objective congruence ratings to evaluate content validity is that the SME's are informed of the objectives purportedly measured by the text before they evaluate the items" (Sireci, 1998, p.2). Taking this weakness into consideration the present research meets or exceeds the AERA's *Standards for Educational and Psychological Testing* (1999), Standard 1.7. which states that "validation rests in part on the opinions or decisions of expert judges" (p. 19), and addresses the lack of content validity of many evaluations and measures associated with adult learning (DeVellis, 1991; Germain, 2006)

Web-Base Delphi Method to Develop a Valid Instrument

This section of the study outlines the procedures used to develop and carry-out the Delphi. It also includes a sampling of the actual results based on these procedures.

The present study used a web based Delphi method to develop and establish content validity of the Online Adult Learning Inventory, a survey-based measurement of adult learning principles used in HRD and training & development. Typical Delphi procedures call for the development of a questionnaire. In the present study development of a valid survey following sound psychometric processes was the primary purpose of the Delphi, thus, criticisms of poor questionnaire construction (Mullen, 2003) were overcome. Secondary objectives included examining the use of the internet as an analysis/research tool for geographically separated and diverse panel of experts. Research methods for validity included: (a) a thorough review of the literature to construct an item pool of adult learning principles and instructional methods and (b) a Delphi expert panel consensus. The mean, mode, standard deviation, interquartile range, and skewness of the data were calculated from the voting procedures for determination of consensus. Evidence of reliability was indicated by the interrater reliability coefficient from a field test. In addition, the Gunning Fog Index (1983) for readability was calculated to improve the readability of the instrument.

The pioneering Web-based Delphi process used in the present study proved to be a method rich in qualitative data and was an excellent way of bringing together diverse experts to discuss, debate, and organize a body of information in order to develop a validated instrument, reach agreement on an issue, uncover common factors, or forecast trends. This method has

potential for use by HRD researchers and practitioners to build a validated knowledge construct utilizing the resources of the internet for convenience, ease of use, and depth of discussion.

International T&D and other business and industry personnel may use the Web-based Delphi method to validate instruments or knowledge constructs across cultures.

The following procedure was used for the online Delphi to develop and establish content validity of an instrument and is recommended as a valid and useable procedure. A visual representation of the procedures used is illustrated in Figure 1. Web-based Delphi procedures included:

1. Literature review: Preliminary content collected for the instrument using established quality filters, criteria for selecting the expert panel is established, and appropriate research methods are selected through a literature review. In the present study the topics of principles of adult learning and web-based instructional methods were reviewed. Preliminary items (and/or other content depending upon the focus of the study) to be discussed by the panel of experts are identified from the review of literature.
2. Selection of the expert panel: Selection criteria for panel members should be based on a review of the literature, potential panel members are then selected based on the established criteria, and approval of the potential expert panel members was obtained from the studies' sponsor(s). Human subjects' protections should also be established at this time as applicable. Potential panel members are reached by telephone and/or email to seek their acceptance. Upon acceptance, a follow-up letter along with any required release forms is faxed or e-mailed to the experts who accepted the invitation to participate.

-Place Table A, Procedure for selection of expert panel members about here-

3. Review of initial readability of draft instrument: Knowledgeable subject matter experts review the preliminary draft instrument/survey for appropriate wording and ease of understanding. Revision is made to wording based on suggestions.
4. Preparation of the discussion forum: The discussion forum is set up on the Web site with the latest revision of the instrument and other applicable support data. Pen names and passwords are selected for each participant to insure anonymity. Choose gender-neutral pen names for participants.
5. Round one of the Delphi: Establishment of instrument content by discussion and vote for possible consensus. In the present study the experts were given a draft instrument with general adult learning principles, as derived from the literature and developed by the researchers, as the general structure of the instrument. The main points of consideration were: Is the principle represented relevant to web-based course development, and, if so, is it worded correctly? They had three weeks to discuss items on this list, suggest changes to the list, collapse any two principles into one, separate one complex principle into two separate principles, alter wording and phrasing, and make additional comments that came to mind. This phase of the Delphi resulted in a depth of discussion not previously obtainable in paper-pencil based Delphi procedures. For example,

Mango (penname) asked to soften the language, especially the wording “to cope effectively” as it suggests survival, yet many adults enroll in courses for pleasure.

Mango's suggestion was to re-word the principle as: "Adults become ready to learn those things ... with which they can or wish to relate their real-life experiences." Celery (penname) agreed that the principle needed to be re-worded and referred to the "primacy" in adult learning, the need to know something becomes of primary importance. Although agreeing with the above experts, Broccoli (penname) stated that adults are motivated by life events "to pursue formal educational opportunities and to conduct informal learning projects." Tomato (penname) related that, "we design instruction to solve a problem." Kiwi (penname) offered, "Web-based learning systems can and should connect learning to the learner's life experiences" as an alternative re-wording. Kiwi commented that "the concept, premise, principle applies to all learners, but might be more relevant or pertinent to adult learners."

- Experts then had another two weeks to vote on the list. Prior to voting, the list of adult learning principles was revised based on suggestions by the expert panel. Voting ended the round. Results of round one were displayed on the discussion forum. Mean, median, mode, standard deviation, and interquartile range were calculated. Based on the suggestions and a statistical analysis of the vote, the instrument and its structure of adult learning principles were revised again. Note that the amount of time given for discussion is variable and is set by the researcher.
6. Round two of the Delphi: Round two consists of establishing and sorting of an item pool completed by a vote. Consensus is typically not expected at this point. Expert panel members in the present study were asked to list one or more instructional methods that applied to an agreed-upon adult learning principle (Round One) to Web

instruction or training for adults. Because of the opportunity for discussion and debate that a threaded discussion forum afforded, there was expected to be some negotiation toward consensus during the dialogue. Results of the listing of instructional methods were displayed on the discussion forum. One week was given to the expert panel for reflection on the draft instrument as again revised with the list of instructional methods included. Then, a vote was conducted on the large item pool or list of instructional methods, which applied the various adult learning principles to Web courses, using a Likert scale. Descriptive statistics were calculated to indicate consensus. Edits were made by the researchers to the list of instructional methods based on the results of the vote, comments on the voting ballot, correspondence, and references from the literature where necessary. Items receiving weak consensus (mean of 3.0 or higher and an interquartile range of 2 or greater) were retained for a re-vote for the third round to allow panel members to consider changing their vote.

7. Round three of the Delphi: Follow up discussion was available and a second vote was performed on the revised list of instructional items either to include in the instrument or consider for elimination. Statistics were calculated as before. Items not having reached consensus to be included in the instrument were considered for elimination from the final instrument. Edits were made to the list of instructional methods based on the results of the vote, comments on the voting ballot, correspondence, and references from the literature where necessary.
8. Field test for indication of reliability: A field test was conducted using fourteen university or community college faculty or staff who had knowledge of Web course development and/or evaluation. Participants first participated in an overview of adult

learning principles, then used the draft instrument to conduct an evaluation of one pre-chosen instructional Web course. Comments by the participants related to the draft instrument were recorded. Results of the Web courses review were analyzed for an indication of inter-rater reliability using standard correlation procedures for estimating agreement corrected for chance. The inter-rater reliability statistic gives an indication of the reliability and internal consistency of the instrument. Participant comments and results of the analysis were used for the final revisions of the instrument. The Gunning FOG Index (1983) was also computed for final reading level.

Selected Results

Due to the large volume of original results only selected samples are offered in the present study. For complete results and findings see Colton (2002).

The initial listing of items for the adult learning principles required discussion and agreement by the Delphi panel. To develop items for the instrument a list of adult learning principles was needed. The first round of the Delphi process was devoted to defining the list of adult learning principles and creating with them a structure for the instrument. There were 54 discussion sessions in round 1, not including comments from the researcher (an additional 12 comments). The following is a sample of two items from the draft of instrument #1.

- A. Adults become ready to learn those things they need to know in order to cope effectively with their real-life situations.
- B. Adult learners need to know how learning will be conducted, what learning will occur, and why learning is important.

The second draft of the instrument served as the format for vote 1 to end round 1 of the Delphi process. The ballot that experts voted on included a list of the same adult learning principles previously discussed with the addition of two questions:

- a. Should #A and #E1 be collapsed into one principle?
- b. The list of principles all contain the word "adult" in the principle. Should this be changed (as suggested) away from being centered on "adult" to instead be centered on "Web-based learning systems" (e.g., Web based learning systems can and should empower role playing and simulations where situational differences can be exploited to enrich learning activities)?

The voting options for vote 1 were a Likert scale of 1 to 4. (1 - does not apply, 2 - moderately applies but not strongly enough to use in the instrument, 3 - applies enough to be included in the instrument, and 4 - outstanding application and definitely to include in the instrument) and “yes” or “no” for the additional two questions. The voting options for the two additional questions above were yes or no. Panel members were encouraged to add any comments. The results of vote 1 are listed in the following table:

PENNAME	A.	B.	C.	C2	D.	E1	E2*	F.	G.	H.	I.*
Radish	4	4	3	3	2	4	1	2	3	4	1
Orange	4	4	4	4	4	4	1	3	4	4	0
Mango	3	2	4	3	3	1	0	2	3	4	0
Kiwi	4	4	4	2	4	4	1	2	4	4	1
Artichoke	2	4	4	4	4	4	1	2	3	3	1
Apple	3	4	4	4	4	4	0	4	4	4	0
Tomato	3	1	2	1	2	2	0	2	1	2	0

Celery	4	2	3	2	3	4	0	2	4	3	0
Broccoli	4	4	3	3	3	4	1	2	3	4	1
Pineapple	4	3	3	3	2	4	0	2	2	4	0

The instrument was divided into sections A-H based on the original items of eight adult learning principles. Instructional techniques were then developed by the Delphi panel under each section. The following is a sample of results from Section D and is representative of results of each section.

Section D, titled, “Because of their prior experiences, adults tend to develop mental habits and biases and may need to reassess their beliefs in order to adopt alternate ways of thinking.” received consensus in round one. The following is a summary of instructional items (item pool) that were generated by Delphi expert panel members for Section D:

1. The instructor provides pre-registration self-assessment tools to allow the learner to make a realistic decision about their ability to succeed in the course (computer skills, attitudes, etc.).
2. Provide orientation activities at the beginning of the course that allows learners to develop the skills necessary to complete the course (e.g., “introduce yourself to the discussion forum,” “send me an e-mail saying you were able to get on”).
3. Threaded discussions allow students to see and reflect on each other’s responses in comparison to their own which has an enormous benefit in assessing different attitudes. The instructor of the course, thus, encourages all students to post responses to questions, read other comments, and reflect.

4. Activities are build early into the course to build trust among the group of learners. This will stimulate learners to truly reflect upon their experiences in order to modify well-established beliefs or patterns of behavior.
5. The course provides a conceptual framework that allows students to generalize their mental models to the new environment. This can be done with visual concept maps that show the linking of old concepts to new.
6. The instructor uses common language characteristics between old and new models or concepts and does not introduce new jargon too quickly.
7. The instructor pays attention to the meanings of concepts and their relationships and also provides a means to check meanings with students both visually and in written form.
8. The instructor encourages students to share their derivation of meanings and their progress with other students through discussion postings, reflection papers that are posted, and class e-mails.

Many of the discussion comments in Section D dealt with including threaded discussion as a means of reflection, visual concept maps for linking old to new concepts, and orientation or pre-assessment. One expert panel member, Radish (penname), commented that “this is where adults differ significantly from children”. As a result of the discussion in round two, the item pool was edited. The following is a sample of edited items of Draft instrument # 5, Section D:

1. The instructor provides pre-registration self-assessment tools to allow the learner to make a realistic decision about their ability to succeed in the course (computer skills, attitudes, etc.).

2. Provide orientation activities at the beginning of the course that allows learners to develop the skills necessary to complete the course (e.g., “introduce yourself to the discussion forum,” “send me an e-mail saying you were able to get on”).
3. Threaded discussions allow students to see and reflect on each other’s responses in comparison to their own which has an enormous benefit in assessing different attitudes. The instructor of the course, thus, encourages all students to post responses to questions, read other comments, and reflect.

The list of instructional methods in Section D, served as the ballot for vote 2, Section D. Partial results of that vote are listed in the following Table, “Rationale for retaining, editing, eliminating Section D items after vote 2” which is representative of results for each section of the instrument.

Rationale for retaining, editing, eliminating Section D items after vote 2

Original Item	Status After Vote 2				Status of Item after Vote 2
	M	SD	IQR	Rank	
D1	3.29	1.11	1	3	Unchanged
D2	3.57	1.13	0	1	Re-worded to be parallel in form to other items
D3	3.14	1.46	0	4	Unchanged
D4	3.29	1.25	0	2	Re-worded (from comments)
D5	2.43	1.13	1	7	Re-worded (from comments); considered for elimination
D6	3.14	1.07	1	5	Unchanged

There were again eight panel members who participated in this vote. One expert panel member (orange), instead of voting on the ballot, sent a copy of the instrument with extensive edits. There were few comments from panel members attached to vote 2, section D. Most concerned specific wording of items or the combining of items. There was some discussion from two panel members that instructional item #9 was not clear. The researcher edited the items extensively and as a result decided to retain those items with marginal votes for consideration in the next round.

As stated previously, The Gunning FOG Index (1983) was computed to determine the level of readability of the instrument. The following table displays a sample of the results from the computation:

Sample of Results of the Gunning FOG Index for readability

Section of the instrument	Gunning Fog Index readability level (educational grade level)
Section A	11.2
Section B	11.6
Section C	12.2

The average Gunning FOG Index readability score for the instrument was 13.4. Although most of the sections rated in the high school level, two sections, D and F, were rated at graduate school level. It was assumed that the audience for the instrument, educators, trainers, and researchers, will be college students or graduates.

Overall Conclusions

While Delphi is not a new method, the Web-based Delphi process used for this study is relatively new to the field of research design especially in HRD and T&D. This study demonstrated the power of technology in enhancing a classic and ethical Delphi research process, in facilitating in-depth discussion among diverse participants separated by time and place, and providing a venue for voting, all while preserving the anonymity of the participants. It yielded rich qualitative and rigorous quantitative data resulting in a content validated instrument, resulting in a more in-depth content validation, applicable to educational, business, industrial, and government research as well as using the tenets of adult learning principles in 21st century technology.

To address the first research question we suggest that a valid instrument can be developed by a diverse Delphi expert panel that measures the application of adult learning principles to fully-mediated World Wide Web-based training. The second research question was answered by illustrating that the internet can assist a group of diverse and geographically dispersed subject matter experts in establishing a content valid measurement of instructional methods and techniques that demonstrate the application of adult learning principles to fully-mediated Web-based training. And finally, we conclude that a Delphi process can be established as a web-based method to validate research measures.

The present study also supported recent uses of web-based Delphi and its use as a research tool (Okoli, Pawlowski, 2004). The Delphi used in this research also adds to the existing literature on Delphi and HRD, training & development, and related disciplines (McGuire & Cseh, 2006; Chiang & Chen-Liang, 2006; Smeltzer & Davey, 1988; Miller & Trehan, 2004; Pollard & Pollard, 2004-2005; Cabaniss, 2002).

Implications for HRD and T&D Research and Practice

The procedures used in this study are applicable to human resource development, training and development and adult education research and practice in that with the ubiquitous nature of the technologies used in the study it makes replication of the process possible for researchers, practitioners and others seeking to develop valid tools to measure related content.

This process also insured anonymity of diverse, geographically separated participants and confidentiality of data throughout the process as well as addressing issues around power and rank inherent in face-to-face subject matter expert-based research. Anonymity of responses allowed consensus to take place without the undue influence of rank, power, personality or persuasive speaking which is common to group meetings (Westbrook, 1997). Required anonymity in the Delphi process is based on an expert making a commitment to a stand then being reluctant to change it, the different academic and reputation standings of the participants, not losing face, and elimination of the usual biases based on gender, race, ethnicity, sexual orientation and age. This study provided a method to significantly reduce or omit ethical concerns around power, personality and biased influence of participants. Thus, when HRD scholars seek to use multi-cultural participants in their research the typical ethical problems they face in terms of anonymity and power based on cultural biases are addressed through the web-based Delphi procedures illustrated in this study.

Finally, this research helps to address the critical issue of how research is used in practice. Reasons that this research lends itself more to practice than other HRD research using

more common qualitative or quantitative methods include a. it is a relatively simple procedure requiring less than expert-level skills, b. the Delphi uses expert opinion that is commonly used in training and development practice, and c. results are easy to interpret and practical.

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Step	Procedure	Result
Step 1	Review literature to compile a list of potential panel members based on one recent book or journal article on Web course development.	Compile list of names.
Step 2	Check books or articles (or other articles or books by the same author) for evidence of knowledge of adult learning principles.	Mark for evidence of adult learning principles.
Step 4	Check <i>ISI Social Sciences Citation Index</i> for number of citations.	Mark number of citations.
Step 5	Evaluate potential experts as to their contributions to the scholarly discussion and/or subject(s) under investigation. In the presents study adult learning, courseware development, or familiarity with instructional methods appropriate for Web courses were considered.	Rate potential experts on a suitability-to-the-study scale of 1 to 3 (1 = not useful, 2 = moderately useful, 3 = very useful to the study).
Step 6	Present evidence of potential panel member's expertise to the Dissertation Committee members for review.	Develop a final list of potential expert panel members to invite to participate and a list of substitutes.
Step 7	Telephone each potential panel member to explain the purpose and scope of the study, with invitation	Follow-up w/ ea participant committed to the study with

	to participate.	letter.
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Table A. Procedure for selection of expert panel members

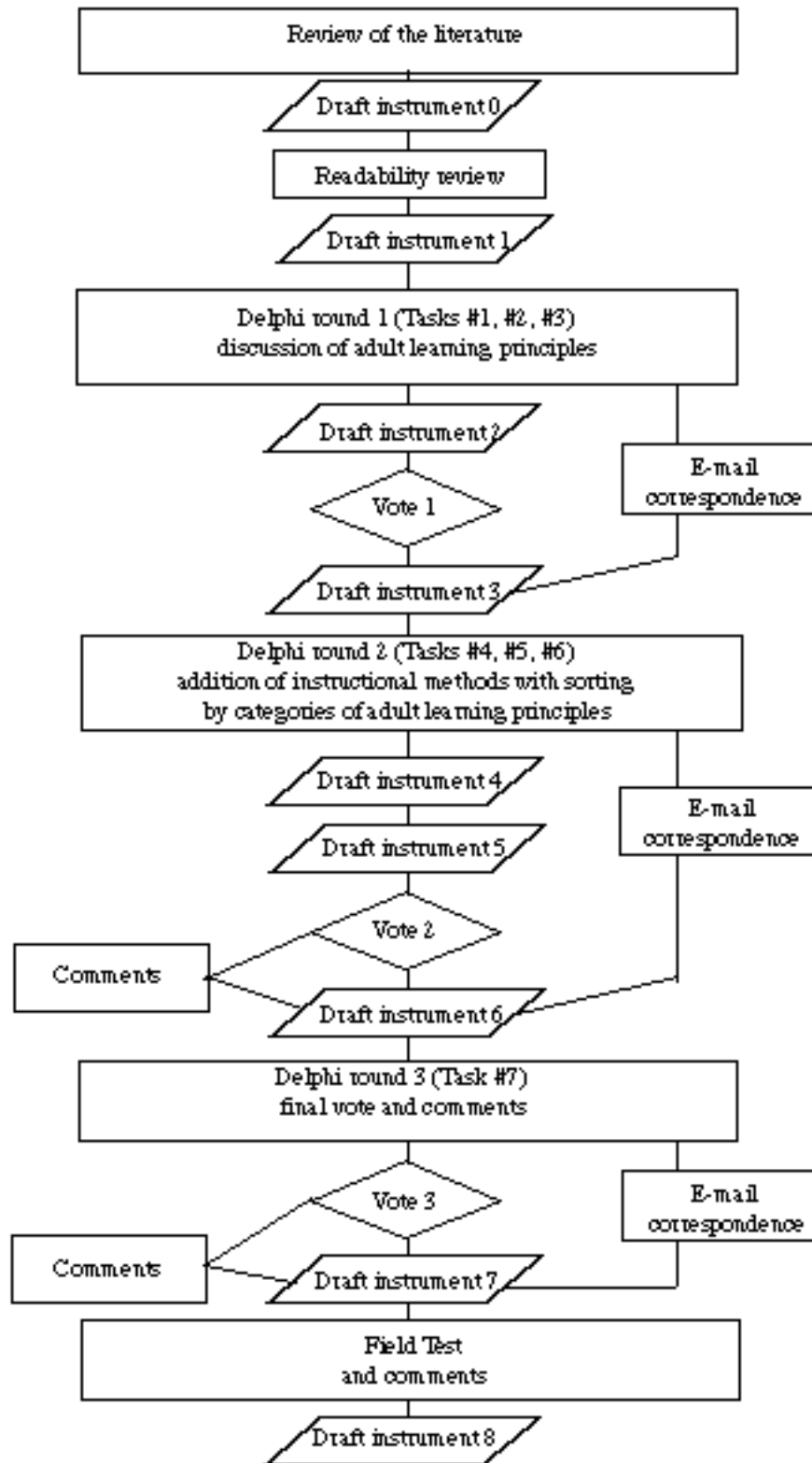


Figure 1. Web-based Delphi procedures