Teacher Beliefs About Educational Software: A Delphi Study

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Abstract

A Delphi method was used to determine the extent to which current educational software was meeting the needs of teachers; as well as what changes needed to occur in educational software to make it more effective. Five overarching themes emerged: (a) instructional design issues, (b) curriculum, (c) materials, (d) cost, and (e) meeting specific needs. The cost of software was a concern throughout the study. The belief that educational software should be grounded in both content and purpose was also a major concern. Deficiencies and suggestions for improvement were found.

OVERVIEW

In the past two decades, technology has become increasingly prevalent in the workings of the educational system, with today's classrooms using more and more technology to enhance their curricula (Char, 1990; Heinich, Molenda, Russell, & Smaldino, 2002; Jeffries, 2000; Pastor & Kerns, 1997, Perkins, 1995; Shelly, Cashman, & Gunter, 2002; Skinner, 2002; Tiu, Guglielmi, & Walton, 2002). Nonetheless, how best to utilize and integrate technology effectively into schools and classrooms is a question that generates many diverse responses.

Effective use of technology is a phrase that educators seem to use repeatedly when discussing the integration of technology into the classroom (Barrett, 1993; Newby, Stepich, Lehman, & Russell, 2000), however, it remains unclear to what extent educational software really is meeting the needs of teachers and students today (Crosier, Cobb, & Wilson, 2002; Cuban, 2001, Forcier, 1999; Mills, 2001).

LITERATURE REVIEW

Although there is a wealth of information in the current professional literature focusing on integrating computer technology into all aspects of the curriculum, there are two important areas for which there is a dearth of information (Cuban, 2001; Perkins, 1995; Sivin-Kachala, Bialo, & Langford, 1997). At the heart of these related areas are software evaluation from the perspective of summative evaluation (e.g., student achievement outcomes) and formative evaluation of the software (e.g., appropriateness of instructional design elements such as content, interface, and degree of computer mediation) and how it is used in classrooms (Mills, 2001; Sugar, 2001). This study focused mainly on the latter area, that of formative evaluation and instructional design of software.

It appears that many commercial educational software publishers do not use the time-tested formative evaluation process that is generally accepted by instructional designers for most types of educational materials (Boone, Higgins, & Williams, 1997; Higgins, Boone, & Williams, 2000; Lockard, Abrams, & Many, 1997). Without formative evaluation, which is a cornerstone of instructional systems design (Dick & Carey, 1990; Fleming & Levie, 1993; Shiratuddin & Landoni, 2002), the appropriateness of a piece of educational software for a particular student audience is questionable. Additionally, much of the extant research on educational software in the classroom has focused predominately on software specifically created for research and not software produced in the commercial market (Richey & Morrison, 2002; Rosenberg, 1997). This poses a potential problem when ascertaining the value of educational software as curriculum material.

Teachers rely on experts to produce quality instructional materials for classroom use with the assumption that these commercial products have been properly designed, developed, and evaluated. However, this is not necessarily the case (Shiratuddin & Landoni, 2002; Sugar, 2001). Boone, Higgins, and Williams (1997) found that commercial educational software publishers are generally unwilling to talk when asked about their instructional design process and evaluation procedures. Many do not have a set of procedures, and few have teachers or students evaluate their software prior to marketing (Higgins, Boone, & Williams, 2000; Mills, 2001).

Even though today's software tends to be more user friendly than ever, many aspects of its design can be very complicated (DiSessa, 2000; Hannafin & Hill, 2002; Poole, 1995; Rosenberg, 1997). And although it can be argued that many of the traditional materials widely used in the classroom may not have undergone a rigorous instructional design process (ISD), it can be maintained that it is more critical for educational software to undergo a more stringent ISD process than other educational materials. This is due to the fact that the educator generally mediates other materials as they are being used to make them more effective. In essence, materials such as filmstrips, worksheets, textbooks, and other instructional materials go through a formative evaluation process as the teacher interacts with the materials and the students. That is to say, the teacher adapts these materials to improve and to fit better the needs of the students (Gagné, Briggs, & Wagner, 1988; Joyce & Weil, 2000). Often with educational software there is less, if any, teacher mediation of the instruction.

Many teachers lack (a) the expertise to select appropriate software and adapt it for use by their students, (b) the technical skills and training needed to evaluate the effectiveness of educational computer programs, (c) training in effective pedagogical strategies for incorporating software effectively into their teaching, and (d) experience and guidance in facilitating computer-based learning within the context of time constraints and prerequisite student skills (Drake, 2000; Hinostroza & Mellar, 2001; Kelley & Ringstaff, 2002; Nations, 2000). Thus, there is a concern as to whether the design of educational software does in fact meet basic instructional requirements for flexibility and attention to individual needs (Hinostroza & Mellar, 2001; Merrill, 2002; Shiratuddin & Landoni, 2002).

Technology integration in the traditional sense referred to courses in computer programming, keyboarding skills, word processing, or drill-and-practice and tutorial software. However, the role of current technology requires educators as well as learners to utilize technology as a tool for inquiry, problem solving, and collaboration, making it an integral part of learning rather than an isolated, compartmentalized part of the curriculum (Benson, 2000; Kelley & Ringstaff, 2002). Educational software, then, must be designed not only to actively engage learners in reflection and inquiry, but must also be cognitively, socially, and pedagogically appropriate for students (Haugland & Shade, 1994). Gardner's theory of multiple intelligences (1993) holds that children learn in at least seven different ways (i.e., verbal/linguistic, logical-mathematical, visual/spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal). Designers of educational software should bear in mind different learning styles, particularly when the users are young children (Shiratuddin & Landoni, 2002).

Although some research has indicated a positive effect for computers in some specific educational settings (Elliott & Hall, 1997; Means & Golan, 1998; Roblyer, 1991; Sandholtz, Ringstaff, & Dwyer, 1997), there remains an absence of supported data for much of the application of technology that is used in schools. Absent as well from the literature were any data that gave voice to teacher concerns regarding the educational software they were using with their students.

PURPOSE

The purpose of this study was to examine the views of technology-using educators toward the software that they used with their students. The study developed a consensus of what these educators saw as the limitations of educational software currently being used and their beliefs about what needed to be done for it to be more effective and useful as an integral part of the curriculum.

DELPHI

A Delphi method was used to build a consensus in the specific topic area of educational software (Hiltz & Turoff, 1993; Sim, 1977). In the Delphi process, the participants generated their own opinions and also had the opportunity to think about the judgments of others on the topic (Barnette, Danielson, & Algozzine, 1978; Hiltz & Turoff, 1993). In this process, the individuals participated in creating an aggregate opinion and then determined a consensus on the topic through a structured series of questions stemming from previously formed answers (Hiltz & Turoff, 1993; Ricketts, 1985).

METHOD

Participants

The participants included a stratified sample of educational computer specialists (ECSs) and technology-using teachers from 10 elementary schools, 10 middle schools, and 10 high schools from a large metropolitan school district. The ECSs were asked to participate themselves as well as provide two teacher participants from their schools based on the following criteria:

1. The teacher used educational software at least once a week.
2. The teacher created assignments that incorporated technology into the curriculum as opposed to being used simply as playtime when classroom work was finished.
3. The teacher used a computer for his/her own work.

Of those who initially agreed to participate, 21 were educational computing specialists (ECS) and 37 were teachers in either a classroom or a computer lab setting.

Research Questions

Although much discussion has occurred in forecasting for technology needs in the near future, much of that discussion has centered on hardware needs and connectivity issues for Internet use (Cuban, 2001; Poole, 1995; Roblyer, Edwards, & Havrikluk, 1997; Rosenberg, 1997). Very little evaluation or critical discussion of commercial educational software has been reported (Forcier,1999; Higgins, Boone & Williams, 2000; Sugar, 2001). The Delphi process was used to determine how the current body of educational software was viewed by teachers and school district technology experts. Questions that were investigated included:

1. What deficits do computer-using teachers find existing in current educational software?
2. What adaptations do computer-using teachers routinely make to use educational software effectively?
3. What suggestions do computer-using teachers have for improving current educational software?
4. What changes need to occur in educational software design to meet the needs of today's classrooms?
5. How do computer-using teachers envision the future of educational software?

Setting

This study took place in a large metropolitan school district in the southwestern United States. The district had implemented a technology support system in the form of a cadre of educational computer specialists (ECSs).

Data Collection

The Delphi process began with the following question sent to each participant in Phase 1 of the study.

Please provide five (5) specific suggestions for improvement and five (5) significant deficits associated with the educational software you are currently using or have used in the past with your students. You may include adaptations that you have made in using the software for it to work well in your classroom.

A feedback report including a comprehensive list of responses was constructed, with similar responses combined and listed only once. The report also included a summarization of the seven most frequent items from the original response set.

In Phase 2, participants were given a survey containing the aggregate list of responses from Phase 1 and the summary of the seven most frequent items. They were asked to perform three tasks: (a) rate each of the items in importance on a five-unit Likert scale (b) select the five most important items from the list, and (c) provide a brief explanation for choosing each of the top five.

Data Analysis

Domain analysis (Spradley, 1980) was used as the qualitative method to determine the themes and categories from the Phase 1 Delphi query. Data were described using frequency counts, mean scores, and standard deviations. Frequency scores were calculated in both Phase 1 and Phase 2 of the study.

Participant counts. Participant counts reflected the number of responses from individual participants that fit into particular categories. In this analysis, a participant could have multiple response items in a single category, but the participant frequency count for that category would be 1.

Top five items. Frequency scores were tallied on all of the items chosen by the participants as their top five choices. This information was used in the description of consensus material. In addition, the frequency scores of the categories and themes were tallied.

Narrative rationales. The narrative rationales linked to the participants' top five choices were examined to see if any additional information was given. Information beyond the reiteration of the survey items was reported.

Likert scale data. The Likert scale information was analyzed using both mean scores and standard deviations. A mean score was calculated for each item to describe the importance of that particular item.

Consensus. Varying levels of consensus on the different categories or themes that emerged were expected. Determining consensus was not the same as achieving a majority vote.

Response tables were constructed to help present and describe much of the consensus data.

RESULTS

Participants

With 23 schools agreeing to participate, there were 69 participants possible. Fifty-eight of those individuals agreed to participate, giving a participation rate of 84% from the total possible participants. Forty-eight participants returned the Phase 2 surveys, giving a return rate of 69% of the surveys that went out.

Phase 1 Results

After the responses were separated and coded into separate themes and their smaller categories, all similar items were easily identifiable. An aggregated item was then created to represent these similar items, which reduced the list from 297 to 78 distinct items.

Item frequencies. Responses were grouped into categories and then the categories were grouped into themes. Frequencies were calculated for items, categories, and themes based on the number of separate responses they represented.

Items were ranked based on their frequencies. The item frequency was calculated on the number of responses the aggregated items represented. For example, the following responses were combined:

1. Frequently manuals are poorly written.
2. In general, documentation is either insufficient or tedious.
3. Better documentation would allow students to quickly navigate the software so more time could be spent with the content or purpose of the software.

An aggregate item, "Manuals and help materials need to be better written," represented all of these items and had a frequency count of 3.

Top six items. Six items were reported because there was a significant break between the frequency counts of the sixth-ranking item and the seventh. The top six items (i.e., the six aggregate items with the highest frequency counts) were as follows:

1. Software should be simplified in terms of required operating systems, file interchangeability, color settings, network/stand-alone versions, use of virtual memory, etc.
2. Quality educational software needs to be less expensive for single purchases, network versions, and site licenses.
3. Software should have multiple modification components to adapt to teacher and student needs.
4. Software is not easy enough to use "out of the box" and requires significant time to learn and training with suggestions on how to use the software.
5. Current software is too predictable, repetitive, uninteresting and does not incorporate relevant and real-life situations into the curriculum.
6. Software's content should be grounded in education content and purpose.

Themes. Instructional Design and Curriculum were the top two themes based on frequency counts. Theme frequencies were calculated by adding the frequencies of the categories that fell under them. Eight themes had a frequency of 17 or more. The cut off of eight was due to a significant difference in the frequency counts between the eighth and subsequent themes (see Table 1).

Categories. Adaptability and External Events were the top two categories with the highest frequency counts. The frequencies for categories were calculated as the sum of the frequency totals of the items that fell under each category. Six categories had a frequency count of 10 or more. The cut off of six was due to a significant difference in the frequency counts between the sixth and subsequent themes. The top five categories all fell within the Instructional Design Issues theme (see Table 2).

Items. The following six items represented responses from at least 15% of the participants.

Table 1: Top Eight Themes with the Highest Frequency Counts

Theme	Frequency	Percentage
Instructional Design Issues	85	28.62%
Curriculum	37	12.46%
Materials	24	8.08%
Teacher Training/Teacher Ideas	22	7.41%
Program types	22	7.41%
Usability Design	19	6.40%
Cost	17	5.72%
Meets Needs	17	5.72%

Note. Values indicate the number of responses and the percentage the theme represents

Table 2: Top Six Categories with the Highest Frequency Counts

Category	Frequency	Percentage	In Theme
Adaptability	16	5.39%	Instructional Design Issues
External Events	13	4.38%	Instructional Design Issues
User Friendly	12	4.04%	Instructional Design Issues
Expert Input	11	3.70%	Instructional Design Issues
Accurate Information	10	3.37%	Instructional Design Issues
Supplementary	10	3.37%	Materials

Note. Values indicate the number of responses and the percentage the category represents.

1. "Quality educational software needs to be less expensive for single purchases, network versions, and site licenses" represented 24% of the participants.
2. "Software should be simplified in terms of required operating systems, file interchangeability, color settings, network/stand-alone versions, use of virtual memory, etc." represented 21% of the participants.
3. "Software should have multiple modification components to adapt to teacher and student needs" represented 19% of the participants.
4. "Educational Software should be easier to use, self-explanatory, and more intuitive" represented 17%.
5. & 6. The items "Software is not easy enough to use 'out of the box' and requires significant time to learn and training with suggestions on how to use the software" and "Current software is too predictable, repetitive, uninteresting and does not incorporate relevant and real-life situations into the curriculum" each represented 16% of the participants.

Phase 2

Mean scores from Likert instrument. Based on data from all participants, there were 13 items that had a mean score of 4.0 or better (see Table 3). The two items with the highest average rating of importance both concerned Curriculum issues. Of the items with an average score of four or higher, three fell under the theme Curriculum, three under the theme Materials, two under the theme Instructional Design, and one each concerned the themes Meets Needs, Upgrades, Cost, Preview/Demos, and One-Computer Classroom.

Lowest standard deviations for all participants. The item with the lowest standard deviation for all the participants was "Software needs to contain a variety of skill levels to

Table 3: Items With an Average Rating of 4 or Higher

Average	Standard Deviation	Survey questions	Categories	Themes
4.52	0.752	57. More educational software needs to be created that uses higher order thinking skills using inquiry methods and open-ended questions.		Curriculum
4.30	0.840	51. Software's content should be grounded in education content and purpose.		Curriculum
4.26	0.743	28. Software needs to contain a variety of skill levels to meet the needs of students.		Meets Needs
4.24	0.970	20. Software upgrades should be downward compatible and be provided to schools as soon as they are put on the market.		Upgrades
4.20	1.014	12. Quality educational software needs to be less expensive for single purchases, network versions, and site licenses.		Cost
4.13	0.909	5. More educational software should be available online.	Online	Materials
4.11	0.948	6. More examples should be provided for use in the classroom and for modeling purposes.	Examples	Materials
4.09	0.915	53. Software should test student mastery of stated objectives.		Curriculum
4.07	0.854	21. More fully active demo software should be provided for evaluation purposes.		Preview/demos
4.07	0.975	36. Software developers should work closely, use and incorporate ideas and suggestions of educators to improve their software.	Expert Input	Instructional Design Issues
4.07	1.136	50. All educational software should be hybrid (cross-platform) so that they work on both platforms.	Accurate Information	Instructional Design Issues
4.07	1.124	60. There needs to be more quality software aimed at one-computer classrooms.		One Computer Classroom
4.00	1.033	1. Manuals need to be better written with more trouble shooting tips.	Manuals	Materials

Note. _Values indicate the mean scores and standard deviations of the survey items with a mean score of 4.0 or higher._

meet the needs of students," with a standard deviation of .743. The item with the second lowest standard deviation was "More educational software needs to be created that uses higher order thinking skills using inquiry methods and open-ended questions," with a standard deviation of .752. Third lowest standard deviation (.816) was for the item "Supplementary materials need to be improved, more detailed and more accurate for specific software that makes using the software smoother." The item with the fourth lowest standard deviation, "There is no benefit in using educational software," had a deviation of .816. The item with the fifth lowest standard deviation (.839) was for the item "Current educational software does not meet everyone's needs."

Top five choices. Participants were asked to select the five most important items from the Phase 2 survey. Frequency counts were calculated for all participants and again separately for teachers only, ECSs only, elementary school teachers only, middle school teachers only, and high school teachers only.

The item that ranked number one for all participants was the single item under the theme Cost. When recalculated for the separate groups, this item also ranked first for all teachers, elementary school teachers, and high school teachers (see Table 4).

Ranking second with participants was the item concerning software being hybrid versions, which was an instructional design issue. This item stated that there is a need for software to install on either Macintosh systems or Windows systems from the same CD (see Table 5).

Table 4: Response Table for First Choice Survey Item

Survey item:
Quality educational software needs to be less expensive for single purchases, network versions, and site licenses.

Rank:

All Participants: 1st	Elementary School Participants: 1st
Teachers: 1st	Middle School Participants: 3rd
ECS personnel: 2nd	High School Participants: 1st

Representative Verbatim Responses:
Software is too expensive.
Can't afford site licenses or network versions of software.

Table 5: Response Table for Second Choice Survey Item

Survey item:
All educational software should be hybrid (cross-platform) so that it works on both platforms.

Rank:

All Participants: 2nd	Elementary School Participants: 5th
Teachers: 12th	Middle School Participants: 4th
ECS personnel: 1st	High School Participants: 3rd

Representative Verbatim Responses:
More hybrid software for cross platform use
More crossover between platforms
Software does not work properly over different platforms and operating systems
Multiple platform and file format support

An item concerning curriculum tied for third. This item pointed out the need for open-ended questions and the need for software to use higher-order thinking skills instead of regular drill-and-practice software or information software, such as encyclopedias (see Table 6).

The need for software aimed at the one-computer classroom ranked third as well. However, it was ranked first with teachers in general (see Table 7).

Ranking fifth overall was Internet effectiveness (see Table 8). Participants also saw a need for software developers to work closely with other experts such as teachers and to incorporate their knowledge in the materials. This item was ranked fifth as well (see Table 9).

Rationales for top five choices. The diverse nature of the responses received as rationales precluded the construction of an effective coding system for qualitative analysis. Some of the responses reiterated the survey item. Some of them explained the importance or the item or explained the thinking of the educators concerning the effective use of educational software. The rationales that explained the choices or demonstrated how the experts were thinking were used to discuss and explain the results.

Table 6: Response Table for Third Choice Survey Item (Tie)

Survey item:
More educational software needs to be created that uses higher order thinking skills using inquiry methods and open-ended questions

Rank:

All Participants: 3rd	Elementary School Participants: 6th
Teachers: 8th	Middle School Participants: 4th
ECS personnel: 4th	High School Participants: 3rd

Representative Verbatim Responses:
I would like to see software that helps student logically work through the process of solving problems
Use more higher level thinking skills when challenging students
More flexible or open-ended software

Table 7: Response Table for Third Choice Survey Item (Tie)

Survey item:
There needs to be more quality software aimed at one-computer classrooms

Rank:

All Participants: 3rd	Elementary School Participants: 6th
Teachers: 1st	Middle School Participants: 2nd
ECS personnel: 14th	High School Participants: 14th

Representative Verbatim Responses:
Software is intended for each student to have a computer.
Many times classrooms have access to only one computer.
Only one computer available
More English and reading software should be developed, specifically for the one-computer classroom.

DISCUSSION

Response Rates

This study enjoyed an exceptionally high return rate of surveys and other query materials in both phases. While Phase 1 had a participation rate of 84%, Phase 2 had an effective return rate of 96%. The return rates were very high in terms of what is necessary to achieve a reliable and valid data set within a Delphi method (Hiltz & Turoff, 1993; Sim, 1977).

Discussion of Findings

The study was reasonably successful in detecting consensus about important ideas and concerns regarding educational software. Rather than attempting to apply an across-the-board rubric for determining overall consensus, however, levels of consensus were determined for (a) themes generated from the initial Phase 1 query, (b) aggregated items constructed from the Phase 1 results, and (c) participant category data from Phase 2.

Table 8: Response Table for Fifth Choice Survey Item (Tie)

Survey item:
Due to current constraints (filters, speed, etc.), the Internet cannot be used effectively

Rank:

All Participants: 5th	Elementary School Participants: 6th
Teachers: 8th	Middle School Participants: 9th
ECS personnel: 5th	High School Participants: 2nd

Representative Verbatim Responses:

Hotlinks to Web searches on pertinent information.

This would provide a vastly greater amount of resource than a Help file with in the software. If Internet access is unavailable, the could be disabled.

Not challenging for upper level learners who thrive on the variety provided by the Internet

Internet has too many firewalls through district intranet system.

Table 9: Response Table for Fifth Choice Survey Item (Tie)

Survey item:
Software developers should work closely, use and incorporate ideas and suggestions of educators to improve their software.

Rank:

All Participants: 5th	Elementary School Participants: 15th
Teachers: 5th	Middle School Participants: 1st
ECS personnel: 6th	High School Participants: 33rd

Representative Verbatim Responses:

It appears that developers are not asking the teachers what is useful in the classroom for thirty to forty students (applicability).

Companies do not respond to input from educators about improvements, upgrades, and enhancements, etc.

Work more closely with educators in the design and content of software

Have teachers help create or create software for areas of education ease of use or user friendly for both teacher and student

Themes

Five overarching themes emerged from the study. They included (a) instructional design issues, (b) curriculum, (c) materials, (d) cost, and (e) meeting specific needs. In order to determine a level of consensus for each of the five main themes, the following data were considered: (a) number of responses from Phase 1, and (b) rating from "Top Five" selections in Phase 2.

Instructional design issues. This theme had the overwhelming majority of responses from the initial Delphi query in Phase 1 with a total of 85 individual response items. These 85 individual responses encompassed 11 different categories, all dealing with instructional design issues. Thirty-three percent of the highest-ranking "Top Five" items that were collected in Phase 2 were items representing the instructional design theme as well.

Several participants indicated that they considered instructional design issues very important. They indicated that it was important that software companies work closely with educators and students. Several indicated through the Phase 2 rationales that they believed that software companies were doing that. This, however, appears not to be the case. Rather, software developers rarely follow a formal instructional development procedures in regards to evaluation (Boone, Higgins, & Williams, 1997; Higgins, Boone, & Williams, 2000; Lockard, Abrams, & Many, 1997; Dick & Carey, 1990). With the number of items related to instructional design that were generated in Phase 1 and chosen as very important by participants in Phase 2, instructional design was considered an issue that should not be ignored.

Curriculum. Curriculum was ranked the second highest in importance in Phase 1. Likert scale data showed high mean scores for all items associated with curriculum.

Some of the rationales for items in this theme were statements such as "this is just good educational practice." To educators, these issues were obvious; however, educational software developers seem not to have deemed these issues important enough (Shade, 1996; Sugar, 2001).

Materials. Materials included both training materials and supplementary materials. The need for better and more accurate materials was expressed by the participant group as a whole and by all the subgroups.

Cost. Overwhelmingly, cost was considered important throughout the study. It ranked high in every combination of data, such as frequency counts in Phase 1 and 2, as well as mean scores in Phase 2. This issue was unexpected, because no reference to cost as an educational issue of software was encountered during the literature review for this study.

Meets needs. Meeting needs specifically concerns the need for software to provide more teacher options, assessment and monitoring components, and a variety of skill levels to meet various students' needs (DiSessa, 2000; Nations, 2000; Newby, Stepich, Lehman, & Russell, 2000; McKenzie, 2003). Participants stated that to use technology effectively, they needed more control over software to do what the teacher expects it to do.

Items

To help determine a level of consensus for specific items, the following data were considered: (a) number of similar responses that were aggregated into a

single item from Phase 1, and (b) rating from "Top Five" selections in Phase 2. Only three items appeared in the list of highest-ranking items for Phase 1 and in the list of highest-ranking items from Phase 2. The three general areas of consensus were (a) cost of software, (b) ease of use, and (c) educational content and purpose.

The item concerning cost, "Quality educational software needs to be less expensive for single purchases, network versions, and site licenses," had the second highest frequency of response in the initial Phase 1 query and was selected the most often in the "Top Five" part of Phase 2. The item concerning ease of use, "Software is not easy enough to use 'out of the box' and requires significant time to learn," was ranked fourth in frequency of response in Phase 1 and was ranked tenth in Phase 2. The item concerning content, "Software's content should be grounded in education content and purpose," ranked sixth in frequency of response in Phase 1 and had the seventh highest selection rate in Phase 2.

Interestingly, however, four items from Phase 1 that had a frequency of only one (i.e., only one participant gave this response) were selected as "Top Five" choices by more than 10% of the participants in Phase 2. This indicates that the consensus-building process that is attributed to the Delphi method was working in this situation.

Participant Categories

Different items and different themes were clearly of more or less importance to specific subgroups of participants; with a higher level of consensus shown within the smaller subgroups. Cost was important to all the groups, but items such as the need for software aimed at a one-computer classroom setting were more important to middle school participants, who ranked the item second, than to high school participants, who rated the item fourteenth. The item "Software's content should be grounded in education content and purpose" was much more important to the ECS participants, who rated the item second, while the teachers rated it thirty-fourth. The elementary participants ranked the item first, middle school ranked it seventh, and high school ranked it thirty-third. This indicates that the different subgroups or levels of participants had very different needs. This divergent set of views is consistent with the way technology is often viewed within the culture of a single school (Matthews, 2002).

Research Questions

What deficits do computer-using teachers find existing in current educational software?

Teacher materials were reported to be deficient in the areas of supplementary student materials, teacher training, and lesson integration ideas. Participants indicated that teacher materials for educational software needed to be improved and expanded to be used effectively. Also indicated was a need for better and more accurate tutorials for students and for the teachers themselves.

What adaptations do computer-using teachers routinely make to use educational software effectively?

Participants reported that they adapted their lessons and expectations to the software rather than adapting the software to fit the lessons and expectations.

This was due to the unavailability of teacher options, which were either too limited in scope or nonexistent. Without these adaptive abilities, the instructional materials cannot meet the needs of the users.

What suggestions do computer-using teachers have for improving current educational software?

Many of the suggestions made by the participants concerned issues of formative and summative evaluation for educational software. For example, participants believed that "Software developers should work closely, use and incorporate ideas and suggestions of educators to improve their software." Some other issues raised included ideas that were not currently in place but would be beneficial if implemented. For example, one participant suggested that software companies maintain a user group on the Internet so that teachers could share ideas and lessons.

What changes need to occur in educational software design to meet the needs of today's classrooms?

Participants indicated many instructional design issues for improving educational software. These were grouped into three main categories: (a) content, (b) interactivity, and (c) usability. Under content, the need for educators to be involved in the formative and summative evaluation process was mentioned repeatedly. Accuracy of the content was a consistent concern, along with choices in media types of content (e.g., graphics, editable text, and high quality sound).

How do computer-using teachers envision the future of educational software?

The data did not provide any clear evidence for building a vision of the future of educational software. The educators who participated in this research did not take a visionary or proactive stand on the future of educational software.

SUMMARY

This study uncovered areas in which improvement was needed concerning educational software. Various levels of consensus were achieved, with the major concerns being cost, curriculum, and instructional design issues. The data provided information necessary for the creation of better software and for devising necessary support to effectively and efficiently use educational software in the classroom.

Limitations

One possible limitation to the study was that the information gathered was specific to a particular school district. However, the software used in the district was indicative of the software used in other school districts nationwide.

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