# Determining Faculty and Student Views: Applications of Q Methodology in Higher Education

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## Abstract

William Stephenson specifically developed Q methodology, or Q, as a means of measuring subjectivity. Q has been used to determine perspectives / views in a wide variety of fields from marketing research to political science but less frequently in education. In higher education, the author has used Q methodology to determine views about a variety of situations, from students' views about a newly developed bioinformatics course to faculty members' views of reading circles

as a professional development experience to improve teaching and learning in their classrooms. The purpose of this article is to introduce Q methodology and demonstrate its versatility in addressing research purposes in higher education, especially where the focus is on determining student or faculty perceptions about a topic. Such determinations can be helpful for program evaluation and improved teaching/learning in higher education.

## Determining Faculty and Student Views: Applications of Q Methodology in Higher Education

The purpose of this article is to introduce Q methodology and demonstrate its versatility in addressing research purposes in higher education, especially where the focus is on determining people's perceptions and / or grouping people based upon their views. William Stephenson specifically developed Q methodology, or Q, as a means of measuring subjectivity (Brown, 1980, 2008; McKeown & Thomas, 1988; Stephenson, 1953). Q has been used to determine perspectives / views in a wide variety of fields from marketing research to political science (Brown, 1980; McKeown & Thomas, 1988) but less frequently in education (Brown, 1980). In higher education, the author has used Q methodology to determine views about a variety of situations, from students' views about a newly developed bioinformatics course (Ramlo, McConnell, Duan, & Moore, 2008) to faculty members' views of reading circles as a professional development experience to improve teaching and learning in their classrooms (Ramlo & McConnell, 2008).

A Q study begins with the selections of items to be sorted. These items, typically statements related to the topic, often come from qualitative beginnings such as focus groups and interviews (McKeown & Thomas, 1988; I. Newman & Ramlo, 2010). These items are then sorted by participants as they provide their perspectives by sorting these items into a grid, typically with a range such as +5 (most like my view) to -5 (most unlike my view). The participants judge each item relative to the others as they place them into the grid and rearrange as they desire (Brown, 1980; McKeown & Thomas, 1988; Stephenson, 1953). The sorts are then entered into specialized software for analysis, such as PQ Method (Schmolck, 2002), which produces a variety of informative tables based upon factor analysis results (Brown, 1980; I. Newman & Ramlo, 2010; Schmolck, 2002). In Q, the sorts are factor analyzed such that people with similar views are grouped into factors. Thus, each factor represents a view about the topic (Brown, 1980; McKeown & Thomas, 1988; Stephenson, 1953). Factors are interpreted based upon the tables produced from the analyses of the Q sorts (Brown, 1980; I. Newman & Ramlo, 2010). More information on the process of Q methodology follows along with examples from a variety of studies to assist in describing the application of Q methodology in higher education. We will begin with the Q-sample and the Q-sort.

## The Q-sample

The items are derived from various means including interviews and focus groups (Brown, 1980; McKeown & Thomas, 1988; I. Newman & Ramlo, 2010). The items for the Q sort may consist of anything from statements to pictures (Brown, 1980; McKeown & Thomas, 1988; Stephenson, 1953). In some studies, the statements are created by the researcher or someone involved with the project based upon program goals or other criteria such as with the evaluation of a new bioinformatics course (Ramlo et al., 2008)or of a faculty reading circle program designed to improve faculty's teaching (Ramlo & McConnell, 2008). An earlier study by Ramlo (2005) developed 50 items for sorting by having faculty use a think-pair-share (Lyman, 1992) exercise early within the discussion about the creation of a School of Technology on a university campus (Ramlo, 2005). In that Ramlo (2005) study, participants wrote down two weaknesses, two strengths, and any other concerns about the proposed creation of a School of Technology at a large, public university. Individuals then broke into groups of two or three to discuss what they had written which then led to a large group discussion. This method led to 50 unique statements for the participants to later sort.

## The Q-sort

Items, such as statements, are typically placed on individual strips of paper. Instructions for the Q sort typically begin by asking the participants to place the statements, as they read them, into one of three piles based on the condition of instruction: (1) More Like My View (2) Neutral (3) Least like my view about the topic. It is helpful if participants can make these piles relatively equal in preparation for the final sort. Once the three piles are created, participants distribute the statements into a grid such as the one shown in Figure 1. Because the items are on individual strips of paper, participants can re-arrange them until they are satisfied that their placements match the participant's view. It is important to note that because participants judge each statement relative to the others based upon their own views, each sort represents the participant's subjectivity about the topic. Because participants interpret each statement, operational definitions and validity are not concerns in Q methodology (Brown, 1980).

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| # statements that go here | **2 statements** | **3** | **4** | **4** | **4 statements** | **4** | **4** | **3** | **2 statements** |
| Ranking on grid | **-4** | **-3** | **-2** | **-1** | **0** | **1** | **2** | **3** | **4** |
| Range | **Most unlike my view** | | | | **Neutral** | | | | **Most like my view** |

Figure 1 A Q-sort grid showing the number of statements to be placed within the range from -4 (most unlike my view) to +4 (most like my view).

## The analyses

In Q, the sorts are factor analyzed such that people with similar views are grouped into factors. Each factor represents a view about the topic (Brown, 1980; McKeown & Thomas, 1988;

Stephenson, 1953). The analyses produce a number of descriptive outputs that are interpreted to confirm or explore people's perspectives. Thus, Q methodology shares many of the focuses of qualitative research while utilizing the type of statistical analyses typically found in quantitative studies. In this way, Q methodology fits into the paradigm of mixed methods research (I. Newman & Ramlo, 2010; Stenner & Stainton-Rogers, 2004). As Bazeley (2010) suggests, the integration of qualitative and quantitative research into mixed methods allows the researcher to produce findings that are of greater use and better address the research purpose (I. Newman, Ridenour, Newman, & DeMarco, George Mario Paul Jr., 2003). However, the mixing of qualitative and quantitative methods affects interpretations of research quality (Greene, 2008). For instance, differences in statistical considerations related to grouping people with factor analysis with subjective/qualitative data (Q sorts) versus objective data (Likert surveys) are discussed elsewhere (Stephenson & Burt, 1939). As an example, however, in Q methodology frequently there are misinterpretations about sample size. In Q the sample size is represented by the number of statements sorted, not the number of participants sorting the statements. Thus in Q methodology researchers are concerned about having sufficient number and types of statements to represent the communicability of the topic (Brown, 1980). The number of participants sorting is determined by the purpose of the study (Brown, 1980; I. Newman & Ramlo, 2010; Stephenson, 1953).

## three Q studies in higher education

Three distinct studies, each with a different purpose and population, are discussed within this section. Because it is not practical to discuss the results of three studies in higher education in detail, the results and conclusions from several studies are briefly presented within this paper. Each of these studies is published thus readers may find details elsewhere. The purpose of this article is to demonstrate the versatility of Q methodology within higher education. With this in mind, the author has selected three studies to profile here: Evaluating a new course in bioinformatics; creating a new school of technology; and investigating students' views of learning physics. The study about investigating students' views of learning physics is discussed first. Only this study includes data tables and this is done to help the reader understand the types of information reported within Q and to help interpret the discussions about the subsequent studies contained within the article.

## Investigating students' views of learning physics

Our first example is one that focuses on curriculum, teaching, and learning in a first semester physics course for engineering technology majors, both associate and bachelor degree level, at a large Midwestern public university. Considerable research and curriculum development has focused on students' learning of force and motion concepts yet research shows that many students fail to gain Newtonian-based understanding of force and motion concepts(Ramlo, 2008c; Redish, Saul, & Steinberg, 2000; Thornton & Sokoloff, 1998). Research has demonstrated the connection between learning in physics and students' personal epistemologies (Halloun & Hestenes, 1998; Hammer & Elby, 2003; Lising & Elby, 2005). Yet this research has typically used time intensive qualitative methods or Likert scale surveys which can result in loss of meaning (McKeown, 2001). Thus, this study used Q methodology to determine the various perspectives of students related to their learning within a first semester, college physics course.

The use of Likert-scale surveys for a more objective means of assessing epistemological beliefs started in the mid-1980's (Ryan, 1984) and has continued to be popular with the development of instruments such as the survey developed by Schommer (1990). In this study, concourse development started with the items from Schommer's survey and supplemented them with statements taken from student interviews (Ramlo, 2006/2007; Ramlo, 2008a; Ramlo, 2008b). The Q sample consisted of 30 statements related to learning physics.

In this study, first semester college physics students sorted the Q-sample into a grid similar to the one shown in Figure 1, after completing the final exam. The condition of instruction was to sort the statements based upon their view of their learning in this first semester physics course, both lab and lecture. The week before, during the last lab meeting, these same students completed the Force and Motion Conceptual Evaluation (FMCE). They also completed the FMCE during the first lab meeting of the semester. The FMCE is frequently used to determine conceptual understanding of force and motion (Dykstra, Boyle, & Monarch, 1992; Thornton, 1997; Thornton & Sokoloff, 1998) and has been found to be valid and reliable (Ramlo, 2008d).

Eighteen students completed the Q-sort and the FMCE posttest. Analyses of the Q-sorts revealed four factors/views about learning physics in the course. The view represented by those on factor 1 contains the largest factor group from the class, seven students. In contrast, factors 2 and 3 are represented by three participants each. Factor 4 is represented by only one student. Similar factor structure was found in prior studies that used the same Q-sample (Ramlo, 2008a)or a Q-sample that was very similar (Ramlo, 2006/2007).

Table 1 - Correlations between the factors (views) and the FMCE posttest scores

| Factor/View | Correlation with Posttest score | Average Posttest score | Standard Deviation | Number of students |
|---|---|---|---|---|
| 1 | .463 | 31 | 7 | 7 |
| 2 | -.393 | 16 | 11 | 3 |
| 3 | -.171 | 21 | 3 | 3 |
| 4 | -.318 | 12 | N/A | 1 |

*Notes: The Force and Motion Conceptual Evaluation (FMCE) was used for the posttest and has a maximum of 47 points possible. Only Factor 1 had a positive correlation with the posttest.*

From the correlations shown in Table 1, it is apparent that there is something unique about the view represented by Factor 1. This particular view has a high positive correlation (.46) with the Force and Motion Conceptual Evaluation (FMCE) posttest scores. The remaining views (factors) all have negative correlations with the posttest scores, ranging from -.393 to -.171. The mean FMCE posttest score for Factor 1 is 31 +/- 7 whereas the remaining factors' mean FMCE posttest scores ranged from 12 to 21. Thus, the correlations indicate that the factor 1 view may be important to investigate.

The results from the analyses for all four factors are given in Table 2. This table contains the 30 statements from the Q-sample and their resulting grid positions for each of the four factors/views. Statement grid positions with an asterisk indicate that these statements were distinguishing for that factor when compared to the statement's grid position for each of the other factors.

Table 2 – Statements and their positions for each of the four factors

| Statement # | Statement | Factor 1 grid position | Factor 2 grid position | Factor 3 grid position | Factor 4 grid position |
|---|---|---|---|---|---|
| 1 | I see the ideas of force and motion as coherent and interconnected. | 1* | -4 | -4 | -2 |
| 2 | I think of learning as reconstructing and refining my current understanding. | 2 | -3 | 2 | -3 |
| 3 | When my predictions in lab don't match my lab results I question my understanding. | -1 | 1 | 0 | 3 |
| 4 | I like it when my instructor gives me the answer instead of making me figure it out myself. | -2 | 3 | 2 | -4 |
| 5 | I have very little control over how much I learn in this course. | -3 | -1 | -1 | 2* |
| 6 | In lab, if I don't understand | 0 | -2 | 0 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| | something right away, I will keep on trying until I get it. | | | | |
| 7 | Learning something really well takes me a long time in this course. | -3 | 1* | -3 | -1 |
| 8 | In this course, if I don't understand something quickly, it usually means I won't understand it. | -4* | 0 | 3 | 1 |
| 9 | Working with classmates helps me learn in this course & lab. | 2 | 2 | -1 | -3 |

Table 2 – Statements and their positions for each of the four factors (continued)

| Statement # | Statement | Factor 1 grid position | Factor 2 grid position | Factor 3 grid position | Factor 4 grid position |
|---|---|---|---|---|---|
| 10 | I can tell when I understand the material in this class. | 3 | 3 | 1 | 2 |
| 11 | I feel comfortable applying what I learned in this class to the real-world. | 2 | -1 | -2 | 2 |
| 12 | I like the exactness of math-type subjects. | 4 | -2* | 4 | 1* |
| 13 | What I learn in this class will help me in other classes. | 3 | 1 | -2 | -2 |
| 14 | When I don't understand something in my physics lab, I try to figure it out myself. | 1 | -3 | 2 | -1 |
| 15 | When I don't understand something in my physics lab, I ask another student to help me understand. | 3 | 2 | 1 | 3 |
| 16 | If I am going to understand something in this course, it will make sense to me right away. | -3* | 2 | 2 | 3 |
| 17 | Sometimes I just have to accept answers from my professor even though I don't understand them. | -1* | 2 | 1 | -4* |
| 18 | What I learn in lab will help me in other classes. | -1 | -2 | 4* | 0 |
| 19 | I am genuinely interested in learning about force and motion. | 0 | -4* | -1 | -1 |
| 20 | When I don't understand something in my physics lab, I ask my instructor to help me understand. | 1* | 0* | -4* | 4* |

Table 2 – Statements and their positions for each of the four factors (continued)

| Statement # | Statement | Factor 1 grid position | Factor 2 grid position | Factor 3 grid position | Factor 4 grid position |
|---|---|---|---|---|---|
| 22 | I try to relate my life experiences to the lab activities and/or ideas. | 2 | 0 | -3 | 0 |
| 23 | Sometimes I found the lab results hard to truly believe. | -4 | -1 | 0 | -3 |
| 24 | Sometimes I find I have problems understanding the terms used in physics. | -2* | 3* | 1 | 1 |
| 25 | My lab results are often consistent with my every day thinking about how things work. | 1 | 0 | -2 | 0 |

We focus our attention on the grid positions for the Factor 1 statements because this factor is of greatest interest. These +/-4 and +/-3 position statements indicate that those represented by the Factor 1 view were reflective, help seeking, and enjoyed math / problem solving. Those represented by the Factor 1 view also saw the relevance of this physics course and its relationship to future classes they would take in their engineering technology major. These students also did not see learning as immediate (disagree with statements 7, 8, and 16) but did see that they have control over their learning (statement 5).

To further differentiate this view from the remaining three, we consider the distinguishing statements for Factor 1. These statements distinguish this view from the other three views statistically. The examination of the distinguishing statements reveals that Factor 1 students sought a coherent view of force and motion (statement 1) and believed that their learning would take time (statements 8 and 16). It is important to note that only those represented by this view agreed that they sought coherence for the force and motion concepts and disagreed that learning needed to be immediate (statement 16).

Results from this study indicated the need for changes in the lab and course activities for this first semester physics course. For instance, although lab activities ask students to reflect on earlier, related activities, students disagreed that they try to combine these ideas across the lab activities. A need for more effective ways of assisting students in combining these ideas across the lab activities is indicated with this finding. The results of this study also indicate the importance of helping students seek coherence among the concepts of force and motion. The force and motion relationships are stressed throughout the course, including the Realtime Physics Laboratory Activities (Sokoloff, Thornton, & Laws, 2004). Yet this study reveals only those that seek this coherent view become Newtonian thinkers about force and motion.  Assessing students' views about learning physics early in the semester may help reveal the need for interventions to assist students to become Newtonian thinkers about force and motion.

## Evaluating a New Bioinformatics Course

Q methodology was used to as part of a program evaluation plan to determine students' views of a bioinformatics course created as part of a National Science Foundation grant (Ramlo et al., 2008). Bioinformatics is, essentially, the application of computational tools to biological data. Thus one of the challenges to creating such an interdisciplinary course was serving the needs and backgrounds of a diverse set of students. Primarily these students were a mixture of computer science and biology students; students were at both the undergraduate or graduate level. In this study, students sorted 29 statements about the course. The two course sections, one spring 2005 and the other spring 2006, were evaluated separately because of changes made to the 2005 course. These changes were based upon the 2005 students' written and verbal feedback.

The results of the analyses of the Q sorts revealed two factors (views) for each of the course sections. Each factor consisted of both computer science and biology students as well as both undergraduates and graduate students. Thus, the views that emerged about the course and the study of bioinformatics were not similar among those with the same major or student status (undergraduate versus graduate) (Ramlo et al., 2008). This is important to note for program evaluation (McNeil, Newman, & Steinhauser, 2005). The Q methodology results indicated that changes made to the course after 2005 eliminated some students concerns about their learning, primarily related to the computer programming aspects of the course. These course changes also appeared to promote a more a positive view of bioinformatics both academically and as a potential field of study for the students. This type of information may be helpful for others creating bioinformatics courses or programs as well as other inherently interdisciplinary academic opportunities (Ramlo et al., 2008).

## Faculty Views about the Creation of a School of Technology

The investigation of faculty views and consensus regarding the creation of a School of Technology at a large Midwestern public university (Ramlo, 2005) demonstrates how Q methodology is a powerful tool for determining consensus and perspectives of a group. In this study, the administration of the university suggested that a School of Technology be created virtually (electronically but not physically) and formed a committee of faculty to investigate this conceptualization, including strengths and weaknesses. This type of organizational change in higher education can prove difficult and time consuming (Bender & Schuh, 2002). Kezar (2005) suggests that successful promotion of organizational change in higher education requires a shared and inclusive process. The use of Q methodology allowed the researcher to make this process efficient as well as inclusive. Comments from the participants included an appreciation for the democratic nature of Q.

As already mentioned, the participants / committee members statements of strengths and weaknesses related to the creation of the School of Technology were used to develop the Q sample that they later sorted. Ten committee members sorted the 50 statements of the Q sample. Analysis via PQ Method (Schmolck, 2002), a program designed specifically for the analysis of Q sorts using Q methodology, revealed three unique views / factors. The tables produced by the Q analyses include a representative sort for each view. It also produces a table of consensus statements (agreement) among the factors as well as distinguishing statements (those statements that differentiate each factor/ view from the others).

Half of the sorters (5) were represented by factor 1 which possessed a positive view about the creation of the School of Technology. The representative sort for this view as well as the distinguishing statements revealed that this view was extremely positive about the creation of the School of Technology. They were not concerned about details such as funding, location, or name. Instead, this view believed that the creation of the School of Technology would improve programs' images, promote their bachelor degrees, and encourage innovation.

The second factor / view produced was bipolar with two loaders. Thus, persons 1 and 2 on this factor have inverted sorts or, in other words, opposing views. One loader has a positive factor score and the other a negative factor score. Conceptually this is like having one person positively correlated with the factor and the other negatively correlated. The positive loader was cautious about the creation of the School of Technology because of the need for additional resources that may not be included and because the proposed organization is not similar to other schools of technology at other institutions. The negative loader has an inverted view; in other words this person is not concerned about resources and believes that it is good that the School of Technology is not organized like those at other universities. The remaining view represented only one sorter. This view saw the creation of the School of Technology as a marketing opportunity for the pre-existing bachelor degrees that would be associated with the school. This view also saw students as a key component to the choices made about the school as it was organized.

The six consensus statements revealed that all three views agreed that the organization would need to be flexible with constant evaluation and assessment such that changes could be made to improve the School of Technology. Other shared concerns included the ability to market the School of Technology and its program separately from the university and the potential of an increase in revenue from the programs not being fed back into the School of Technology.

The revealing the differing views within a group is important for collaboration (Clark et al., 1996). In this study, not only did Q reveal the differing views in detail, but it also did this in a efficient manner; this is also important for the type of assessment used to promote organizational change (Bender & Schuh, 2002). Q also determined consensus items which also promoted discussion and collaboration. This consensus, along with the determining of different views, promoted the type of facilitation suggested by Witte and Engelhardt (2004). These findings were supported by committee members' comments about the empowering and democratic feelings they had about the study and its results.

## Conclusions

The findings from this study are unique compared to other studies that investigated students' epistemological views related to learning physics and their conceptual understanding. Unlike the CLASS (Adams, Perkins, Dubson, Finkelstein, & Wieman, 2005; Perkins, Adams, Pollock, Finkelstein, & Wieman, 2005; Perkins, Gratny, Adams, Finkelstein, & Wieman, 2006) and VASS (Halloun & Hestenes, 1996; Halloun & Hestenes, 1998) surveys, this Q methodology study revealed a variety of views about learning physics. Unlike the CLASS studies, students' views were not simply measured relative to the views of selected experts (Adams et al., 2005; Perkins et al., 2005; Perkins et al., 2006). Instead, four unique views were determined from students' sorts that revealed a richer picture of the beliefs about learning physics within the course, including the inquiry laboratories. These perspectives led to modifications within the laboratories and course. Evaluation of students' views of learning physics is ongoing for students enrolled within this first semester physics course.

The bioinformatics study demonstrated that classifying individuals into groups is helpful in various research situations including program evaluation. Using Q methodology to group people based upon their perspectives, using factor analysis to correlate their views as expressed by their Q sorts, is a more effective method of grouping people than using surface characteristics such as race, sex or academic major because surface characteristics do not necessarily determine similar views / perspectives. This is frequently important in program evaluation, where there is often value in addressing the various stakeholder groups differently to ascertain their needs and make effective program improvements (McNeil et al., 2005). In addition, the use of Q methodology also effectively reduces the huge amount of qualitative variables into groupings to better investigate research questions. Thus, it behooves education researchers to learn more about Q methodology and learn about the types of research purposes that Q can be used to address.

Within the School of Technology study, Q methodology allowed the researcher to promote the type of assessment that Bender (2002) describes as optimal for organizational change. She specifically stated that organizational change assessment needs to be effective in that the appropriate issues must be identified, the right questions need to be asked, and collection and analysis of data needs to be efficient. Q methodology demonstrated each of these traits for assessment within this study. The Q results also allowed committee members to feel empowered and that everyone's voice was heard; these feelings are important for effective collaboration (Clark et al., 1996).

In summary, the studies discussed here demonstrate that Q methodology is a powerful tool for determining personal perspectives within higher education. In two of the studies, students' views were determined and then used to make course changes to improve students' learning and attitudes toward the subject. In the third study, faculty collaboration was improved and ideas about organizational change were revealed via the use of Q methodology. Thus, these studies demonstrate the versatility of Q methodology in addressing research purposes in higher education and the importance of determining the variety of views that exist about a topic, whether that topic is organizational change, a newly developed bioinformatics course, or learning in a first semester college physics course.

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