2006-1120: A VALID AND RELIABLE SURVEY INSTRUMENT FOR MEASURING K-12 TEACHERS' PERCEPTIONS AND NEEDS ON DESIGN, ENGINEERING, AND TECHNOLOGY

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A Valid and Reliable Survey Instrument for Measuring K-12 Teachers' Perceptions and Needs In Design, Engineering, and Technology

Abstract

Increasing the number of technologically literate people through teaching design, engineering, and technology (DET) in K-12 classrooms is increasingly becoming a national goal. National Science Education Standards, Benchmarks for Science Literacy, and Standards for Technological Literacy list similar objectives related to DET education. While the need and objectives are clear, teachers' familiarity and confidence in teaching DET concepts are not well known. Therefore, the purpose of this research was to develop an instrument that would identify K-12 teachers' perceptions of, and needs for, DET. The survey results will provide insights and information for curriculum developers who want to bring engineering concepts into the K-12 curriculum. The instrument was developed by collaboration among people with backgrounds in science education, K-12 teaching, counseling, and engineering. The principal component analysis method was used to validate the instrument. This analysis revealed four factors defined as: 1) the importance of DET; 2) teachers' familiarity with DET; 3) teachers' perceptions of stereotypical characteristics of engineers; and 4) teachers' perceptions of characteristics of engineers. The internal consistency reliability estimate for the survey was 0.88. The analysis of 98 teachers' responses to these items indicated that: a) the importance of DET in the curriculum was stronger for female teachers as compared to male teachers, $t\,(96) = 2.42$, $p < 0.05$; b) elementary school teachers were least likely to teach DET in their curriculum as compared to middle school and high school teachers, $F\,(2, 28.81) = 4.35$, $p < 0.05$; and c) DET was more likely to be integrated into the science curriculum by teachers with moderate experience compared to teachers with little experience or extensive teaching experience, $F\,(2, 85) = 2.86$, $p < 0.05$. In addition, teachers were unfamiliar with DET, lacked confidence in their ability to teach DET, and held stereotypes about the skills needed to be an engineer. Implications of the results are discussed in terms of K-12 pre-service teacher preparation and in-service teacher professional development.

Introduction

On one hand, technology plays an important role in many aspects of our daily lives. On the other hand, 75% of the public has a narrow view of technology and thinks of technology as computers, electronics, and the internet[1]. There is increasing interest in making technology education a priority in the K-12 curriculum[1, 2]. Bringing design, engineering, and technology (DET) into the K-12 curriculum requires long term planning, as many teachers are not trained to teach DET. DET is a neglected tool in science education in the U.S. despite the potential uses of DET to foster student interest in science and provide familiar and concrete contexts for abstract science and math concepts[3,4]. Therefore, the first step before implementing a DET curriculum is to investigate teachers' familiarity, perceptions, and views of DET. It is also necessary to understand the barriers teachers might face when implementing DET in their classrooms.

Benchmarks and Standards on DET Education

Various documents recognize the importance of teaching and learning about DET in K-12 classrooms including Science for All Americans[5], Benchmarks for Science Literacy[6], the National Science Education Standards[7], and Standards for Technological Literacy[8]. Each addresses the importance of technology within the educational framework and explains various aspects of design, engineering, and technology.

For example, the National Science Education Standards includes the Science and Technology strand defining the DET concepts K-12 students should know, such as the "abilities to distinguish between natural objects and objects made by humans, "abilities of technological design," and "understanding about science and technology" (p.135)[7]. The National Science Education Standards also addresses the understanding of the social, political, economic, and ethical impact of science and technology at local, national, and international levels in Standard F, Science in Personal and Social Perspectives, and the importance of the human component in science and technology in Standard G, History and Nature of Science.

While these standards emphasize the importance of teaching and learning DET, many students' only experience with technology is through computers. Most states do not include DET in their academic standards for K-12 (e.g., Arizona) and teachers are not familiar with the national standards and benchmarks related to DET education. Thus, it should be no surprise that students have a limited view of technology and equate technology with computers[1].

Barriers in Implementing DET Benchmarks and Standards

There are barriers to implementing DET into K-12 classrooms. One is that DET is not a priority in American schools. While increasing levels of support for DET education may be one solution to improving technological literacy, this alone is not adequate. Other countries, such as Great Britain[9], New Zealand[10], and Northern Ireland[11] have made design and technology concepts a priority in K-12 classrooms. However, they discovered barriers when implementing DET finding that even experienced teachers had difficulty teaching it the first time[12]. Furthermore, teachers did not have a concrete understanding of the meaning, content, and aim of technology education. And, as in the U.S., secondary teachers' perception of technology was found to be limited.

Purpose

This research had three purposes: 1) design an instrument to collect reliable and valid data on teachers' perceptions and understanding of DET; 2) identify K-12 teachers' perceptions and understanding of DET as well as factors hindering or supporting teaching DET; and 3) develop a set of recommendations for infusing DET into teacher education and the K-12 curriculum.

Method

Survey Construction and Administration. Survey development was an iterative process in which items were developed and discussed to see if they provided the information being sought. Numerous drafts were written and revised.

The first set of questions were developed by graduate students who had teaching experience and were familiar with both science and technology standards. These students were taking a graduate level science education class on the subject of assessment taught by a faculty participating in the development of the survey. Students conducted a literature survey of journal articles available via the internet in order to locate possible questions and wrote new questions addressing DET.

Next, a group of education and engineering faculty reviewed the survey items and identified the items that best reflected the information being sought. A hard copy of the second draft of the survey was then created and field tested with a focus group of five teachers who helped refine the wording and added or eliminated items. These teachers were given an honorarium for their participation. A final electronic version of the survey was placed on a website that allowed teachers to respond to the survey via internet. The final version of the survey included 69 items, each with a four-point response format ranging from one to four. Sixty-five of the survey items were to be answered by teachers at all grade levels. The last four items, which assessed the role of counselors in introducing DET careers to the high school students, were designed only for high school teachers. These four items also included an additional response option, "don't know".

Respondent Sample. The final version was posted on a website and mailed to 27 school districts throughout Arizona. The sample was a good representation of the target population covering a diverse array of science teachers in terms of their teaching experiences and the socioeconomic status of the schools they are teaching at. The sample included only the science teachers because science teachers are more likely to teach DET concepts in K-12 classrooms. Compared to the other content areas science is the only content with The National Science Education Standard strand, *Science and Technology,* explicitly covering DET concepts (NRC, 1996). Teachers who were currently teaching science at any grade level were invited to complete the survey. Of the 98 teachers who responded, 56 were females and 42 were males. Their mean age was 39.97, and the mean years of teaching experience was 10.49. Sixty-one percent were teaching in grades 1 through 8, and 39% were teaching in grades 9 through 12. Sixty percent were Euro-American, 15% Latino/a, 9% African American, 7% Native American, and 4% Asian American. Thirty-eight had a BA/BS degree, and 59 had a MA/MS degree.

Factor Analysis

Validity. To evaluate the construct validity of the instrument, a principal component factor analysis was conducted. The extraction factors were selected by looking at the points of discontinuity of the scree plot and on the examination of the logical categories revealed by various rotations. The 69-item survey was reduced to 41 items as a result of the rotation and item elimination when items did not load on any of the factors. The principal component analysis with varimax rotation of the 41-item survey extracted 4 factors, which explained 43.5 % of the cumulative variance. The *importance of DET* factor accounted for 18% of the variance while the *familiarity with DET* factor accounted for 10.9% of the variance. The *stereotypical characteristics of engineers* factor and *characteristics of engineers and engineering* factor accounted for 7.4% and 7.3% of the variance, respectively. Table 1 gives factor loadings and the means and standard deviations of each factor. The factors were named based on the items loaded on each factor. Factor loadings of individual items are presented in the appendix.

Reliability. The internal consistency estimates of reliability were computed on the teachers' responses to the survey. The alpha coefficient for the whole survey of 41 items was $\alpha = 0.88$. In addition, the internal consistency estimates of reliability were computed for all four factors individually. The first factor, *importance of DET*, included 18 items and had a reliability coefficient of $\alpha = 0.91$. The second factor, *familiarity with DET*, included 12 items and had a reliability coefficient of $\alpha = 0.83$. The third factor, *stereotypical characteristics of engineers*, included 5 items and had a reliability coefficient of $\alpha = 0.76$. The level of reliability was satisfactory to make judgments based on the data (Aiken, 2000, p.88). The fourth factor, c*haracteristics of engineers and engineering* included 6 items and had a reliability coefficient of $\alpha = 0.66$. The alpha coefficient was lower for the fourth factor. This could be attributed to the small number of items loaded on this factor. Another explanation is that the between subjects variability was not homogeneous and might reflect teachers' inconsistent perceptions of engineers especially if they answered these question based on engineers they personally know.

Results of the Survey

We first examined the mean scores of each factor. Then, we analyzed the relationship between scores on each factor and the independent variables (teachers' gender, the grade level they were teaching, and years of experience as a full time teacher). The mean scores for each factor are presented in Table 1.

Table 1. *Means, Standard Deviations, and Variance Accounted for by Each Factor*

	All Teachers (n=98)		
Factors	Mean	SD	Variance
Factor 1: Importance of DET	3.43	0.46	18%
Factor 2: Familiarity with DET	2.19	0.58	10.9%
Factor 3: Stereotypical Characteristics of Engineers	2.71	0.62	7.4%
Factor 4: Characteristics of Engineers and Engineering	3.60	0.36	7.3%

Importance of DET. As a whole, the teachers thought that DET was important. As indicated by item means of three or higher, teachers were more interested in learning more about DET through workshops than through in-service, peer training, or college courses and believed that pre-service education was important for preparing them to teach DET. The teachers' main motivations for teaching science were:

- to promote an enjoyment of learning,
- to promote an understanding of the natural and technological world,
- to prepare young people for the world of work,
- to promote an understanding of how DET affects society, and
- to develop scientists, engineers, and technicians for the industry.

In addition, teachers especially wanted to teach their students to:

- understand types of problems DET should be applied to,
- the science underlying DET,
- the use and the impact of DET,
- communication of technical information, and
- the design process.

Familiarity with DET. Item means for familiarity with DET concepts were in the range of 1.6 to 2.6. Teachers' confidence in integrating DET concepts was not strong and their familiarly with DET was even weaker. Teachers attributed their unfamiliarity with DET and difficulty integrating DET into their curriculum mainly due to lack of administration support, lack of knowledge, lack of training during pre-service education and other opportunities for training, and lack of time to learn about DET. The few teachers with high familiarity mean scores also had high mean scores for administrative support and reported using DET activities in their classrooms.

Stereotypical Characteristics of Engineers. Mean item scores of less than 3.0 indicated that most teachers held stereotypical views of engineers and their skills. They did not think engineers had particularly good writing, verbal, or people skills. Teachers also thought that most people have stereotypical perceptions of females and minority students not being able to do well in engineering. It is likely that the responses also indicate that teachers themselves also hold the same negative perceptions about female and minority students' ability of not being able to do well in engineering.

Characteristics of Engineers and Engineering. Mean item scores above 3.5 indicated that, overall, teachers had positive views of engineers and engineering. They viewed engineers as males who have good mathematical skills and a strong science background, like to fix things, and earn good money. DET was perceived as good for society.

Examination of Factors by Gender, Grade Level, and Teaching Experience

Gender Differences. We explored the four factors for any gender differences (Table 2). Independent samples t-tests were used for data analyses. The analysis of the *importance of DET* factor showed that there were significant gender differences, with female teachers perceiving DET as being more important to teach than did their male colleagues, t (96) = 2.42, $p < 0.05$. Gender differences were also found for the *characteristics of engineers and engineering* factor. Female teachers scored significantly higher than male teachers, t (96) = 3.33, $p < 0.01$, indicating that female teachers were more familiar with the characteristics of engineers.

No significant gender differences were found for the second factor, *familiarity with DET*, t (96) = 0.22, $p = 0.83$. In addition, there were no gender differences based on teachers' perceptions of s*tereotypical characteristics of engineers*, t (96) = 1.26, $p = 0.21$.

Table 2. *Mean Scores and Standard Deviations based on Gender*

	Female (n=56)		Male (n=42)	
Factors	*M*	*SD*	*M*	*SD*
Importance of DET*	3.48	0.44	3.25	0.47
Familiarity with DET	2.20	0.55	2.18	0.62
Stereotypical Characteristics of Engineers	2.78	0.65	2.62	0.59
Characteristics of Engineers and Engineering**	3.70	0.30	3.47	0.38

* p < 0.05, **p < 0.01

Grade Level Differences. Teachers' view of the *Importance of DET* (Factor 1) was related to the grade level being taught, F (2, 28.81) = 4.35, p < 0.05. Middle school teachers viewed DET as the most important followed by the high school teachers. Elementary school teachers scored

DET as the least important compared to the middle and secondary school teachers. On the other hand, there were no significant grade level differences among the teachers' *familiarity with DET* or their views of the *characteristics of engineers* (Table 3). The other two factors related to the characteristics of engineers and engineering didn't significantly differ based on the grade level teachers taught.

When the items that loaded on Factor 1 were analyzed, there were significant differences in teachers' preferences to learn DET during in-service, F (2, 86) = 3.49, p = 0.04. Middle school teachers (*M* = 3.56, *SD* = 0.63) were more interested in learning more about DET through in-service activities than were secondary (*M* = 3.11, *SD* = 1.02) and elementary (*M* = 3.00, *SD* = 1.00) teachers. There was a similar pattern in their interest in learning about DET through workshops, *F* (2, 27.52) = 8.41, *p* < 0.001. Middle school teachers were the most interested in learning DET through workshops (*M* = 3.76, *SD* = 0.43). This was followed by the secondary (*M* = 3.17, *SD* = 0.98) and then the elementary (*M* = 3.00, *SD* = 0.91) school teachers.

Table 3. *Mean Scores and Standard Deviations based on Grade Level*

Factors	Elementary			Middle			Secondary		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Importance of DET*	13	3.14	0.59	42	3.52	0.32	35	3.29	0.52
Familiarity with DET	13	2.05	0.51	42	2.13	0.48	35	2.32	0.70
Stereotypical Characteristics of Engineers	13	2.55	0.50	42	2.77	0.60	35	2.67	0.67
Characteristics of Engineers and Engineering	13	3.57	0.31	42	3.64	0.32	35	3.58	0.38

* p < 0.05

There were also grade level differences about learning DET through peer training, *F* (2, 85) = 4.01, *p* = 0.02. Elementary school teachers (*M* = 2.62, *SD* = 1.12) were least interested in learning more about DET through peer training as compared to secondary (M = 3.09, SD = 0.95) and middle (M = 3.40, SD = 0.74) school teachers.

Teaching Experience Differences. We need to specify how the teachers were placed in the four groups (Table 4). None of the factors revealed any significant differences based on years of teaching experience. On the other hand, an examination of individual items indicated that there were only three items that revealed significant differences (*p* < 0.05) based on teachers' years of experience (Tables 4). These items were the effectiveness of pre-service curriculum to teach DET, *F* (3, 87) = 3.50, teachers' interest in learning more about DET through college courses, *F* (3, 90) = 3.02, and teachers' view of lack of time to learn about DET as a barrier in integrating DET into their curriculum, *F* (3, 89) = 2.86.

The teachers with the least amount of teaching experience indicated that their pre-service curriculum had better prepared them to teach DET (*M* = 2.17, *SD* = 1.07). The scores on this item were the lowest for teachers who had 6-10 years of experience (*M* = 1.38, *SD* = 0.77). Teachers' interest in learning about DET through college courses decreased as their teaching experience increased. Interest in learning more about DET through college courses was highest with the teachers with less than five years of teaching experience (*M* = 3.16, *SD* = 0.89) followed by teachers with moderate (6-10 years) teaching experience (*M* = 3.13, *SD* = 0.95). Interest in learning more about DET through college courses was lowest with more experienced (11-15 years) and the most experienced teachers respectively (*M* = 2.70, *SD* =1.06; *M* = 2.45, *SD* = 1.06). Furthermore, as compared to teachers with more years of experience, the teachers with the fewest years of experience (*M* = 1.92, *SD* = 0.78) indicated lack of time to learn about DET as a greater barrier. Teachers with the least amount of teaching experience (*M* = 1.92, *SD* = 0.78) considered lack of time as the most significant barrier to integrate DET into their curriculum compared to all other teachers. Teachers with a moderate amount (6-10 years) of teaching experience (*M* =1.33, *SD* = 0.64) considered lack of time to learn about DET as the least significant barrier as compared to the teachers with 11-16 years of teaching experience (*M* =1.67, *SD* = 0.71) and more than 16 years of teaching experience (*M* =1.68, *SD* = 0.89).

Table 4. *Survey Items Significantly Correlated with Full-time Teaching Experience*

	<= 5 years (n= 35)		6-10 years (n= 24)		11-15 years (n= 9)		> 16years (n= 23)	
Items	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pre-service curriculum effective to teach DET*	2.17	1.07	1.38	0.77	1.56	1.01	1.74	0.96
Interested to learn more about DET through college courses*	3.16	0.89	3.13	0.95	2.70	1.06	2.45	1.06
Barriers in integrating DET- lack of time to learn about DET*	1.92	0.78	1.33	0.64	1.67	0.71	1.68	0.89

* $p < 0.05$

Conclusions

Through this research we have developed a survey that examined teachers' perceptions of DET. It has reasonable reliability and validity that has enabled us to gain insight into teachers' perceptions of engineering and familiarity with teaching DET. Since the survey accounted for 43.5% of the variance, it is clear that there are other factors that may influence whether teachers will infuse DET into their curriculum. However, this survey is an important step as it provided us with initial insights as to how we might proceed, based on teachers' perceptions; familiarity and confidence; barriers and affordances to implementation; stereotypes, gender, teaching experience, and grade level differences; and preferred modes of acquiring DET knowledge.

Two primary findings were that: 1) teachers believed that DET was important and should be part of the K-12 curriculum; and 2) teachers were unfamiliar with DET and not confident in their ability to teach it.

Female teachers were more likely to believe that DET was important than were male teachers. Furthermore, it was female teachers who wanted to integrate DET into the curriculum. Since no gender differences were found for confidence in teaching DET or familiarity with DET, the differences in how important male and female teachers perceived DET does not appear to be based on these factors. Perhaps female teachers attached more importance to DET because they felt DET contributed to society to a greater degree than did male teachers. Or, perhaps female teachers' views of importance of DET was related to altruistic reasons such as their motivation to help students obtain good jobs or have students understand how DET affects society.

DET was found to be most important to middle school teachers followed by secondary teachers. Elementary school teachers did not place much importance on DET. These results mirror the emphasis given to science at these three grade levels as well as greater flexibility found in the middle school curriculum. These differences are unrelated to confidence and familiarity with teaching DET, since no significant differences were found for confidence and familiarity by grade level. In fact, all teachers were unfamiliar with DET and not confident in their ability to teach it. Consequently, differences may be attributable to the interests and goals of the teachers themselves. Middle and secondary teachers are likely to be science specialists more interested in content, as opposed to elementary teachers who are generalists interested in children.

Less experienced teachers felt better prepared by their pre-service education to teach DET and teachers with more years of experience felt least prepared by their pre-service education. This may be due to the strong emphasis on the National Science and National Technology standards in more recent teacher preparation programs as well as a greater emphasis on teaching with a variety of technologies. Less experienced teachers were also more willing to learn more about DET through university courses, while more experienced teachers favored other means such as in-service activities. Despite a willingness to learn, time was cited as the greatest barrier to learning more about DET by the least and most experienced teachers. Teachers with moderate amounts of teaching experience were less concerned about time. It is easy to understand why the least experienced teachers were concerned about time since they have many new skills to acquire and practice. Moderately experienced teachers are moving into a time when they are becoming experts, and this point in their career may reflect a critical point in their development when they are ready, able, and interested in acquiring new knowledge. The most experienced teachers may be past this critical time and too comfortable in what they are currently doing to make changes. In addition, since the most experienced teachers were the least familiar with DET, acquiring new knowledge would mean expending greater effort for them than perhaps for the less and moderately experienced teachers.

The teachers in this sample held stereotypical views of engineers that reflected a lack of understanding about what engineers do. Engineers were seen to have poor writing, verbal, and people skills. On the other hand, they did recognize the need for good mathematics and science skills. This narrow view of engineering ignores the realities of team work and team-based projects, working with clients locally and globally, and the numerous presentations given or reports written by engineers. Teachers with this narrow view of engineering might not encourage all able students to consider engineering as a career and might misrepresent the skill requirements of engineering careers to students.

Since we used indirect measures to determine bias we cannot unequivocally determine whether teachers' perceptions of the ability of female and minority students to do engineering is a report of what they think other people believe or is a projection of their own feelings upon others. Given the wording, it appears that teachers think that most people have stereotypical perceptions of the limited ability of females and minority students to do well in engineering and their responses may well indicate that they hold these same perceptions themselves. Indirect support for this conclusion comes from their perception of engineers and engineering and their stereotypical views of engineers. Nevertheless, stereotypical views of engineers should be addressed. Research in science indicates that teachers' gender biases affect their teaching[13]. Consequently, teachers' stereotypical views of engineers might add to the current problem with diversity in engineering education[14].

Administrative support was also related to familiarity with DET. We might speculate that teachers who felt that their administration supports infusing DET into the curriculum are more likely to learn about DET to do so. On the other hand, if it does not support teaching with DET, there is no reason to spend time familiarizing themselves with the concepts and content of DET.

Implications for the K-12 curriculum

Anyone interested in working with classroom teachers to infuse DET into the K-12 curriculum should be cautioned that teachers are not a homogeneous group. Different approaches will have to be developed for teachers at different points in their careers and at different grade levels. In addition, administrators should be targeted along with the teachers in their schools. Professional development must provide experiences that will broaden the narrow view of technology that most people hold but also be sensitive to the multiple demands placed on teachers such as the issues of time. It should also make explicit how infusing DET into the curriculum is not an additional task for teachers but a way to make what they are already required to do easier. This is particularly important when working with secondary school teachers who must teach a prescribed curriculum and who may be having difficulties seeing how DET fits with what they must teach. An emphasis on the reciprocal relationship between science and technology might help overcome this barrier[15]. In addition, helping teachers see the simple technologies around them, such as zippers and Velcro, may help elementary teachers see the importance of DET. In addition, professional development should build on the interests of female teachers by emphasizing the role of DET in improving human life and contributing to society.

Addressing stereotypes about who is an engineer and who can be an engineer should be a critical component of teacher professional development with an emphasis on the value of a diversified workforce. Teachers also need more familiarity with what engineers do as they work in a global community.

Pre-service teacher education faces other challenges. The first is to create courses and experiences for potential elementary teachers that help them to see the importance of DET. Providing experiences for potential elementary teachers to identify and explore the simple technologies around them is a good first step. Another challenge is to build upon the writing, verbal, and people skills needed to do engineering without undermining the intent of most science methods courses to teach teachers to use a hands-on inquiry approach. Helping pre-service elementary teachers to make writing and discussion a part of a science lesson, rather than the entire lesson, could draw on the work of Wallace, Hand and Prain[16] and the science writing heuristic. Science writing heuristics promote writing as a mode of thinking and metacognition when students negotiate meaning, support their claims with evidence, discuss and write about their science experiments.

Pre-service secondary teacher preparation faces a different kind of challenge. To help pre-service science teachers to infuse DET into an already overstuffed curriculum, a science teaching methods course must address how infusing DET is not an add-on but a way to help teachers accomplish their goals more easily. For example, we must show how DET can provide a concrete platform for contextualizing abstract scientific concepts and demonstrate how DET activities are tied to standards and to district and state assessments.

Engineering, with its emphasis on DET, is the most recent discipline to argue for a place in the K-12 school curriculum. In order to be successful, we must begin to work with teachers to infuse DET into the curriculum and then follow up with well-crafted research that documents the benefits to students. DET has a great deal of potential, but to truly make a difference in the way the K-12 curriculum is configured, and the way teachers are prepared, arguments must be based on evidence. We believe that the development of an instrument to assess teachers' perceptions of engineers and familiarity with teaching design, engineering, and technology, we have established a baseline to help guide professional development efforts.

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Appendix

Factor Loading of 41 Survey Items

	Importance of DET	Familiarity with DET	Stereotypical Views of Engineers	Characteristics of Engineers
Factor 1: Importance of DET				
I would like to be able to teach my students to understand the use and impact of DET	**0.830**			
I would like to be able to teach my students to understand the science underlying DET	**0.743**			
I would like to be able to teach my students to understand the design process	**0.730**			
I would like to be able to teach students to understand the types of problems to which DET can be applied	**0.726**			
My motivation for teaching science is to promote an understanding of how DET affects society	**0.672**			
I am interested in learning more about DET through in-service	**0.665**			
I would like to be able to teach students to understand the process of communicating technical information	**0.659**			
My motivation for teaching science is to prepare young people for the world of work	**0.652**			
My motivation for teaching science is to promote an enjoyment of learning	**0.599**			
I believe DET should be integrated into the K-12 curriculum	**0.592**			
I am interested in learning more about DET though workshops	**0.591**			
I am interested in learning more about DET through college courses	**0.581**			
In a science curriculum, it is important to include the use of engineering in developing new technologies	**0.572**			
I am interested to learning more about DET through peer training	**0.564**			
My motivation for teaching science is to help students develop an understanding of the natural and technical world	**0.511**			
My motivation for teaching science is to educate scientists, engineers and technologists for industry	**0.459**			
In a science curriculum, it is important to include planning of a project	**0.435**			
How important should pre-service education be for teaching DET?	**0.418**			

Familiarity with DET				
How familiar are you with DET?		**0.747**		
Have you had any specific courses DET outside of your pre-service curriculum?		**0.652**		
How confident do you feel about integrating more DET into your curriculum?		**0.646**		
Barrier in integrating DET - lack of teacher knowledge		**0.602**		
Was your pre-service curriculum effective in supporting your ability to teach DET at the beginning of your career?		**0.601**		
Did your pre-service curriculum include any aspects of DET		**0.569**		
Barrier in integrating DET - lack of training		**0.567**		
I use DET activities in the classroom		**0.561**		
Barrier in integrating DET - lack of time for teachers to learn about DET		**0.560**		
I know the national science standards related to DET		**0.516**		
Barrier in integrating DET - lack of administration support		**0.448**		
My school supports DET activities		**0.429**		
Stereotypical Views of Engineers				
A typical engineer has good verbal skills			**0.734**	
A typical engineer works well with people			**0.691**	
Most people feel that minority students can do well in DET			**0.686**	
Most people feel that female students can do well in DET			**0.662**	
A typical engineer has good writing skills			**0.620**	
Characteristics of Engineers				
Most people feel that male students can do well in DET				**0.668**
A typical engineer does well in science				**0.614**
A typical engineer has good math skills				**0.450**
A typical engineer earns good money				**0.423**
A typical engineer likes to fix things				**0.413**
DET has positive consequences for society				**0.390**

Biographical Sketches

ŞENAY YAŞAR is a Ph.D. student in Science Education at Arizona State University. She earned her MA degree in Science Education at ASU. Her principal research focus is on systems thinking and engineering education. She also teaches elementary science methods courses for undergraduate students.

DALE R. BAKER is a Professor of Science Education in the Department of Curriculum and Instruction at ASU. She teaches courses in science curricula, teaching and learning, and assessment courses with an emphasis on constructivist theory and issues of equity. Her research focuses on issues of gender, science, and science teaching. She has been the co-editor of the *Journal of Research in Science Teaching* for five years. She has won two awards for her research in these areas. In 2005 she was made a fellow of the American Association for the Advancement of Science.

SHARON E. ROBINSON KURPIUS is a professor of Counseling Psychology. She has received numerous national grants examining undergraduates' academic persistence and the academic success of talented adolescent girls. She was recently named a "Multicultural Scholar" by the NACAC for her work on the retention of racial/ethnic minority students in higher education.

STEPHEN J. KRAUSE is Professor and Associate Chair of the Chemical and Materials Engineering Department. He teaches courses in general materials engineering, polymer science, characterization of materials, and materials selection and design. He conducts research in innovative education in engineering, including a Materials Concept Inventory, and also in adapting design, engineering and technology concepts to K-12 education. He is currently working on an NSF sponsored MSP developing courses for high school teachers connecting math, science and engineering.

CHELL A. ROBERTS is an Associate Professor and industrial engineer who conducts research in design, robotics, and engineering systems. He is Director of Engineering Development at ASU and has led the redesign of the freshman engineering design curriculum and also founded the Integrate Manufacturing Laboratory. He received his Ph.D. in Industrial Engineering and Operations Research from Virginia Tech in 1991. He has a MS in Industrial Engineering and a BA in Mathematics from the University of Utah. He is a member of the board of directors for the Society for Computer Simulation International.