p-ISSN: 2184-2205 e-ISSN: 2184-3414 ISBN: 978-989-35106-6-7 © 2024

EPISTEMOLOGICAL FRAMING IN STATISTICS COURSES FOR PSYCHOLOGY STUDENTS

Carlos Vargas Morales
El Paso Community College (United States of America)
The University of Texas at El Paso (United States of America)

Abstract

As psychology grows in popularity, most students select professions related to therapy, which constantly deem statistics courses as irrelevant and accentuate negative attitudes. This study explored perspectives of knowledge, known as epistemological frames, that students enrolled in a psychology-based course in statistics generate and the extent to which these relate to attitudes, thus leading to three research questions: What are the range of attitudes from students enrolled in a psychology-based course in statistics and would these vary among instructors? What type of epistemological frames do students enrolled in a psychology-based statistics course generate? How do epistemological frames relate to course attitudes? This mixed-methods study gathered data from students enrolled in an introduction to statistics course in different institutions to evaluate attitude ranges and chose nine students for a qualitative analysis on their epistemological frames. The results evidence similarity in attitudes toward statistics, regardless of the instructor teaching the course or the institution where the course was offered. Furthermore, the qualitative analysis evidence the existence of productive and unproductive frames which significantly relate to positive, neutral and negative attitudes. This study should encourage every statistics professor to question not only if the delivery of material is effective to generate knowledge, but if this knowledge transitions to the construction of productive epistemological frames that can foster positive attitudes as this course is useful for every psychology student, regardless of the specialization area.

Keywords: *Epistemological framing, student attitudes, psychology education.*

1. Introduction

As of 2017, nearly 3.5 million people in the United States held a Bachelor's degree in psychology, out of which almost 1 million have received degrees over the last decade and data as recent as 2020 evidence a career growth of 3.46% as 183,794 degrees were awarded that year (Bureau of Labor Statistics, 2023). However, despite its growing popularity most students select specialization areas related to therapy, which leaves them frequently surprised when encountering math requirements on their degree plan, more specifically in statistics courses (Prayoga & Abraham, 2017). Consequently, psychology students frequently frown on the reality of enrolling in at least an introductory course on statistics during their undergraduate education and often dread on the possibility of encountering more statistics courses through graduate programs (Counsell & Cribbie, 2020).

1.1. Statement of the problem

Research methods courses can be perceived as difficult and dull by social and behavioral science students (Murtonen, 2005), and statistics courses are often among the most problematic for psychology students (Gal et al., 1997). Two decades worth of academic literature suggest that psychology students continuously hold negative attitudes toward statistics, or neutral at best (e.g. Hogg, 1991; Ruggeri et al., 2008), and most set only for the required statistics modules while postponing them as much as possible (Onwuegbuzie, 2004). Traditionally, negative attitudes toward statistics are explained by adverse experiences with mathematics through primary education, which can trigger negative emotions toward any related topic such as statistics (Onwuegbuzie, 2000). However, these dreadful attitudes are especially relevant among psychology students due to the misconceived connection of the discipline with qualitative oriented methods when associating the field with careers in therapy (Murtonen et al., 2008) and ignorance about the usefulness of quantitative courses with this area of study (Griffith et al., 2012). Addressing the concept of attitudes and perspectives of knowledge in statistics courses, a research gap exists in tracing a

potential link among these two variables; possibly the perspectives of knowledge that students generate in statistics courses can mediate attitudes toward the course.

1.2. Literature review

Framing is an interpretation to a situation, also described as an answer to the question "What is going on here?" (Goffman, 1974). Framing is predisposed by schemas, which are created by life experience; thus, two individuals with different life experiences can perceive the same situation differently. A point to consider here is that a source generating frames may not be aware of how simple verbal and non-verbal behaviors can modify the interpretation of a situation. Therefore, the way in which a situation is framed can alter the interpretation of a message, which gives the messenger enormous influence (Entman, 1993). This leads to an interest of frames in education, primarily focused on the study of epistemological framing.

Research in learning sciences evidence the existence of frames in education within a context of knowledge, which can be answers to questions such as "What do I expect to learn?" and "By what standards will my intellectual contributions be judged?" (Redish, 2004). By the time a student steps into a new classroom there are many years of experience that already built a schema to evaluate the situation: where to sit, what to do, how to act. Once class begins a student generate frames to develop expectations about what is required, such as deciding what is relevant to succeed in a course (Scherr & Hammer, 2009); this notion of students' framing emphasizing knowledge and learning is known as epistemological framing. Recent studies suggest that students with diverse epistemological frames can understand the same lesson differently since the interpretation of a lecture is not directly tied to the lecture itself, but to the perspective that a student creates about the subject (Krupnik et al., 2018). Therefore, a productive epistemological frame of the student coherent with the frame of an instructor can influence whether class instruction will achieve successful or unsuccessful goals (Hammer et al., 2005).

As noted on the following examples, unproductive frames often involve automatic thought processes that require little to no effort or no sense of voluntary control, while productive frames require conscious efforts and prompts the student to take responsibility for knowledge. Examples of unproductive frames include classroom strategies of accumulating facts without considering their connection to real life (Hutchison & Hammer, 2010), misunderstanding the purpose of lecture as an attempt to hoard facts without relevance (Scherr & Hammer, 2009), and a "cut and paste" mentality when unquestioningly accepting knowledge from perceived authority sources, such as a high achieving classmate (Shim & Kim, 2018). On the other hand, examples of productive frames include a comprehension of the logic behind the content being taught (Krupnik et al., 2018), a classroom strategy of storytelling (Rosenberg et al., 2006), and shifts in positionality among classmates so every student receives a chance to lead during discourse (Shaban & Wilkerson, 2019). As evidenced by these studies, research on epistemological framing indicates an influence of teaching strategies that can foster productive frames, and their existence links to student success (Hutchinson & Hammer, 2010).

1.3. Student attitudes toward statistics

The concept of student attitudes toward statistics courses has been studied for over 30 years, with outcomes suggesting that psychology students often hold negative attitudes or neutral at best (Counsell & Cribbie, 2020), up to the extent at which many may perceive required statistics courses an obstacle toward reaching their academic goals, and as a result, students can even avoid or postpone quantitative statistics courses (Prayoga & Abrams, 2017). Controlling attitudes is a concept worth exploring, as studies already associate positive attitudes toward statistics with higher grades (e.g., Dempster & McCorry, 2009). Furthermore, student attitudes can impact factors such as the development of statistical thinking skills, the willingness to enroll in statistics courses and general achievement (Hilton et al., 2004).

1.4. Research questions

The conclusion from these studies leads to the prediction that epistemological frames will follow different patterns among students with low (negative), medium (neutral) and high (positive) attitudes with a trend tracking productive frames among medium and high attitude students and unproductive frames being especially evident among low attitude students. This interest leads to the following research questions:

- Q1: What are the range of attitudes from students enrolled in a psychology-based course in statistics and would such range of attitudes significantly vary among instructors?
- Q2: What type of epistemological frames do students enrolled in a psychology-based statistics course generate?
- Q3: How do epistemological frames generated by these students relate to course attitudes?

2. Methods

This study followed a mixed-methods design as it integrates quantitative and qualitative research. Data was collected from introduction to statistics courses both at El Paso Community College (Psyc 2317; n = 45) and the University of Texas at El Paso (Psyc 1303; n = 63) during Summer and Fall 2022. At EPCC data was collected from 6 courses that were taught by 4 different professors; at UTEP, data was collected from 3 courses taught by 2 different instructors. The instrument used for the qualitative analysis is the *Survey on Attitudes toward Statistics* (*SATS;* Schau, 2003) to establish a range of attitudes from psychology students enrolled in a statistics course. This scale was chosen due to its good convergent validity with similar scales, along with good reliability as researchers support the proposed factor structure (Nolan et al., 2012). The results provided varying attitudes and distinguished students holding low (negative), medium (neutral) and high (positive) attitudes. The study originally pursued a follow-up interview with three students of each range (n = 9) and although quantitative data gathered 103 students, the follow-up qualitative analysis incorporated unequal sample sizes with 3 students with low attitudes, 4 students with medium attitudes and 2 students with high attitudes.

3. Results

The first research question led to a quantitative data analysis as it combined two interests: What are the range of attitudes of students enrolled in a psychology-based class in statistics and would such range of attitudes significantly vary among psychology instructors? The following table summarizes data.

Table 1. Descriptive statistics from sample.

Subscales	M	SD
Affect	4.91	1.79
Cognitive competence	5.51	1.62
Value	5.01	1.79
Difficulty	4.02	1.66
Interest	4.92	1.64
Effort	6.19	1.29

Note. Each mean is based on a range of scores from 1 to 7.

The *SATS* is structured in six subscales, representing different aspects of attitudes concerning classes in statistics (Schau & Emmioglu, 2012). According to the authors, the following descriptions can help understand what each subscale measures:

- Affect: Positive and negative feelings concerning statistics.
- Cognitive competence: Intellectual knowledge when applied to statistics.
- Value: Usefulness and relevance of statistics in personal and professional life.
- Difficulty: Perceived difficulty of statistics as a subject of study.
- Interest: Level of individual interest in statistics.
- Effort: Amount of work expected to learn statistics.

Inferential statistics were conducted to test if range of attitudes significantly varied on each subscale when comparing scores from all six professors. To conduct this comparison, the first round of analysis was taken by running a Kruskal-Wallis one-way analysis of variance as this method is recommended to compare two or more independent samples of unequal sample sizes (Kruskal & Wallis, 1952). Six separate tests were run, one for each subscale. Surprisingly, for neither of the subscales did the significant value lied below .05, therefore which retaining each null hypothesis; regardless of the professor teaching the course and the academic setting (EPCC or UTEP), students held the same attitude level across each of the six subscalesfrom the *SATS*.

3.1. Qualitative analysis

As discussed in the methods section, the *SATS* provided varying attitudes and distinguished students holding low (negative), medium (neutral) and high (positive) attitudes. The interviews were semi structured to allow for better responses about the situation at hand, to the emerging worldview of the interviewee and the ideas arising on the topic. The initial structure consisted of 10 questions addressing

three main areas of interest: perspectives of knowledge, teaching techniques and knowledge of course material. These three areas were chosen to represent the most common interests when addressing epistemological framing, as studies have focused primarily on perspectives of knowledge (e.g. Hutchison & Hammer, 2010; Redish, 2004; Scherr & Hammer, 2009), the influence of teaching techniques (e.g. Rosenberg et al., 2006) and the framing evoked when inquired about knowledge of course material (e.g. Hammer et al., 2005; Krupnik et al,. 2018). The results evidenced patterns of unproductive frames among low and medium attitude students differing from high attitude students on perspectives of knowledge and course content knowledge, but not on teaching techniques. These results further validate the quantitative data analysis as student attitudes varied similarly regardless of which teacher taught the course, and the qualitative data analysis further evidenced the different patterns of teaching techniques that did not differ among students, regardless of their attitude level.

An example from a response worth exploring came near the end of an interview with a medium attitude student who solidified a course lesson that not only connected to his understanding of statistics in the classroom, but with its importance in the real world as he connected the lesson to a relevant topic in his life, this is one of the most insightful lessons from the interviews: *One lesson that I probably learned and I don't know why it stuck with me, when we were learning about the nasty null. I believe it was on week 2 when we were learning how to write hypotheses, she ended up telling us that right now in the class we're taking we don't want the null to be true, but one think she did say that researchers actually sometimes when the null is proven true and the alternative hypothesis is proven correct that is ok cause that is what data is, sometimes you're going to get good results, sometimes you'll get null results and sometimes you'll get decreasing results and that's ok if it happens. I like to relate that to the ying and yang symbol, which I guess I'm very fascinated in because it represents the bad and the good and when she told me that that's what it kind of reminded of.*

4. Discussion

The current study explored student attitudes about a course in statistics and the extent to which these can be impacted by perspectives of knowledge generated through the course. This interest led to the hypothesis that despite the range of attitudes generated through the course, there would be substantial variability at least from the course of one professor; our results failed to support this hypothesis. The second part of the hypothesis predicted a connection between student attitudes and different perspectives of knowledge generated by these students, and this was supported as evidence shows a consistent pattern of productive frames held primarily by high attitude students, while a pattern of unproductive frames was held primarily by low attitude students, with medium attitude students remaining ambivalent as they projected a positive impression of their course, which was coupled by an assertion on the usefulness of statistics in their fields of study; yet when prompted to provide concrete examples they often failed to provide one. However, these patterns were evident with questions addressing perspectives of knowledge (theme 1) and the understanding of a standard deviation (theme 2), but not with teaching techniques (theme 3).. This is coherent with the results from the quantitative analysis that could not define substantial attitude change by the respective professor; the results suggest that students hold a range of attitudes due to the class, not the professor.

Tracing this study back to its theory, this study evidenced that students generate perspectives of knowledge and develop a range of attitudes regardless of the instructor, but it does not test if conscious strategies to evoke productive frames make a difference. The professor should not be relegated to be a supplier of information with the student perceived as a static source contained to receive and repeat knowledge as this process constructs an unproductive frame of "knowledge propagated from authority" (Hutchison & Hammer, 2010); the professor can do more. The results from this study should encourage every statistics professor to question not only if the delivery of material is effective to generate knowledge, but if this knowledge transitions to the construction of productive epistemological frames that can impact the understanding of a course in statistics as more than just math, more than just a grade and more than a course useful only for researchers. Professors in statistics should be encouraged to question if current teaching methods aid in the construction of productive epistemological frames, as this study evidence that these frames will invariably affect student attitudes toward the course, solidifying the strength of the course not only for academics, but for professionals in applied fields related to Psychology.

References

Bureau of Labor Statistics, U.S. Department of Labor. (2023). *Occupational Outlook Handbook: Psychologists*. Retrieved from https://www.bls.gov/ooh/life-physical-and-social-science/psychologists.htm#tab-3

Counsell, A., & Cribbie, R. A. (2020). Students' Attitudes toward Learning Statistics with R. *Psychology Teaching Review*, *26*(2), 36-56.

Dempster, M., & McCorry, N. K. (2009). The role of previous experience and attitudes toward statistics in statistics assessment outcomes among undergraduate psychology students. *Journal of Statistics Education*, *17*(2).

Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of communication*, *43*(4), 51,58.

Goffman, E. (1974). *Frame analysis: An essay on the organization of experience*. Harvard University Press.

Griffith, J. D., Adams, L. T., Gu, L. L., Hart, C. L., & Nichols-Whitehead, P. (2012). Students attitudes toward statistics across the disciplines: A mixed-methods approach. *Statistics Education Research Journal*, *11*(2), 45-56.

Hammer, D., Elby, A., Scherr, R. E., & Redish, E. F. (2005). Resources, framing, and transfer. In J. P. Mestre (Ed.), *Transfer of learning from a modern multidisciplinary perspective* (pp. 89-119). Greenwich, CT: Information Age Publishing.

Hilton, S. C., Schau, C., & Olsen, J. A. (2004). Survey of attitudes toward statistics: Factor structure invariance by gender and by administration time. *Structural Equation Modeling: A Multidisciplinary Journal*, *11*(1), 92-109.

Hogg, R. V. (1991). Statistical education: Improvements are badly needed. *The American Statistician*, *45*(4), 342-343.

Hutchison, P., & Hammer, D. (2010). Attending to student epistemological framing in a science classroom. *Science Education*, *94*(3), 506-524.

Krupnik, V., Fukawa-Connelly, T., & Weber, K. (2018). Students' epistemological frames and their interpretation of lectures in advanced mathematics. *The Journal of Mathematical Behavior*, *49*, 174-183.

Kruskal, W. H., & Wallis, W. A. (1952). Use of ranks in one-criterion variance analysis. *Journal of the American statistical Association*, *47*(260), 583-621.

Murtonen, M. (2005). University students' research orientations: Do negative attitudes exist toward quantitative methods? *Scandinavian Journal of educational research*, *49*(3), 263-280.

Murtonen, M. Olkinuora, E., Tynjala, P. & Lehtinen, EL. (2008). Do I need research skills in working life? Uiversity students' motivation and difficulties in quantiative methods courses. *Higher Education*, *56*, 599-612.

Onwuegbuzie, A. J. (2000). Statistics anxiety and the role of self-perceptions. *Journal of Educational Research*, *93*(5), 323-330.

Onwuegbuzie, A. J. (2004). Academic procrastination and statistics anxiety. *Assessment* & *Evaluation in Higher Education*, *29*(1), 3-19.

Prayoga, T., & Abraham, J. (2017). A psychological model explaining why we love or hate statistics. *Kasetsart Journal of Social Sciences*, *38*(1), 1-8.

Redish, E. F. (2004). A theoretical framework for physics education research: Modeling student thinking. *arXiv preprint physics/0411149*.

Rosenberg, S., Hammer, D., & Phelan, J. (2006). Multiple epistemological coherences in an eighth-grade discussion of the rock cycle. *The Journal of the Learning Sciences*, *15*(2), 261-292.

Ruggeri, K., Dempster, M., Hanna, D. & Cleary, C. (2008). Experiences and expectations: The real reason nobody likes stats. *Psychology Teaching Review*, *14*(2), 75-83.

Schau, C. (2003). *Survey of attitudes toward statistics (SATS-36)*.

Schau, C., & Emmioğlu, E. (2012). Do introductory statistics courses in the United States improve students attitudes? *Statistics Education Research Journal*, *11*(2), 86-94.

Scherr, R. E., & Hammer, D. (2009). Student behavior and epistemological framing: Examples from collaborative active-learning activities in physics. *Cognition and Instruction*, *27*(2), 147-174.

Shaban, Y., & Wilkerson, M. H. (2019). The co-construction of epistemological framing in clinical interviews and implications for research in science education. *International Journal of Science Education*, *41*(12), 1579-1599.

Shim, S. Y., & Kim, H. B. (2018). Framing negotiation: Dynamics of epistemological and positional framing in small groups during scientific modeling. *Science Education*, *102*(1), 128-152.