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Ambiguous Terminology: A Challenge in Teaching Social Science Research Methods and Statistics

Maria M. Talbott and Junghee Lee
Portland State University

Research terminology is an underexamined challenge in the teaching of social science research methods and statistics courses. An important problem in research terminology is that many of the common terms have more than one meaning in English, which students often confuse. For example, the words random, pretest, validity, and regression have more than one meaning and are often problematic for students. Clarification of the most common of these misunderstandings is provided, and teaching strategies are suggested. This issue of ambiguous terminology has not previously been directly addressed in the literature.

Research methods and statistics are important components of higher education in the social sciences. Social science students must learn about research in order to critically evaluate and appreciate the research findings they are taught. In our field of social work, learning research skills also enables social work students to discover best practices, evaluate their own practices and their own agencies, and contribute to the knowledge base of the profession (Cameron & Este, 2008; Moore, Avant, & Austin, 2008; Rubin & Babbie, 2014)

A substantial portion of the teaching of research involves the teaching of research terminology. Learning the correct meanings of research terms allows students to understand research. Acquiring the vocabulary of research also allows students to describe their own research to others, as well as to communicate about research in general with faculty, researchers, and colleagues (Grix, 2002). Being able to understand and use research jargon is an important learning objective of research education in the social sciences. Even internationally, social work research is often taught in English. Here, we attempt to deal with one aspect of research that poses difficulties for some students: ambiguous research terminology in American English.

Since we are social workers, we looked at the research literature on teaching research in social work. This literature on teaching research in social work education covers many topics. A good deal of the scholarship focuses on strategies to overcome students' anxiety, lack of interest, and resistance to research and statistics. For example, several authors have described evaluation projects involving service learning partnerships with community agencies that helped students to overcome their reluctance to learn how to conduct research (e.g., Harder, 2010; John, & Bang, 2017; Kaye-Tzadok, & Spiro, 2016; Postlethwait, 2012; Shannon, Kim, & Robinson, 2012; Taliaferro & Ames, 2010). Others have recommended data mining to help students become more interested and more competent in research (Auslander & Rosenne, 2016; Fouché & Bartley, 2016). Cameron and Este (2008) reviewed several strategies to increase students' involvement in research, including a recommendation that students disseminate their work through publication. Moore and colleagues (2008) espouse including students in faculty research projects. Elliot, Choi, and Friedline (2013) described an innovative online statistics lab that improved students' attitudes toward statistics.

There has also been work on specific topics related to improving the teaching and the understanding of research. Henderson, Acquaye-Doyle, Waites and Howard (2016) presented a culturally relevant research pedagogy that uses the Black perspective and is informed by historical trauma theory. Mapp (2013) and Slayter (2017) provided ideas about how better to integrate social justice issues into research courses. Calderwood (2012) developed a decision-making flow chart to facilitate the teaching of inferential statistics. Baker, Hudson, and Pollio (2011) developed the Practice Evaluation Knowledge Scale, an assessment tool to evaluate the effectiveness of social work research courses related to empirically-based practice. These represent just a sample of some of the more recent topics that have been addressed regarding the teaching of research to social work students. However, we have not discovered any work that addresses the challenges of teaching research terminology, despite its importance.

This article focuses on research terms with more than one meaning in English, which is a prevalent but underexamined concern in teaching research. First, we note that research terminology is a source of concern for students in research classes. We then offer authoritative clarification of the some of the ambiguity in research terms, based on reliable sources. We suggest innovative teaching strategies to improve the understanding and use of these terms by social science students. This article provides helpful attention to an important yet previously unnoticed issue in teaching social research—ambiguous terminology.

Student Concern About Learning Research Terminology

We are two experienced research teachers in a school of social work (30 years and 14 years) in the Pacific Northwest. Between us, we have taught research at all three levels of social work education: bachelor's, master's, and PhD. We both ask students in our research classes to complete anonymous questionnaires during the first class meeting. These questionnaires cover the students' attitudes and knowledge about research before they begin taking our research classes. These questionnaires are used in several ways in teaching the classes. Here, we report some of the data we have obtained through these pre-test questionnaires, which are comments indicating students' attitudes about research terminology. The use of these anonymous data was approved by our university's Institutional Review Board.

Findings from these pre-test questionnaires show that research terminology is a troublesome area for many students. For example, one question on a pre-test asked the students about their negative thoughts and feelings about research. (See Appendix for exact wording of questions.) This question has elicited comments about not being able to understand research and being confused, as illustrated in, "Lack of understanding the terminology," "Jargon is difficult to decipher," "I sometimes feel overwhelmed by the terminology," and "I'm afraid of the language used." On other pre-tests, a question asked the students to name their fears about research. Many students reported that they feared they would not be able to understand the concepts. Students replied, "Getting confused by definitions," "Getting used to the language and terminology," and "It seems like a foreign language to me." These data indicate that some students' apprehension about learning research is partly related to research terminology. The data do not indicate that terminology is the primary concern of most students as they begin a research course, but it is an important concern. There is a corresponding question on the pre-test, asking for students' positive thoughts and feelings about research. There, one student wrote, "I place great value on understanding research methods and terminology—in order to better inform my practice." Another question on the pre-test asks about any topics the student is particularly hoping to learn more about in the course. One Ph.D. student answered, "Get a very thorough understanding of research and research terminology."

Ambiguous Terms in Research and Evaluation

Research is known for its carefulness and precision. By a painstaking process, knowledge is gained, and the strengths and limits of the process to gain the knowledge can also be known. Paradoxically, while research requires precision about language, in social science research the terms used are often confusing. Specifically, some research terms have different meanings in general usage and/or in social work practice theory and/or in research, and some terms have more than one meaning in research. Social science research textbooks introduce these terms and provide research definitions, but they do not often address the ambiguity.

In our teaching experience, these ambiguous terms contribute noticeably to the confusion that students sometimes encounter when learning about research. Students experience difficulties when they have a prior vernacular understanding of a word and are taught an additional new, different, and technical meaning of it. They also experience challenges when one word is used in research in two or more different ways. We have found it more useful to confront and address the possible confusion than to ignore it. To promote the carefulness and precision that are valuable characteristics of the research process, we here point out some of the major sources of confusion and provide clarification. The terms we focus on here are not the only instances of ambiguity in research, but they are the ones that are most likely to be taught at the different levels of higher education and appear to cause the most confusion. Similarly, we do not present all of the definitions of the terms we review here, but only the common definitions that are the most troublesome.

Sources of Clarification about the Terms

To establish different meanings and to obtain all the relevant definitions, we used a variety of current dictionaries and a few research sources. Three types of definitions are presented here: (1) as used in general or vernacular usage, and in one case, slang, (2) as used in theory about social work practice and therapy, and (3) as defined in social science and social work research. We consulted the following dictionaries and sources:

1. For vernacular or general usage, and for slang:
   - *The American Heritage Dictionary of the English Language* (5th Ed.). (Kleinedler, 2016).
   - *The Merriam-Webster Dictionary* (New Ed.). (Merriam-Webster, 2005).
   - *The New Oxford American Dictionary* (3rd Ed.). (Stevenson& Lindberg, 2010).
   - *Cassell's Dictionary of Slang*. (Green, 2006).
2. For practice and therapy usage:
   - *The Social Work Dictionary* (5th Ed.). (Barker, 2003).
   - *APA Dictionary of Psychology*. (VandenBos, 2007).
   - *The Penguin Dictionary of Psychology* (4th Ed.). (Reber, Allen, & Reber, 2009).
   - *A Student's Dictionary of Psychology* (4th Ed.). (Hayes & Stratton, 2003).

3. For research usage:
    - *The SAGE Dictionary of Statistics and Methodology* (5th Ed.). (Vogt & Johnson, 2016).
    - *Pocket Glossary for Commonly Used Research Terms.* (Holosko & Thyer, 2011).
    - *APA Dictionary of Statistics and Research Methods.* (Zedeck, Harlow, Blozis, & Panter, 2014).
    - *Quasi-Experimental Research Designs.* (Thyer, 2012).
    - *Experimental and Quasi-experimental Designs for Generalized Causal Inference*. (Shadish, Cook, & Campbell, 2002)
    - *Research Methods for Social Work* (8th Ed.). (Rubin & Babbie, 2014)
    - *Handbook of Mixed Methods in Social Behavioral Research* (2nd Ed). (Tashakkori & Teddlie, 2010)

The Terms

Random: Two Vernacular Definitions and A Research Definition with Two Research Applications

Random has two related vernacular or general usage meanings, as well as a research meaning. The general usage definition is haphazard, chance, or occurring without intention or design. This is related to an informal or slang usage of unplanned, odd, or unexpected. In research, random refers to processes that are governed entirely by chance. Usually it refers to a process such as a coin toss; or one in which cases or units are assigned numbers, and then a table of random numbers is used to select the units. While the vernacular and the research meanings of random overlap, they also diverge. In this case the research meaning of the term is more precise than, and somewhat different from, the general usage dictionary definitions. Without explicit clarification students may assume that the three types of meanings overlap more than they do, and students may form an inaccurate understanding of the research meaning of random. For example, walking outside and asking whoever one sees to answer a questionnaire does not meet the criteria for a random sample, at all, yet it does meet the vernacular criteria of being unplanned and without design.

There is additional confusion about the word random in research, in that it is applied to different processes. The two major processes are random sampling and random assignment. *Random sampling* refers to a sampling method where the sample is chosen by chance only, and each individual in a population has the same independent probability of being chosen. Usually this sampling method employs a table of random numbers on the sampling frame to obtain the sample. *Random assignment* refers to using a method of assignment of cases to experimental groups, in which each case has an equal chance of being assigned to each condition, and the assignment is made entirely by chance. A coin toss or a table of random numbers may be used on the sample to assign cases to different experimental conditions. A further wrinkle is the term randomization, which usually refers to random assignment. Random sampling and random assignment are two different processes with two different names. One might think that they would not be confused; however, it is our experience that since both random sampling and random assignment begin with the word random, they are sometimes used interchangeably by students. Highlighting the difference between these two separate meanings has been useful.

Chance: A Vernacular Definition, a Research Definition, and Two Research Applications

The vernacular meaning of *chance* is somewhat imprecise, while its meaning in research is technical and specific. But then there are two uses of chance in research that are not as precise as the strict research meaning. In vernacular usage, chance refers to possibility, or accidental, or luck, or without design or premeditation. The general research meaning of chance is the likelihood of a particular event. Chance refers to a purely random process, such as is seen in using a coin toss or a table of random numbers. So, saying something occurred by chance in a normal conversation does not have the same meaning as saying something occurred by chance in a research context.

Moreover, there are two uses of the term chance in research that relate to but do not apply this strict definition of chance. Chance is used to refer to, first, the effects of extraneous unmeasured variables. Those effects may or may not actually be due to chance; they may be attributable to other variables that were not measured in the study. Secondly, while not definitional, chance is sometimes used for sampling error, the difference between a sample statistic used to estimate a population parameter and the relevant parameter. For example, the likelihood that a particular finding of a relationship between variables in a sample would occur where the variables are not related to one another in a population is sometimes referred to as by chance or sampling error. The problem here is that some of these differences (between estimates and the real parameters) are due to chance, but some of them may be due to systematic bias in how the sample was selected.

Therefore, chance should not be used to refer to all sampling error. We recommend using the term

sampling error instead of chance when referring to the difference between sample estimates and the actual population parameters. And it can be misleading to use chance to refer to the effects of unmeasured independent variables, also. More generally, while the overlap in the research definitions and uses can be helpful, it would be problematic and misleading to include the vernacular notions of chance in any of the research definitions. In research, we recommend using the word chance only for strictly random processes.

a (alpha): Three Research Definitions and Several Synonyms for One of the Definitions

The terms alpha level, p value, and Type I error can be confusing to students. While at a theoretical level they differ somewhat, they all refer practically to the same thing, namely, the likelihood that a particular relationship we observed in our findings through our study sample can be attributed to sampling error and not to the general veracity of our research hypothesis. To be statistically significant, the observed relationship's probability of occurring due to sampling error must be below a cutoff point that we have identified in advance as so low that we are willing to risk refusing sampling error as a plausible rival hypothesis. The cutoff point is called the level of significance. The p value indicates the actual probability for a particular finding that the finding is not generalizable to the population. Thus, $p < .05$ indicates that the relationship observed has a less than 5% chance of being observed by sampling error in the study sample; on the other hand, the finding has a 95% chance or more of being observed in population. Since our conclusion to accept/reject the null hypothesis and subsequently support/not support the research hypothesis is based on probability and not on absolute certainty, there is the possibility of making an erroneous conclusion. At this point in the process of learning statistics, students are introduced to Type I error, which is making a false-positive conclusion based on data, or of claiming a relationship where it does not really exist in the population. The probability of a Type 1 error is the same in practice as the *p* value. When a researcher reaches a statistical conclusion based on $p < .05$ level of significance, there is the same level of probability to commit Type I error. If the *p* value of a particular inferential finding is .02, then there is a 2/100 or 2% chance of making a Type 1 error, that is, of accepting the research hypothesis when the null hypothesis is accurate for the larger population.

In an effort to distinguish Type I error from Type II error, which is making a false-negative conclusion based on data, or of not claiming a relationship where it does really exist in population, a test's probability of making a Type I error is denoted by α while Type II error is noted by β. In this regard, p value and *a* value are used interchangeably.

These learners face another frustration related with *a*, when they learn Cronbach's α, a measure of the internal consistency or reliability of a measurement or scale. At this point, some students cry, “Too many alphas!” Regrettably, though, there is yet another use of alpha in basic statistics. It is also used as the symbol for the constant or the y-intercept in a regression equation defining a line. Alpha is used in the population form of the equation: $y = \alpha + \beta(x)$, while the sample form of the equation is $y = a + b(x)$.

As usual, we suggest drawing attention to the synonyms and the multiple meanings, as they arise, so that students understand the practical use of the terms when they encounter them. We also recommend using the terms p value or significance level in place of α level for the probability of a Type I error in a particular finding, and Cronbach's α for the indicator of internal consistency of a measurement.

Pre-test: Two Research Definitions

Pre-test has two research meanings. In experimental design, a pre-test is a measure of the dependent variable(s) that is administered before the introduction of the experimental independent variable. For example, in an intervention study where the intervention is supposed to reduce ageism, a pre-test would measure ageism before the intervention begins. The pre-test would usually also include measures of some other relevant variables.

In measurement, a pre-test refers to pilot testing a measure or data collection instrument before it is finalized and used to study the phenomenon. The nearly final version of the instrument is administered to a small number of people who will not be in the actual study in order to discover and fix any problems with the instrument. The purpose of a measurement pretest is to discover problems in the measurement instrument, so that the problems can be solved before the actual study begins. Pre-test is thus used with two distinct meanings in research. Usually the context makes clear which meaning of the word is intended, but the use of the same word can be problematic for students. Calling the testing of a measurement instrument a pilot test of an instrument while reserving the word pre-test for the usage in experimental design would be helpful.

Validity: Three Research Definitions

In research, the term validity is used in different ways. While there may be some overlap among all three meanings, in that validity always refers to stronger, more accurate, and more generalizable methods, we have found that the three different meanings are best differentiated

from each other. The term validity is used to describe the quality of a measure. Validity refers to whether a particular measure does indeed measure the concept it is intended to measure. It could more clearly be called measurement validity, but it is often just called validity.

Internal validity and external validity are terms that refer to study design, usually with respect to experimental and quasi-experimental designs. Internal validity is concerned with the issue of whether the studied independent variable(s) is (are) likely to be responsible for the effects that were produced on the dependent variable(s). The more likely it is that the studied independent variable, as opposed to other possible variables, is the cause of the relevant reactions in the dependent variable, the stronger the internal validity. There is no such thing as the internal validity of a measure; however, students often are confused between internal validity and internal consistency perhaps due to the same word: internal. Internal consistency is an aspect of measurement reliability. Internal consistency is about the issue of whether the different components of a scale or index correlate with one another and thus are or are not measuring the same concept. Internal consistency is about measurement reliability, not about measurement validity.

External validity refers to study design and is concerned with generalizability of study findings. The more generalizable the study's findings, the stronger the external validity. Students sometimes also talk about the external validity of a measure, but external validity refers to the generalizability of an experiment and is not about measurement.

Some students never sort out these differences and use these four terms ([measurement] validity, internal validity, internal consistency, and external validity) somewhat loosely and interchangeably, although they refer to very different phenomena. We recommend that the validity referring to measurement always be called measurement validity to assist in making the distinctions among these terms.

Mortality: A Vernacular Definition and a Research Definition

Mortality refers to death and being subject to death in general usage. In research, mortality refers to the dropping out of subjects in an experimental design that may or may not have an effect on the outcome of the study. The dropping out of the study may be a result of death, but it is more often an effect of losing interest in the study, leaving the area, not liking the intervention, etc. For example, if a good number of participants who are receiving the experimental intervention drop out, but the participants in the control group are more likely to stay in the experiment, then it becomes harder to interpret the findings because not only is there differential loss in the two groups, but also the participants who dropped out may be substantially different from those who remained in the experimental intervention.

Students need to be told that experimental mortality does not refer only to death, and that mortality can provide a threat to the internal validity of experiments. The use of mortality in research appears to be declining, while the word attrition may be gradually replacing it. This is a welcome development, as the meaning of attrition is much closer to the meaning of this threat. Students still need to be taught about the word mortality, because they may encounter it, but they can also be encouraged to use the word attrition instead.

Regression: A Developmental Theory Definition, and Two Research Definitions

In some theories of human development, *regression* refers to returning to an earlier and less mature level of development. It is posited to happen for a variety of reasons, for example, experiencing crisis or trauma at one level of development is thought to sometimes lead to regression to an earlier stage of development.

In research, regression has two other meanings. These two meanings overlap historically and at a high level of abstraction, but in their usage in most social science research and evaluation classes, the distinctions between them are far more important than their similarity. The first research meaning is that regression refers to a particular type of statistical analysis of the relationship between one or more independent variables and a dependent variable, ideally where all the variables are continuous variables. This may be called linear regression in the form of simple or multiple regression, logistic regression, or other types of regression analysis.

The second research meaning refers to regression toward the mean. This refers to the tendency of extreme scores to move closer to the average on subsequent measures. Groups of people with extreme scores from a measure administered at one time will, when tested again at a later time, have a tendency to move closer to the mean. This is a threat to internal validity that is often relevant in intervention studies. So, for instance, if a community health center collected data about recent substance abuse on intake forms, then offered an intervention to those whose substance abuse scored at the highest levels, those people on average would tend to show improvement in subsequent questioning about substance abuse, whether or not the intervention was beneficial, because of regression toward the mean. At the intake, some of the individuals scoring the highest would be individuals whose substance use was consistently very high, and some of the individuals scoring the highest would be individuals who had just experienced an unusually high intake of substances in

the previous week or month. So overall the average of this group would tend to decline, getting closer to the mean, at the second measurement point.

Unhelpfully, the modifier statistical is sometimes placed in front of the word regression, but this does nothing to indicate if it thereby refers to the method of statistical analysis or to regression toward the mean; statistical regression may mean either one. Since the use of the term statistical regression adds to the confusion between the two research meanings, we suggest not using this terminology. To differentiate the three meanings of regression, as usual we point them out to students as they arise, and we also talk about the method of statistical analysis as regression and the threat to internal validity as regression toward the mean.

Triangulation: A Family Systems Practice Theory Definition, and a Research Definition

In family systems theory, *triangulation* refers to an interaction in which two people communicate or relate to each other through a third person. Sometimes two people who are experiencing difficulty in communication use a third person to try to communicate with each other indirectly. For example, the third person may be brought in to deflect or to act as an ally to one of the original pair or to transmit messages between the original pair. Sometimes the third person inserts herself or himself into the original pair for control or other reasons. In family therapy, triangulation is usually considered dysfunctional and harmful.

In research methods, triangulation refers to the use of two or more sources of information or interpretations on the same topic. The hope is that the different sources will reach the same conclusion to increase the credibility of the data. For example, a study may include both observation and self-report as methods of data collection. Another study may include both qualitative and quantitative components. A qualitative data analysis may be conducted by two or more different types of coders. This triangulation requires a minimum of two sources because the thing being studied constitutes the third point of the triangle. This concept of triangulation is loosely borrowed from trigonometry and surveying, in which the location of a third point can be determined when there are two other fixed points with a known distance between them, essentially by creating a triangle with the third point. This kind of triangulation, the use of multiple sources, provides extra evidence, and is considered valuable in research.

It is confusing to some students that triangulation refers to two quite different phenomena, and that triangulation is a negative in practice but a positive in research. In addition, due to the connotation of a triangle, some students assume that it requires the use of three sources.

Indications of the Effectiveness of Confronting the Ambiguities in Teaching

Compared to our earlier teaching experiences when we did not directly address these sources of confusion, we have noted improvement in students' understanding since we have started directly confronting ambiguities. As noted earlier, we ask students in our research classes to complete anonymous questionnaires during the first class meeting, as well as sometimes during the next-to-last class meeting. These questionnaires cover the students' attitudes and knowledge about research before and after taking research classes in their social work programs. Here, we report some of the qualitative data we have obtained through these questionnaires related to learning about research terminology. One question on the post-test asks students which aspects of the class worked well for them. (See Appendix for exact wording.) One student wrote, “Excellent and clear presentation of information.” Another said, “Cogent explanations—generally clear and easy to follow.” Another wrote that the instructor “[w]as a great explainer.” A student shared, “I feel much more confident with research terminology,” and another wrote, “I was able to complete my assignment with an understanding of what the terminology is, and what it’s about.” Responding to a more general question about the class, one student wrote, “Teacher was…helpful in clarifying terms.” Not that we are universally successful, for example, on the posttest, one student wrote, “I feel all the hard terminology and concepts were in (this class), and it was too much to absorb.” Quantitative data about the effectiveness of our research teaching and the classes in general are very positive.

Conclusions

We have argued that research terminology is an important source of difficulty in teaching research and that heretofore has not been satisfactorily addressed. Using multiple authoritative sources, we confronted and clarified some ambiguous terms. We recommend that research instructors in the social sciences address the ambiguity and clarify these terms. In our teaching, we talk about this problem early in the term by noting that ordinary, everyday meanings of words may not be relevant to their research meaning and that even in research a term may have two or more distinct meanings. Then we refer back to this discussion as the terms come up during the course. Often a brief mention with a slide about distinctions and overlaps will be sufficient. We sometimes make jokes such as, "There weren't

enough words, so they had to use this one three times!" Students appear primed to listen when these complications come up. Of course, drawing too much attention to these matters may sometimes increase rather than reduce confusion. We do not suggest that teachers belabor these concerns. This article is addressed to research teachers to suggest topics for clarification, but each teacher should gauge for each class how much detail to provide.

We do not have evidence from validated measures about improvement in our students' understanding of terminology, nor has our success in teaching these terms to students been compared to other methods of teaching. Probably there are even better ways of teaching these ambiguous terms; here we only provide the first steps of acknowledging the problem, drawing attention to it, and providing authoritative clarification.

We have made some recommendations here for alternative or modified terminology that assists in clarifying these terms. Some of these recommendations have a broader application than just to research instruction, and they could be beneficial for social science research in general.

In other cases, the terms remain ambiguous, and we only suggest attention to, and clarification of, the ambiguity. The field of social research is vast and multidisciplinary, so it would be difficult to move the field toward new, different, unambiguous terminology, although such a development would be very welcome.

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MARIA M. TALBOTT, MSW, PhD, is an Associate Professor Emeritus at the Portland State University School of Social Work in Portland, Oregon, USA. Her research interests are in social gerontology. She taught classes in aging, and research and evaluation for many years in the BSW, MSW, and PhD programs in Social Work at Portland State University.

JUNGHEE LEE, MSW, PhD, is a Professor and PhD Program Director at the School of Social Work, as well as a Senior Fellow at the Hatfield School of Government, at Portland State University. Her research interests are in social determinants of health especially focused on quality of life among Asian immigrant communities. Her teaching includes courses on: culture, values, and leadership in the Executive Master of Public Administration program, and (a) social welfare policy, (b) research methods and design, and (c) statistical data analysis in the Master of Social Work and Ph.D. Programs in Social Work at Portland State University.

Appendix

Exact Wording of Questions on Pretest and Posttest Student Questionnaires

Pre-test Questions (administered at the beginning of the first class meeting)

1. What are your negative thoughts and feelings about research and evaluation?
2. What are your positive thoughts and feelings about research and evaluation?
3. Are there particular hopes or fears that you have for this class that you want me to know about? For instance, are there certain topics you especially hope to learn about?

Post-test Questions (administered at the beginning of the next-to-last class meeting)

1. What about this class (if anything) worked well for you?
2. What about the class did not work well for you? What things did not produce learning? What could have been done better? Do you have suggestions for improvements?
3. Anything else you want to say about the class or the instructor?