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ABSTRACT

The Force and Motion Conceptual Evaluation (FMCE) is a multiple-choice test that has been used to evaluate physics instruction. However, the validity and reliability estimates have not been determined in a way a social scientist would expect. Few psychometric data were used to estimate the validity and reliability of the FMCE instrument. This study used several methods to estimate the reliability and structural validity of the FMCE instrument. Data from the first semester of a noncalculus physics course was used to calculate Cronbach alpha reliability estimates and, using factor analysis, evaluate the construct validity of the instrument. For the pilot study, the pretest was given to 38 students and the posttest to 20. Fifty-four students participated in the fall 2002 pretest. A table of specifications also was used to estimate the content validity of the FMCE. The pilot study suggested that the FMCE is a valid and reliable measure of the concepts of force and motion, and the ongoing study will provide further investigation. (Contains 4 tables and 22 references.) (Author/SLD)

The Force and Motion Conceptual Evaluation

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Title: The Force and Motion Conceptual Evaluation

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Abstract

The Force and Motion Conceptual Evaluation (FMCE) is a multiple-choice test that has been used to evaluate physics instruction. However, the validity and reliability estimates have not been determined in the way a social scientist would expect. Little psychometric data were used to estimate the validity and reliability of the FMCE instrument. This study uses several methods to estimate the reliability and structural validity of the FMCE instrument. Data from the first semester of a non-calculus physics course was used to calculate Cronbach alpha reliability estimates and, using factor analysis, evaluate the construct validity of the instrument. A table of specifications also was used to estimate the content validity of the FMCE.

Physics Education

The science literacy of most Americans has not kept pace with the role of science in their lives (Committee on Undergraduate Science Education, 1999). Scientific literacy involves the understanding of scientific concepts that occur in everyday experiences (National Research Council, 1996). Similarly, many students emerge from their study of physics with serious gaps in their understanding of important concepts (McDermott & Redish, 1999). Thus, much of the research in physics education has focused on conceptual understanding or problem solving performance (McDermott & Redish, 1999). Strong problem solving skill and conceptual knowledge are the two most important goals of physics instruction (Mestre, Dufresne, Gerace, and Hardiman, 1993).

Lawson (1995) stated that a concept has been formed whenever two or more types of knowledge have been grouped or classified together and set apart from other types of knowledge, based on some common feature, form, or property. Learning important science concepts and principles is difficult because there is resistance to conceptual change due to learners' everyday experiences. Science fields where students' pre-instructional conceptions are deeply rooted in daily life experiences are especially difficult to change (Duit & Treagust, 1998). Such is the case with physics, especially in the domain of mechanics (force and motion) (Gil-Perez & Carrascosa, 1990).

Conceptual change has been defined as the occurrence of changes either within or between existing knowledge structures (Hewson, Beeth, & Thorley, 1998). Students must integrate all of their conceptual understandings (Duit & Treagust, 1998; Hewson et al., 1998; Howe, 1996; Piaget, 1995; Posner, Strike, Hewson, & Gertzog, 1982; Vygotsky, 1986). In general, learners resist changing their current conceptions of physical events (Arons, 1990; Gil-Perez & Carrascosa, 1990; Philips, 1991; Posner, et al., 1982). A radical conceptual change involves a shift between two epistemologically distinct categories. An example of such a shift would be from thinking of force as an entity to force as an event or a process (Hewson et al., 1998). As Vygotsky (1986) and others (Duit & Treagust, 1998; Hewson et al., 1998; Posner et al., 1982) pointed out, conceptual change is an ongoing process.

Student misconceptions are often based on ideas about particular situations (Dykstra et al., 1992). Dykstra et al. (1992) used questions from the Force and Motion Conceptual Evaluation (FMCE) to examine student misconceptions. For example, through student interviews, the researchers found that the students' "motion implies force" conception led students to suggest that objects in motion must be experiencing a force. For instance, students suggested that a force (in addition to gravity) is needed to propel a block down an inclined plane because it is moving down the plane (Dykstra et al., 1992). These findings are consistent with those reported by Thornton (1996). Thornton (1997, p. 251) summarized the views of force and motion as follows:

> Physicist View (model): The relationship between force and motion is very coherent. If there is an acceleration, there is a force in the direction of the acceleration and vice versa. The force is proportional to the acceleration and to the mass of the object (F=ma). The state of motion of the object (e.g. moving or still, slowing down or speeding up), the identity of the object, and the source of force on the object do not alter the force/motion relationship.
>
> Student View: The rules that relate the force to the acceleration and/or velocity for an object can be different for an object speeding up, standing still, moving at constant velocity, or slowing down. The identity of object, the source of force, and the specific situation can sometimes change the view of force required for a particular motion. More than one view may be held at the same time.

Thornton (1997) added that, from a physicist's point of view, the student views of force and motion lack generalizability. However, the student views are not arbitrary. Students in physics or physical science courses in American colleges and secondary schools hold a limited number of common views and combinations of views (Thornton, 1997). However, in order to evaluate student conceptual understanding of force and motion, instruments that can reliably and validly measure these concepts are necessary.

Evaluating the concepts of force and motion

The study by Dykstra et al. (1992) used the FMCE in a qualitative study, as described above. A study by Svec (1999) is an example of how the FMCE has been used in quantitative studies. In his study, Svec compared microcomputer-based laboratory (MBL) instruction and traditional laboratory instruction relative to the learning of graph interpretation skills and motion concepts. This study used students from two different undergraduate introductory physics courses offered in the same state but at two different, large, midwestern universities. Multiple-choice tests included graphing and non-graphing questions on motion concepts, adapted from the Force and Motion Conceptual Evaluation by Thornton (1996), the Mechanics Diagnostic Test by Halloun and Hestenes (1985), and the Force Concept Inventory by Hestenes, Wells, & Swackhamer (1992). The effect sizes were calculated for specific types of questions but not specific concepts. The question types consisted of graphing interpretation skills, conceptual understanding related to the 34 questions that used graphs, and the textual motion concept questions. Gain scores, post-test minus pretest, were used to determine the effect sizes (Svec, 1999). When researchers use gain scores, they are assuming that the factors of the pretest and post-test are the same (Brown, et al., 2002). However, no studies investigating the pretest and/or post-test factor structure of the FMCE were found in the literature.

The Development of the Force and Motion Conceptual Evaluation

The FMCE was developed by Ronald Thornton and the Center for Science and Mathematics Teaching at Tufts University. They constructed the FMCE from earlier testing of students using free response questions requiring written answers and the drawing of graphs (Thornton, 1993; Thornton & Sokoloff, 1998). The FMCE is a multiple-choice test that consists of 47 questions. A copy of the FMCE is in the Appendix. Students choose from a list of five to nine answers for each question. The questions target concepts of velocity, acceleration, and force (Thornton, 1993, 1996, 1997; Thornton & Sokoloff, 1997, 1998). The questions use graphical representations and "natural language" (story problem) contexts. The natural language questions do not involve any coordinate system references and do not explicitly describe the force acting (Thornton & Sokoloff, 1998).

The FMCE was developed for a number of reasons. The multiple-choice questions take less time and less effort is involved in analyzing large samples. More importantly, the evaluation of the FMCE is less subjective than the earlier open response questionnaire (Thornton, 1993). Selections from the FMCE have been used in a number of similar studies to measure student Newtonian conceptual understanding of force and/or motion (Thornton, 1993, 1996, 1997; Thornton & Sokoloff, 1990, 1997, 1998).

Validity and Reliability of the FMCE in the Literature

The evidence given in the literature regarding the validity and reliability of the FMCE lacks the amount of psychometric data that a social scientist researcher would expect. Validity is the most important characteristic of any test. Validity of a test is defined as the degree to which a test measures what it is intended to measure. Reliability of a test is defined as the consistency of the measure (Newman & Newman, 1994).

Discussions, in the literature, regarding estimates of the reliability of the FMCE have included statements such as:

1. Ninety-five percent of all responses were consistent with most common student model or with a Newtonian model (Thornton, 1996).
2. Students appear to give "almost no random answers" (Thornton, 1993, p. 9) and guessing requires students to select from up to nine answers (Thornton & Sokoloff, 1998).

3. Studies that included over 5000 college and university physics students showed that the pretest results vary little from year to year (Thornton, 1993).

Similarly, statements within the literature regarding the FMCE's validity have included statements such as:

1. Thornton (1996) found that student answers to the multiple choice graphical format questions correlated with the answers given for questions probing the same concepts but asked in a very different format.
2. Ninety-five percent of students interviewed gave verbal explanations of velocity and acceleration that were consistent with their earlier graph choices on the FMCE (Thornton, 1993).
3. Students who answered force graph (problems 14 through 21) and sled questions (problems 1 through 7) on the FMCE from a Newtonian viewpoint were able to answer other previously unseen questions about force from a Newtonian view (Thornton, 1996).
4. Free response of more than 200 students matched by more than 98% with their multiple-choice answers given on the FMCE (Thornton, 1996).

Thus, the investigators who have attempted to examine the validity and reliability of the FMCE instrument were not trying to establish these estimates in the way a social scientist would expect. Little psychometric data were used to estimate the validity and reliability of the FMCE instrument. A literature search did not reveal research where the FMCE instrument was evaluated for construct validity. No reliability estimates were calculated in the literature using a measure of internal consistency such as Cronbach alpha (Thornton 1993, 1996, 1997; Thornton and Sokoloff 1990, 1997, 1998). Therefore, a preliminary pilot study was conducted to investigate the reliability and validity of the FMCE during the Spring 2002 semester. A second study is being conducted during the Fall 2002 and Spring 2003 semesters that will include additional estimates of the reliability and validity of the FMCE.

Evaluation of the FMCE

This paper includes the pretest and post-test results from the Spring 2002 pilot study and the pretest results from the Fall 2002 semester investigation. The entire Force and Motion Conceptual Evaluation (FMCE) was used in both of these studies. Pretests and post-tests consisted of the same multiple-choice questions. A copy of the FMCE is in the Appendix.

For the two studies, students took the pretest and completed a questionnaire during the first week of the semester during the lab period. For the pilot study, the post-test was given during the last laboratory meeting, week 14, of the spring semester. The pilot study had a pretest sample size of 38 and a post-test sample size of 20. Fifty-four students participated in the Fall 2002 pretest study.

The participants in both studies were enrolled in the Technical Physics: Mechanics I and/or II courses. These two half semester courses are offered consecutively each semester within the Community and Technical College (C&T). The C&T is on the main campus of a large midwestern state university and offers both associate and bachelor degrees. The Technical Physics courses serve students in six different associate degree programs in engineering technology. The lecture portion of the course consists of 2.5 hours of class time per week spread over two or three class meetings per week. The laboratory meets once a week for 2.5 hrs. The lectures have 25 or fewer students enrolled. The associated laboratories have a limit of 16 students. Students must take the associated laboratory for each half-semester at the same time they take the course. During the laboratory, all students worked in collaborative, self-selected groups of 2 to 4 students. All laboratories used the Realtime Physics MBL Laboratories discussed in Thornton and Sokoloff (1997).

All participants were engineering technology majors. Students in the pilot study had an average age of 25 and 92% of the students were male. Forty-two percent of the pilot study students had taken a prior physics course in high school and/or college. Similarly, participants in the Fall 2002 study had an average age of 24 and 87% were male. Thirty-seven percent of the later study had high school physics and 4% had taken a prior college level physics course.

Statistical Treatment

Reliability estimates were calculated using Cronbach alpha, a measure of internal consistency. An R-factor analysis was conducted using the principal components method with Varimax rotation. R-factor analysis uses a data set where the columns are variables and the rows are participants. Varimax is an orthogonal factor rotation method and is the most frequently used rotation method (Stevens, 2002). Orthogonal solutions are more stable and easier to interpret than oblique solutions (Stevens, 2002). In addition, the factor analysis was run with ones in the matrix diagonal. This is frequently referred to as component analysis. An eigenvalue cut off of one and a scree-test were used to determine when to stop factoring. The scree-test is a graphical method where the magnitudes of the eigenvalues are plotted against their ordinal numbers (Stevens, 2002).

This confirmatory factor analysis enabled the researcher to evaluate the construct validity of the FMCE instrument.

FMCE Evaluation Results

The mean of the 38 scores on the pilot study pretest was 7.74 with a standard deviation of 2.88. Similarly, the mean pretest score for the 54 participants in the Fall 2002 semester was 7.80 with a standard deviation of 3.40. For the pilot study, the mean post-test score was 15.57 and the standard deviation was 9.09. Twenty-one students took the post-test. Of these, 17 had also taken the pretest.

The Cronbach alpha test estimated the reliability of the FMCE instrument at 0.50 at pretest and 0.94 at post-test for the pilot study data. Similarly, Cronbach alpha analysis for the pretest data of the Fall 2002 study, gave an estimated reliability of 54%. In addition, the pretest and post-test data were factor analyzed to examine the construct validity of the FMCE. A scree-plot was used to determine the number of factors for pretest and post-test. Based on these results, eigenvalue-cutoff values of 3 and 2.5 were used for the both sets of pretest data and the post-test data, respectively. These eigenvalue cutoffs yielded three factors for the pretests and five factors for the post-test.

Factor structure was determined by using only clean variables (variables with loadings greater than .3 on no more than one factor). For both of the pretests, the factor structure did not reveal a distinct pattern. This was expected since the pretest was given before any instruction.

For the pilot study, the clean loadings of the post-test questions indicated a distinct factor structure. The factor structure at post-test contained five factors: (1) Concepts regarding Newton's first and second laws; (2) Newton's third law concepts; (3)

Concepts regarding gravitational force; (4) Velocity concepts; and (5) Acceleration concepts. The question distribution among the first four of the factors is given in the tables below. The concept that each question is measuring was determined by a table of specifications described in the next section of this paper.

Table 1

Questions loading on the "Concepts regarding Newton's first and second laws" factor

Question no.	Factor loading	Main question concept
2	.660	Force
3	.685	Force
4	.894	Force
5	.777	Force
6	.894	Force
7	.586	Force
8	.894	Force
9	.894	Force
16	.894	Force
18	.689	Force
19	.894	Force
20	.466	Force
21	.894	Force

Table 2

Questions loading on the "Newton's third law concepts" factor

Question no.	Factor loading	General question concept
15	-.467	Force
17	.802	Force
30	.861	Force
32	.810	Force
34	.883	Force
35	.611	Force
36	.807	Force
37	.526	Force
38	.894	Force
39	.639	Force

Table 3

Questions loading on the "Concepts regarding gravitational force" factor

Question no.	Factor loading	General question concept
10	.670	Force
11	.802	Force
12	.634	Force
13	.802	Force
14	.802	Force

Table 4

Questions loading on the "Velocity concepts" factor

Question no.	Factor loading	General question concept
40	.617	Velocity
41	.812	Velocity
42	.538	Velocity
43	.827	Velocity

The fifth factor, "Acceleration concepts", had only one question, 22, load on it cleanly. Question 22 is one of eight questions on the FMCE that deal with analyzing acceleration graphs. Of the remaining seven questions that dealt with acceleration graphs, all had loadings of .564 or higher on the acceleration factor. However, these questions also loaded on at least one other factor that was related to force. Since Newton's Second Law of Motion demonstrates the relationship between force and acceleration, the dirty loadings of most of the acceleration questions makes physical sense.

Table of Specifications

Four experts evaluated the FMCE. Each expert had a minimum of a master's degree in physics or a related field. These evaluators examined each question of the FMCE and indicated what main concept was being measured by the question and then rated how well that question measured that concept using a scale of 1 to 100%. For 40 out of 47 questions, the experts agreed 100% on the concept being measured. The concept agreement was 75% for the remaining seven questions. Ratings of how well each question measured the chosen concept ranged from 46 to 83%. These results indicate strong content validity of the FMCE instrument.

Discussion of the Results

In general, a test is considered reliable if its reliability estimate is 0.9 or higher (Newman & Newman, 1994). The Cronbach alpha test estimated the reliability of the FMCE instrument at 0.94 at post-test. The factor structure results from the post-test suggested strong construct validity for the FMCE. Construct validity is most important if a test score is to be interpreted as representing a measure of some particular construct or attribute (Newman & Newman, 1994). The content and expert validity from the table of specifications additionally indicates strong validity for the FMCE instrument.

Implications and Further Research

The pilot study results indicated that the FMCE is a valid and reliable measure of the concepts of force and motion. However, the small number of participants limited this pilot study. In addition, only 17 of the pilot study participants who took the pretest also took the post-test. Subsequent investigation of the FMCE validity and reliability needs to take place where the number of participants is larger and where only those participants taking both the pretest and post-test are used in the analysis of the construct validity. The study currently in progress will enable this type of analysis of the FMCE. In addition, the validity and reliability of the FMCE should be investigated in other classroom situations at both the high school and college level. Finally, an investigation that compares the FMCE factor structures of males and females is warranted.

References

Arons, A. B. (1990). *A guide to introductory physics teaching*, New York: John Wiley & Sons.

Brown, R., Zarski, J., Newman, I., Waechter, D., Rosneck, J., & Josephson, R. (2002). *Stability of the second order factor structure of the SF-36 from pre to post-test in phase II cardiac rehabilitation treatment*. Paper presented at the 2002 annual conference of the Eastern Educational Research Association.

Committee on Undergraduate Science Education, Center for Science, Mathematics, and Engineering Education, National Research Council (1999). United States of America: National Academy of Sciences.

Duit, R. & Treagust, D.F. (1998). Learning in science - From behaviourism towards social constructivism and beyond. In B. J. Fraser & K. G. Tobin (Eds.) *International handbook of science education*, (pp 3-26). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Dykstra, D. I., Boyle, C. F., & Monarch, I. A. (1992). Studying conceptual change in learning physics. *Science Education, 76* (6), 615-652.

Gil-Perez, D. & Carrascosa, J. (1990). Concept mapping: What to do about science "misconceptions". *Science Education, 74* (5), 531-540.

Halloun, I. & Hestenes, D. (1985). The initial knowledge state of college physics students. *American Journal of Physics, 53*, 1043-1055.

Hestenes, D., Wells, M. & Swackhamer, G. (1992). Force concept inventory. *The Physics Teacher, 30* (3), 141-58.

Hewson, P.W., Beeth, M.E., & Thorley, N. R. (1998). Teaching for Conceptual Change. In B. J. Fraser & K. G. Tobin (Eds.) *International handbook of science education*, (pp 199-218). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Howe, A. C. (1996). Development of science concepts within a Vygotskian framework. *Science Education, 80* (1), 35-51.

Lawson, A. E. (1995). *Science teaching and the development of thinking*. Belmont, California: Wadsworth Publishing.

McDermott, L. C. & Redish, E. F. (1999). Resource letter: PER-1: Physics Education Research. *American Journal of Physics, 67* (9), 755-767.

Mestre, J. P., Dufresne, R. J., Gerace, W. J. & Hardiman, P. T. (1993). Promoting skilled problem-solving behavior among beginning physics students. *Journal of Research in Science Teaching, 30* (3), 303-17.

National Research Council (2000). *Inquiry and the National Science Education Standards: A guide for teaching and learning*. Washington, D. C.: National Academy Press.

National Research Council (1996). *National Science Education Standards*. Washington, D. C.: National Academy Press.

Newman, I., Newman, C. (1994). *Conceptual statistics for beginners* (2nd ed.). Lanham, MD: University Press of America.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education, 66*(2), 211-227.

Stevens, J. P. (2002). *Applied Multivariate Statistics for the Social Sciences* (4th ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Svec, M. (1999). Improving graphing interpretation skills and understanding of motion using micro-computer based laboratories. *Electronic Journal of Science Education, 3* (4).

Thornton, R.K. (1996). Using large-scale classroom research to study student conceptual learning in mechanics and to develop new approaches to learning. In Tinker, R. F. (ed.), *Microcomputer-based Labs: Educational Research & Standards, Series F, Computer & System Sciences, V156* (pp. 89-114), Berlin: Springer-Verlag.

Thornton, R. K., & Sokoloff, D. R. (1997). Realtime physics: Active learning laboratory. In Redish, E. F. & Rigdan, J. S. (eds.), *The Changing Role of Physics Departments in Modern Universities, Proceedings of the International Conference on Undergraduate Physics Education* (pp. 1101-1108). New York: American Institute of Physics.

Vygotsky, L. (1986). *Thought and language* (A. Kozulin, Trans.). Cambridge, MA: MIT Press (Original English translation published in 1962.)

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