PSYCHOMETRIC PROPERTIES OF PICTURE DATA: ASSESSING THE MARTIN-HELLER COMPUTER ATTITUDE INSTRUMENT

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DEDICATION

To the two EMM's in my life, with love.

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ABSTRACT

The Martin-Heller Computer Attitude Instrument (M-HCAI) is an instrument that purports to measure children's attitude towards computers. The instrument assesses such attitudes through the scoring and interpretation of picture data. Despite wide-spread use in a cross-cultural setting, there has been no published discussion of such psychometric fundamentals as reliability and validity. This research addressed this deficiency by examining the construct validity and internal consistency of the M-HCAI with $\underline{n} = 127$ fifth graders from El Paso, Texas.

Results revealed that the M-HCAI did not differentiate between a) males and females, and b) computer owners and non-owners, as hypothesized. Nor did it exhibit convergent validity with another measure of attitude and an independent observation scale completed by the subjects' teachers. Furthermore, a principal components analysis proved that the M-HCAI was multidimensional. However, extremely poor internal consistency prevented a conclusion regarding whether the M-HCAI does, in fact, measure children's attitude towards computers.

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CHAPTER I: INTRODUCTION TO THE PROBLEM

On April 17th, 1996, the President of the United States of America committed to a national project which would "ensure that American children have the skills they need to succeed in the information-intensive 21st. century" (Executive Order, April 17, 1996, p. 1). This initiative acknowledged the importance of developing technological competancies during the school years. Studies have shown, for example, that children who are heavier computer users consistently excel in various academic areas, especially in math, English, and science subjects (Rocheleau, 1995). Furthermore, computer use can increase social interactions and help foster cooperative learning (Clements and Nastasi, 1988); and help young children become more creative (Clements, 1987; Lehrer and Randle, 1987). The use of technology in the classroom, therefore, can enhance learning and promote academic achievement. The evaluation of programs and initiatives is a key component in developing appropriate curricula to facilitate this growth.

Todman and File (1990) contend that in the evaluation of educational innovations the focus has traditionally been on learning outcomes, an area of neglect is that of attitude and attitude changes. This is of particular concern when one considers that student attitudes play an important role in the success of computer-related components of the school curricula. Positive attitudes increase the prospects of developing positive responses from students (Clements, 1991; Lawton and Gershner, 1982). In 1992, Krendl and Broihier argued that "as technology gains a stronger foothold on our education institutions and becomes a standard instructional tool in the classroom, as well as a fundamental component of cultural literacy, it is critical that we understand student's responses to this medium" (p. 225). Yet a recent review by Kinnear (1995) revealed that research investigation into young children's attitude towards computer use in the classroom are 'few' in number. Other authors conclude that studies of primary school aged children are particularly rare

(Martin, Heller, and Mahmoud, 1992; Bear, Richards, and Lancaster, 1987). Thus, little is known about the attitudes of young children towards computers, and how these attitudes might be shaped by such variables as age, gender, social economic status, and patterns of classroom use, and so forth.

One reason why investigators have not prolifically assessed student attitude towards computers is that "few psychometrically sound instruments for measuring such attitudes have been developed, particularly for elementary and middle school students" (Bear, Richards, and Lancaster, 1987, p. 208). Moreover, no empirical comparison studies have been conducted for those that have been developed. Typically, such comparison studies have been limited to adult scales. Woodrow (1991) for example, examined the Computer Survey Scale (Stevens, 1980; 1982); the Computer Use Questionnaire (Griswold, 1983); the Attitude Toward Computers Measure (Reese and Gable, 1982); and the Loyd and Gressard (1984a; 1984b) Computer Attitude Scale (CAS). A later review by Gardner, Discenza, and Dukes (1993) also examined the CAS, but this time with the Attitude Towards Computers Scale (Raub, 1981), the Computer Anxiety Index (Maurer and Simonson, 1984), and the Blomberg-Lowery Computer Attitude Task (Erickson, 1987). Aside from these studies, Gardner et al. contend that those instruments that have been developed do not yet demonstrate evidence of construct validity outside of the original studies in which the instruments were developed. While Gardner et al. direct this comment to measures of adult attitudes towards computers, the same is pertinent for children's scales. This research proposes to address the needs for empirical comparisons and construct validity evidence through the review of one such scale for young children: The Martin-Heller Computer Attitude Instrument.

Martin-Heller Computer Attitude Instrument

The scale devised by Martin, Heller, and Mahmoud (1992) originated out of an earlier study in 1988 that was the first cross-cultural survey to compare the attitudes of

Soviet and American citizens towards computers (Heller, Schnizlein, and Martin, 1989). The original survey was designed to poll the general public (by country, age, and gender) and compare their attitudes towards computers. Results from this questionnaire revealed similarities between Soviet and American attitudes, in terms of overall responses and patterns of responses. However, the patterns of responses for children under twelve from both countries differed significantly from those of older youth and adults. This prompted Martin et al. to develop a new tool to further examine the differences and similarities in the attitudes of American and Soviet children. The original survey of 20 items formed an item pool of questions addressing a broad range of attitudes about computers, ten of these were selected for inclusion in the new scale (selection procedures are not reported by the authors). As Figure 1 shows, these items took the form of Yes/No responses to such statements as "computers are always right", and "computers always do as they are told." A new feature of the revised Martin-Heller Computer Attitude Instrument (M-HCAI) was the instruction to "draw a picture of one or more persons using a computer" on the reverse of the questionnaire. The ten items from the scale were translated into Russian and tested with a small pilot group for nuances in the language (Martin et al. omit details about this procedure). The drawings from this pilot survey were coded according to the presence of features in the drawings. The categories for this rating included: who was in the drawing, the setting of the drawing, mode of computer usage, number and type of items displayed on the monitor (if any), and computer detail (parts of the computer shown). Drawings were also rated on their complexity: computer detail, computer use, and human figure detail. Interrater reliability was conducted by four different coders, each rating ten drawings (coefficient alpha not reported).

In order to investigate the attitudes of children towards computers in the U.S.A. and in the Soviet Union, Martin et al. administered the M-HCAI to 224 American children between the ages of 8 and 12 (age 8-9, $\underline{n} = 83$; age 10-11, $\underline{n} = 111$; age 12, $\underline{n} = 30$) and 64

male female GENDER	8-9 10-11 12 AGE	YES NO Have you used a computer?
We are interested in your opinions about computers. Please answer the questions above and below. Circle each of your answers. Do not write your name.		
yes	1. Computers are always right	no
yes	2. Computers are more than a tool	no
yes	3. Computers will make life more complex	no
yes	4. Someday everyone will use a computer	no
yes	5. Computers should be developed that understand human language	no
yes	6. Only experts can use computers	no
yes	7. Computers are fun to play with	no
yes	8. Computers are basically good	no
yes	9. Computers always do what they are told	no
yes	10. Most people do not need to learn about computers	no
Instructions on back of survey: Draw a picture of one or more persons using a computer.		

Figure 1. The demographic and ten attitude statements of the Martin-Heller Computer Attitude Instrument. Note. From "American and Soviet children's attitudes towards computers", by C. D. Martin, R. S. Heller, and E. Mahmoud, 1992, Educational Computing Research, 8 (2), p. 161. Copyright 1992 by Baywood Publishing Co., Inc. Adapted with permission of the author (see Appendix D).

Soviet children of similar ages (age 8-9, $n = 25$; age 10-11, $n = 27$; age 12, $n = 12$). Responses from the attitude statements were subjected to chi-square analyses and results revealed marked differences, by country, to the statements "have you used a computer" and "one or both of my parents use a computer." Seventy-four percent of American children disagreed with the statement "computers are always right", whereas 81% of Soviet children believed this to be true. The remainder of the attitude statements proved to have more

similarities than differences in terms of response patterns and proportions. Martin et al. report that gender did not significantly impact the statement responses. The only question that seemed to reflect a mild gender effect was "computers always do as they are told": proportionally more girls disagreed with this statement than boys. Chi-square analysis of the picture data, however, did show significant effects of gender: Girls were twice as likely to draw a boy as a computer user in their picture as boys were to draw a girl. Country comparisons revealed four significant areas of differences: the setting of the picture, the presence of an adult female, presence of certain computer parts, and the complexity of the drawings. Analysis of the data proved that parental computer use was also an affect. Fewer unknown settings and more computers in the home appeared when parents had used a computer, than not. Interestingly, when parents had not used a computer, picture data showed a higher level of human complexity and a lower level of computer complexity. Martin et al. conclude that although the type of exposure to computers differs significantly between children from the U.S.A. and the Soviet Union, children generally have positive attitudes towards computers.

The Problems

The Martin-Heller Computer Attitude Instrument (M-HCAI) has been used in an international setting to establish differences in attitudes towards computers between American and Soviet children. The results of their research findings can be used to interpret differences in the two countries in a number of ways. Martin, Heller, and Mahmoud (1992) cite the differences in computer education and access to computers as major influences. Furthermore, their research signifies a new era of cooperative research projects between one time 'enemies'. Yet no attempt has been made to validate the instrument used to collect their data. The notion of utilizing picture data is an intriguing one, but does the M-HCAI in fact measure attitude? And if so, which composites of attitude?. Bohrnstedt (1970) suggests that a researcher should validate a scale by

investigating whether it confirms or denies a hypotheses predicted from a theory which is based upon the construct. In this case, the theory is one proposed by Cronbach and Meehl (1955, p. 287), that "if two tests are presumed to measure the same construct, a correlation between them is predicted." With respect to the M-HCAI, this type of hypotheses testing has not taken place.

The Martin, Heller, and Mahmoud study revealed no significant differences in statement scores relating to the attitudes towards computers by gender, yet this finding is contrary to many other studies. There is a mounting body of evidence to suggest that gender, as a variable, does influence children's attitudes towards computers (Kinnear, 1995; Krendl and Broihier, 1992; Todman and File, 1990; Becker and Sterling, 1987; Loyd, Loyd and Gressard, 1987; Lieberman, 1985). The issue, therefore, of comparing the M-HCAI with gender as a known group differential would be a worthy endeavor. Such research would contribute to the scales' solely lacking validity data. For an instrument to be considered psychometrically sound, the issue of reliability must also be addressed; the authors, however, omit to report on reliability data. With these issues in mind, the following null hypotheses were generated in order to empirically test the M-HCAI:

Hypotheses

In the proposed evaluation of the M-HCAI, the hypotheses to be tested in this research study were fourfold:

1) The Martin-Heller Computer Attitude Instrument will not exhibit favourable internal consistency;
2) There will be no statistical significant difference in attitude towards computers between a) males and females and (b) computer owners and non-owners;
3) The Martin-Heller Computer Attitude Instrument will not exhibit convergent validity with other instruments presumed to measure the same construct; and
4) The Martin-Heller Computer Attitude Instrument will not be unidimensional.

Definitions

In addressing the hypotheses posed by this research, the following definitions were used:

Construct:

A theoretical quality of trait that is used to explain individual differences.

Attitude:

A reflection or disposition of an inner motivation or inhibition toward a specified class of stimuli.

Attitude Scale:

A test measuring the predisposition to think, feel, perceive, or believe in a certain manner toward some class of stimuli.

Reliability:

The degree to which test scores are consistent, dependable, or repeatable.

Validity:

The degree to which a certain inference from a test is appropriate or meaningful.

Validation:

The process of investigation to ascertain the degree of validity.

Construct-related validity:

Evidence to support whether a test measures one or more dimensions of a trait or theory.

Computer:

Used to denote a microcomputer and its composite parts, including monitor, keyboard, disk drive, etc.

Using a computer:

All activities associated with using a computer as a tool.

Picture data

Data interpreted from artwork.

Young Children:

Primary school-aged children, kindergarten through fifth grade.

Delimitation's

The focus for this research study was narrowed in a number of ways by financial and time restrictions. These restrictions affected the research design and methodology with respect to site and sample selection, instrumentation choice, and scope of the validation process.

Significance

Significance of this research is based on two points: 1) timeliness, and 2) extending previous studies. The research was timely, given the recent Presidential announcement about the importance of introducing technology into modern schools. The research also extends current knowledge by providing empirical evidence of the reliability and validity of the Martin-Heller Computer Attitude Instrument for sample populations possessing similar characteristics to those used in this study.

Chapter Summary

The introduction of computer technology into schools across the country will require the development of appropriate curricula. The assessment of students attitudes towards such technical innovations could provide valuable insights and aid program success. Thus, there is a need for valid tests to measure attitude change. Furthermore, unless there is evidence that the various instruments are measuring the same attribute or dimension then no broad generalizations can be made about the wider population. This research aimed to address this issue by examining a new scale for measuring children's attitudes: the Martin-Heller Computer Attitude Instrument. This scale has been widely used in a cross-cultural setting, without evidence of reporting reliability or validity. This research posited four hypotheses to address this deficiency in psychometric information.

CHAPTER II: REVIEW OF RELEVANT LITERATURE

The purpose of this chapter is to present an overview of the issues surrounding the assessment of children's attitude towards computers. The first section discusses the nature and definition of attitude, as proposed by leading theorists. Understanding what constitutes 'attitude' is an integral component to it's measurement. The theme of measurement is continued through a discussion on validity and reliability: both important considerations in test design and usage. These discussions set the scene for a review of scales designed in this last decade before the new millennium to assess children's attitudes towards computers. The scales identified for this review are those that have been used on young children between kindergarten and fifth grade. One of these measures, the Draw-A-Computer-User Test (Barba, 1990) is an instrument that, like the Martin-Heller Computer Attitude Instrument, also utilizes pictorial evidence to obtain data. The remainder of the scales under review are of the more 'traditional' self-reporting type. These being the Kinnear Scale (Kinnear, 1995); the Krendl and Broihier Scales (Krendl and Broihier, 1992); the Young Children's Computer Inventory (Miyashita and Knezek, 1992; Knezek and Miyashita, 1993); the Bath County Computer Attitude Scale (Bear, Richards, and Lancaster, 1987); the Todman File Scale (Todman and File, 1990). This chapter then concludes with a summary of the literature reviewed and its implications for this research and Martin-Heller Computer Attitude Instrument.

Attitude

Attitude Theories

Attitude, like other constructs such as intelligence and personality, has been the subject for debate by social scientists throughout the years. The main reason for controversy is that attitudes are not directly observable; they are theoretical ideas, developed to explain and organize individual differences and similarities. Thus, theorists have not

agreed on any one single definition of its nature and correlates. For example, Allport (1967), the well-known attitudinal theorist refers to an attitude as "a mental and neutral state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" (p.8). In the same book of readings, Thurstone (1967, p. 77) declares "the term 'attitude' will be used here to denote the sum total of a man's inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats, and convictions about any specific topic." Thurstone makes an interesting differentiation between opinions and attitudes. He subscribes to the view that an 'opinion' is the verbal expression of an attitude, thus an opinion is of interest only in so far as we interpret it to be a symbol of attitude.

On the other hand, Katz (1960) contends that "attitude is the predisposition of the individual to evaluate some symbol or object or aspect of his world in a favourable or unfavourable manner." Katz goes on to add that "attitudes include the affective, or feeling core of liking or disliking, and the cognitive, or belief, elements which describe the effect of the attitude, its characteristics, and its relations to other objects" (p.168). More recently, Fishbein and Ajzen (1975, p. 11) offer the definition of attitude as "a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object." Fishbein and Ajzen reiterate that attitudes are predisposition's of behavior, rather than the actual behavior, and suggest that attitudes consist of four broad categories: affect (feelings/evaluations), cognition (beliefs/opinions), connation (behavioral intentions), and behaviour (observed overt acts). Fishbein and Ajzen note that the most important distinguishing facet of attitude is its affective qualities.

Despite the wide variety of interpretations and definitions, there are areas of substantial agreement. Summers (1970, p. 2) summarizes these as: 1) there is a general consensus that attitude is a predisposition to respond to an object (rather than the actual behaviour toward such object). The 'readiness' to behave is part of this predisposition; 2)

attitudes are persistent over time. Whilst amenable to change, attitudes (especially strongly held ones) require substantial pressure to change; 3) attitudes produce consistency in its manifestations. (i.e., consistent observable approach or avoidance behavior patterns about the object); and 4) attitudes have a directional quality, in that they are not only consistent, but also have a motivational quality to them. Dawes (1972, p. 16) adds to the debate by suggesting that "there is really no necessity that social psychologists agree about the definition of attitude in order to measure attitudes. All that can be measured are specific properties."

Attitude Measurement

"Measurement is the assignment of numbers to observations according to some set of rules" Summers (1970, p.1). This process is true for the quantification of any phenomena, but the process becomes more complicated when attitudes are being examined; attitudes (like intelligence, personality, values, motives, etc.) can not be observed directly from behavior. It is, therefore, important to keep in mind that when measuring attitudes: 1) reliance is on inferences, given that it is not possible to measure attitudes directly; 2) behaviors, beliefs, and feelings will not always match, even when it is correctly assumed that they reflect a single attitude; 3) there are no guarantees that the attitude under inspection will remain static enough for a one-time measurement to be reliable; and 4) when studying certain attitudes, we do so without universal agreement on their nature (Henerson, Morris, and Fitz-Gibbon, 1978). Little wonder that Henerson et al. speculate that attitude measurement is probably the most difficult of all evaluation tasks.

There are many diverse methodologies for assessing attitudes. Such measures include the direct measurement of overt behaviour, non verbal behaviors, and physiological measures. Fishbein, and Ajzen (1975) note that the most commonly accepted attitude-measurement procedures are those that yield a single number designed to summarize the feeling of favourableness or unfavourableness towards the object in question. They