Michael C. Loui, *Purdue University and University of Illinois at Urbana-Champaign*
Renata A. Revelo, *University of Illinois at Urbana-Champaign*

Cooperative Learning and Assessment of Ethics Sessions in a Summer Undergraduate Research Program

In 2010, the U.S. National Science Foundation (NSF) began requiring instruction in research integrity for all students, including undergraduates, who are supported on NSF research grants. Since then, administrators of undergraduate research programs have taken increased interest in providing instruction in research ethics and, specifically, in the responsible conduct of research (RCR).

In social-science programs, advanced undergraduates typically learn about responsible conduct of research in a course on research methods (Punch 2013; Ware and Brewer 2013). In engineering programs, undergraduates learn about professional ethics instead of the responsible conduct of research (Alfredo and Hart 2011). In the natural sciences, little is known about the instruction that undergraduates typically receive in appropriate research practices (Heitman and Bulger 2005), although some instructors have taken the initiative in integrating coverage of responsible research conduct into undergraduate courses and curricula (Fisher and Levinger 2008).

Undergraduate programs in computer science have generally included significant attention to ethical issues in the discipline. Since 1987, the guidelines of the Computer Sciences Accreditation Board have required undergraduate programs in computer science to provide a substantial amount of instruction on social, ethical, and legal issues in computing (Huff and Martin 1995). Curriculum recommendations developed by the Association for Computing Machinery and the Computer Society of the Institute of Electrical and Electronics Engineers have also emphasized instruction in social, ethical, and professional issues (Tucker 1991). These accreditation guidelines and curricular recommendations have significantly influenced the content of all computer science programs. By 1995, about 300 courses on computer ethics were offered in the United States (Crawford 1995). In a random survey of 700 computer science programs in 2005, out of 251 respondents, 172 programs included instruction in computer ethics in required courses (Spradling et al. 2008).

Standard textbooks on ethics in computing (for example, Johnson 2009; Quinn 2005; Tavani 2004) address issues in professional ethics and social ethics, including intellectual property, privacy of individual data on the Internet, malicious software, software risks, and hacking. They neglect ethical issues in computing research, however (Wright 2006).

In this article, we describe the design and assessment of sessions on research ethics and computer ethics in a summer research program for undergraduates. We collected assessment data at the beginning and end of the summer program.

Ethics Sessions

In the summers of 2009, 2010, 2011, and 2012, the Information Trust Institute at the University of Illinois at Urbana-Champaign hosted a summer undergraduate research program focused on reliable and secure computing. This eight- to ten-week program was supported by a grant from the NSF Research Experiences for Undergraduates (REU) Sites program. Most students were majoring in computer science, computer engineering, or another technical discipline. The number of summer students varied from 21 to 26. Each summer, ten domestic students were supported by this NSF grant, a few domestic students were supported through a different REU site grant, and the remaining students, who were international, were supported by other funds.

Each summer's format included six weekly sessions on ethics in the responsible conduct of research (RCR) and in the development and use of information technology. The sessions addressed topics such as authorship standards, plagiarism, mentoring relationships, conflict of interest, privacy of personal data, professional responsibility for software quality, accuracy of computational models, and the social impacts of computers. We chose these topics for their relevance to the students' research projects. We omitted standard RCR topics that were not relevant to these students, such as the responsibilities of peer reviewers and the protection of human and animal subjects. Even the traditional RCR topics of fabrication, falsification, and data management were not relevant for many projects that involved the development of software or the mathematical analysis of algorithms.

To address the ethical topics we focused on, we selected fictional but realistic short cases (scenarios) from a variety of sources (Table 1).

Table 1: Ethics Cases Used in 2009 Summer Program

Week	Topics	Cases and sources
1	Authorship, plagiarism	"Case 1" (Penslar 1995, 31-32); "The Charlie West Case" (Bebeau 1995, 30-31)
2	Mentoring, conflict of interest	"A Question of Mentoring Bias" (Online Ethics Center for Engineering and Science 2006a); "The Endless Dissertation" (Online Ethics Center for Engineering and Science 2006b); "A Conflict of Commitment" (Committee on Science, Engineering and Public Policy 2009, 45)
3	Professional responsibility, software quality, confidentiality of intellectual property	"Software Risks" (Anderson et al. 1993, 102-104); two short cases (see text)
4	Privacy	"Privacy" (Anderson et al. 1993, 100); "Using an Internet Search Engine to Locate a Friend" (Tavani 2004, 137-138); "Toysmart.com" (Tavani 2004, 145); Loyalty Cards [Discussion Questions 40, 41] (Quinn 2005, 238)
5	Social impacts of computers	"Data Mining at the XYZ Bank" (Tavani 2004, 132); "Hacker Ethic" (Tavani 2004, 158); Anonymity in a Political Election [Discussion Question 3] (Tavani 2004, 172); Violent Computer Games [Exercise 10.23] (Baase 2003, 433); Internet Filtering [Exercise 10.29] (Baase 2003, 434)
6	Ethics in computational modeling	"A Sonar Story" (Kijowski 2011, 90-92); "Looking for the Bright Side" (Kijowski 2011, 93-94); "Low Impact" (Kijowski 2011, 96-98)

For example, the following are two short cases that author Loui wrote and used in the third week of the summer program:

> In the early 1980s, Atomic Energy of Canada Limited (AECL) manufactured and sold a cancer radiation treatment machine called the Therac-25, which relied on computer software to control its operation. Between 1985 and 1987, the Therac-25 caused the deaths of three patients and serious injuries to three others. Who was responsible for the accidents? The operators who administered the massive radiation overdoses, which produced severe burns? The software developers who wrote and tested the control software? The manufacturer, AECL? A non-AECL system engineer who noticed the absence of backup hardware safety mechanisms?
>
> You designed the embedded system software for the engines that Galactic Motors hopes to use in future all-electric automobiles. Six months ago, you left Galactic for a managerial position with Forge Motor Company, a direct competitor. After a restructuring, however, Forge's vice president asks you to lead a design team to develop the control software for Forge's planned electric autos. The vice president hints that Forge is interested in the design concepts that you previously developed at Galactic Motors. How should you respond? For what reasons?

During the first summer program, we noticed that some of the students' research projects raised questions about individual privacy. To make the privacy issues immediately relevant to students, in 2010, 2011, and 2012, we replaced one of the privacy cases by short cases involving the privacy of human subjects in Internet-based research on social networking:

> A Facebook user has consented to participating as a subject in your research study of social networking. She reveals information not only about herself and her friends, but also her friends' friends. Under what circumstances can you publish research results about their social interactions?
>
> You are collecting a large amount of data from a social networking site. As you collect the data, you scrupulously replace actual names with numerical codes. Nevertheless, from the anonymous data, it is possible to infer the identities of individuals associated with their data. Under what circumstances can you publish your study?

In 2011 and 2012, we replaced the session on ethics in computational modeling by a showing and discussion of the 36-minute movie *Henry's Daughters*. This movie highlights ethical issues in a dramatized case in which engineers design an intelligent transportation system with autonomous vehicles (Loui et al. 2010). In ethics presentations for other REU site programs in the summers of 2013 and 2014, after the Information Trust Institute's REU grant had ended, we replaced some of the cases with short videos developed at the University of Nebraska—Lincoln (National Center for Professional and Research Ethics 2014). Each of these videos is less than four minutes long. We substituted the video cases for text cases because we expected that students would find

video cases more interesting and memorable. Our expectations were confirmed in the program-evaluation surveys at the end of each summer (not reported here).

The ethics sessions used active learning methods, specifically, collaborative and cooperative learning (Barkley, Major, and Cross 2005; Millis and Cottell 1997). We chose active learning through small-group discussion because, as McKeachie and Svinicki have said, "Discussion methods are superior to lectures in student retention of information after the end of a course; in transfer of knowledge to new situations; in development of problem solving, thinking, or attitude change; and in motivation for further learning" (McKeachie and Svinicki 2006, 58).

After a lunch provided by the program, in each 60-minute ethics session the students were randomly divided into small groups of four to six students. Each group simultaneously read and discussed the same case for about ten minutes. Then author Loui led a discussion of this case with the entire cohort. He asked different groups to respond to questions about the case for about ten minutes. The questions usually asked students to identify the ethical issues and to suggest what the characters in the case should do next, for what reasons. Then the session moved on to another case, again with simultaneous discussions in small groups followed by a discussion with the entire cohort. One session was organized differently: Each small group took responsibility for reading and answering questions about one of five cases dealing with the social impacts of computers. For the first ten minutes, all five groups read and discussed their case simultaneously. Then Loui interacted with each group in turn to discuss that case, while other groups listened.

At the beginning of the first ethics session of the summer program, we presented a general approach to ethical problems (Figure 1) that was inspired by the seven-step guide for ethical decision making developed by Davis (1997). Our general approach uses everyday language because, with limited time in a summer REU program, students need guidance in thinking about ethics issues without having to learn philosophical jargon (Schachter 2003).

Each student received a copy of the booklet *On Being a Scientist* (Committee on Science, Engineering and Public Policy 2009), which provides a basic overview of responsible conduct of research, the Association for Computing Machinery code of ethics (ACM 2014), and a book chapter on ethics for computing professionals (Johnson and Miller 2004). Students were not tested on these readings, however, and they were not assigned any other ethics homework.

Figure 1. A General Approach to Ethical Problems

1. Identify the affected parties, their interests (rights, expectations, desires), and their responsibilities. Determine what additional information is needed.
2. Consider alternative actions by the main actors, and imagine possible consequences.
3. Evaluate actions and consequences according to basic ethical values—honesty, fairness, trust, civility, respect, kindness, etc. —or the following tests:
   - **Harm test:** Do the benefits outweigh the harms, short term and long term?
   - **Reversibility test:** Would this choice still look good if I traded places?
   - **Common practice test:** What if everyone behaved in this way?
   - **Legality test:** Would this choice violate a law or a policy of my employer?
   - **Colleague test:** What would professional colleagues say?
   - **Wise relative test:** What would my wise old aunt or uncle do?
   - **Mirror test:** Would I feel proud of myself when I look into the mirror?
   - **Publicity test:** How would this choice look on the front page of a newspaper?

As learning outcomes, through the ethics sessions, we expected students to learn to identify the ethical problems or dilemmas, recognize the people affected and understand their perspectives, identify a comprehensive list of actions, and provide a justified action to resolve the ethical problem or dilemma.

Assessment

To assess the effectiveness of the ethics sessions in 2009 and 2010, we adopted the two-case method of Kraus (2008). We administered initial and final assessments, in which students analyzed two short cases. Case A highlighted ethical issues in information technology, and case B raised ethical issues in conducting research. The texts of these cases appear in the appendix.

One group of half the students received case A for the initial assessment at the beginning of the summer and case B for the final assessment at the end of the summer. The other group of students received case B initially and case A at the end. The domestic students and international students were equally divided between the two groups.

For each assessment, students were expected to take 30 to 60 minutes, working individually, without consulting any references. There was no limit on the lengths of students' responses. Students typed their responses into text documents

and sent the documents to one of the summer-program coordinators, who removed identifying information before printing the responses.

The learning outcomes were assessed by the rubric shown in Table 2, which follows our general approach to ethical problems shown above; Sindelar et al. (2003) developed a similar rubric for scoring student responses to ethics cases. To state the problem and check the facts, students had to identify the ethical issues in the case. To identify relevant factors, students had to identify who were the persons affected by the case. To develop a list of options and test the options, students had to identify the actions that the characters in the case could take. To make a choice, students had to justify their chosen action with appropriate reasons.

The students' responses from 2009 were scored by one author (Loui) using a rubric similar to the one in Table 2.

Table 2. Scoring Rubric for Assessment Case Responses

	Fair (1 pt)	Good (2 pts)	Excellent (3 pts)
Ethical Issues	Identified at least 1 ethical issue relevant to the case	Identified at least 2 ethical issues relevant to the case	Identified at least 3 ethical issues relevant to the case
Who is affected by this case?	Considered 1 or more affected parties mentioned in case without their perspectives	Considered 1, 2 or 3 affected parties mentioned in case and their perspectives	Considered at least 4 affected parties (or at least 3 affected parties, including at least 1 party not mentioned in the case) and their perspectives
Actions	Identified 1 or 2 practical actions to be executed	Identified 3 practical actions to be executed	Made a comprehensive list of at least 4 practical actions to be executed
What actions should they choose and why?	Provided a solution without argumentation	Provided a reasonable, realistic solution with argumentation	Provided a thorough, reasonable, realistic solution with argumentation and discussion of drawbacks, which led to a consensus

There was one minor difference in the rubrics used in 2009 and 2010. The 2009 rubric scores ranged from zero to two, whereas the 2010 rubric scores ranged from one to three. This difference was accounted for in the analysis of the 2009 data below by transforming the scores to correspond to the scores in the 2010 rubric.

Both authors scored the 2010 students' responses using the following procedure. We independently scored students' responses using a common rubric. There were four questions in the assessment pertaining to the case. The student's answer to each question was scored from one to three points. We compared our scores and discussed differences. After discussion and reconciliation, the combined scores differed by at most one point. We aggregated our independent scores to obtain a cumulative score for each student. As a result, a student could have obtained a maximum score of 24 points. Only after scoring did we learn which responses were initial assessments and which were final assessments.

In the summer of 2009, we had initial and final responses for seventeen students. In the summer of 2010, we had initial and final responses for eight students.

Because the numbers of students were small in both 2009 and 2010, we used the Mann-Whitney U test for independent samples to analyze the differences between the initial and final responses. The Mann-Whitney U test was appropriate because the data did not pass the Shapiro-Wilk normality test or a test of homoscedasticity. We aggregated the 2009 and 2010 data by case. Using the aggregated data, we compared the initial scores for case A with the final scores with case A; we used the same approach for case B. As noted above, the maximum score for any particular student, scored on the rubric shown in Table 2, was 24.

As shown in Table 3, the Mann-Whitney U test for independent samples signed-ranks showed that 2009 and 2010 case A initial scores (median: 16.5) did not differ significantly from the case A final scores (median: 18), $Z = 0.05$, $p = 0.98$. That is, in the two summers, we found no significant differences between the initial and final scores for case A. As shown in Table 3, the Mann-Whitney U test for independent samples signed-ranks showed that 2009 and 2010 case B initial scores (median: 16) did not differ significantly from the case B final scores (median: 16), $Z = 0.35$, $p = 0.74$. That is, in the two summers, we found no significant differences between the initial and final scores for case B.

Table 3. Results of Cases A & B

	Ranks			Test Statistics[a]	
	n	Mean Rank	Sum of Ranks	pre-post	
Scores on Case A					
Initial Ranks	14	12.9	181	Mann-Whitney U	78
Final Ranks	11	13.1	144	Wilcoxon W	144
Total	25			*Z*	0.05
				p (2-tailed)	0.98
Scores on Case B					
Initial Ranks	11	12.4	136.5	Mann-Whitney U	70.5
Final Ranks	14	13.5	188.5	Wilcoxon W	188.5
Total	25			*Z*	-0.35
				p (2-tailed)	0.74

*a. Grouping variable: Initial Scores

We suspect that there was essentially no difference in the initial and final scores because the content of the ethics sessions was not formally reinforced outside of the sessions through additional academic work. In addition, the ethics sessions might not have added significantly to the knowledge and skills of the students who had previously taken computer ethics courses that were required in their undergraduate computer science programs. On the post-test, the students may not have been motivated to complete the assessment to the best of their abilities. At the end of the summer, because the students may have focused on finishing their projects, they may have put only minimum effort into the post-test. For example, several students who earned low scores (less than half the possible points) on the post-test submitted one-line answers. Finally, our intended learning outcomes may have been too ambitious, and thus the assessment task was too difficult. As a consequence, students might have been unable to demonstrate what they had learned.

If the undergraduate research program had continued for additional summers, we could have either increased the attention to ethics, through homework and other academic activities, or reduced our expectations for learning outcomes. In addition, to complement the quantitative analysis, we could have conducted a detailed qualitative analysis of the students' responses to the assessment cases. With a qualitative analysis, we could have classified the different ways in which students thought about ethical issues, identified their conceptual difficulties, found strengths and deficiencies in their case responses, and described how their ethical reasoning developed over the course of the summer.

Conclusions

We have described how we integrated a series of sessions on ethics into a summer undergraduate research program at the Information Trust Institute (ITI). Other undergraduate research programs can implement a similar series of sessions that highlight ethics issues relevant to the programs' themes, using a cooperative learning pedagogy. As in the ITI sessions, students can learn about these issues by discussing short cases in small groups. Relevant cases can be found online at the Online Ethics Center for Engineering and Science (http://onlineethics.org) and at the National Center for Professional and Research Ethics (http://nationalethicscenter.org).

We believe that our assessment method can also be applied broadly. This method uses two short cases as pre- and post-tests. Students' responses to the cases are scored according to a simple common rubric. Using this assessment method, undergraduate research programs can assess the effectiveness of their series of ethics sessions in achieving the intended learning outcomes. As our experience suggests, however, even when the ethics sessions are taught with appropriate pedagogies, and when the assessments are aligned with the learning objectives, students might not demonstrate improved skills in analyzing ethics cases.

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References

ACM. 2014. "Code of Ethics and Professional Conduct." Accessed December 6. http://www.acm.org/about/code-of-ethics.

Alfredo, Katherine, and Hillary Hart. 2011. "The University and the Responsible Conduct of Research: Who is Responsible for What?" *Science and Engineering Ethics* 17: 447–457.

Anderson, Ronald E., Deborah G. Johnson, Donald Gotterbarn, and Judith Perrolle. 1993. "Using the New ACM Code of Ethics in Decision Making." *Communications of the ACM* 36(2): 98–107.

Baase, Sara. 2003. *A Gift of Fire: Social, Legal, and Ethical Issues for Computers and the Internet,* 2nd ed. Upper Saddle River: Prentice Hall.

Barkley, Elizabeth F., Claire Howell Major, and K. Patricia Cross. 2005. *Collaborative Learning Techniques: A Handbook for College Faculty*. San Francisco: Jossey-Bass.

Bebeau, Muriel J. 1995. *Moral Reasoning in Scientific Research: Cases for Teaching and Assessment*. Poynter Center for the Study of Ethics and American Institutions, Indiana University.

Committee on Science, Engineering and Public Policy, National Academy of Science, National Academy of Engineering, and Institute of Medicine of the National Academies. 2009. *On Being a Scientist*, 3rd ed. Washington: National Academies Press.

Crawford, Diane. 1995. "Editorial Pointers." *Communications of the ACM* 38(12): 5.

Davis, Michael. 1997. "Developing and Using Cases to Teach Practical Ethics." *Teaching Philosophy* 20(4): 353–384.

Fisher, Ellen R., and Nancy E. Levinger. 2008. "A Directed Framework for Integrating Ethics into Chemistry Curricula and Programs Using Real and Fictional Case Studies." *Journal of Chemical Education* 85(6): 796–801.

Heitman, Elizabeth, and Ruth Ellen Bulger. 2005. "Assessing the Educational Literature in the Responsible Conduct of Research for Core Content." *Accountability in Research* 12(3): 207–224.

Huff, Chuck, and C. Diane Martin. 1995. "Computing Consequences: A Framework for Teaching Ethical Computing." *Communications of the ACM* 38(12): 75–84. doi: 10.1145/219663.219687.

Johnson, Deborah G., and Keith W. Miller. 2004. "Ethical Issues for Computer Scientists." In *Computer Science Handbook*, 2nd ed., edited by Allen B. Tucker, 2-1 – 2-12. Boca Raton: CRC Press.

Johnson, Deborah G., with Keith Miller. 2009. *Computer Ethics*. 4th ed. Upper Saddle River, N.J.: Prentice Hall.

Kijowski, David J. 2011. "Responsible Conduct of Research with Computational Models and Simulations." M.S. Thesis, University of Illinois at Urbana-Champaign. Last updated January 14. http://hdl.handle.net/2142/18349.

Kraus, Rachel. 2008. "You Must Participate: Violating Research Ethical Principles Through Role-Play." *College Teaching* 56(3): 131–136.

Loui, Michael C., Jimmy H. Smith, Joseph R. Herkert, and Steven P. Nichols. 2010. "Special Session—*Henry's Daughters*: A New Engineering Ethics Movie." In *Proceedings of the 40th ASEE/IEEE Frontiers in Education Conference*, T4B-1 – T4B-3.

McKeachie, William J., and Marilla Svinicki. 2006. *McKeachie's Teaching Tips: Strategies, Research, and Theory for College and University Teachers*. 12th ed. Boston: Houghton Mifflin.

Millis, Barbara J., and Philip G. Cottell. 1997. *Cooperative Learning for Higher Education Faculty*. Phoenix: Oryx Press.

National Center for Professional and Research Ethics. 2014. "RCR Videos." Accessed December 6. https://nationalethicscenter.org/resources/42.

Online Ethics Center for Engineering and Science. 2006a. "A Question of Mentoring Bias." Last updated August 17. http://www.onlineethics.org/Resources/Cases/mentorbias.aspx.

Online Ethics Center for Engineering and Science. 2006b. "The Endless Dissertation." Last updated September 9. http://www.onlineethics.org/Resources/Cases/endless.aspx.

Penslar, Robin Levin, ed. 1995. *Research Ethics: Cases and Materials*. Bloomington: Indiana University Press.

Punch, Keith F. 2013. *Introduction to Social Research: Quantitative and Qualitative Approaches*, 3rd ed. London: Sage.

Quinn, Michael J. 2005. *Ethics for the Information Age*. Boston: Pearson Addison Wesley.

Shachter, Amy M. 2003. "Integrating Ethics in Science into a Summer Undergraduate Research Program." *Journal of Chemical Education* 80(5): 507–511.

Sindelar, Mark, Larry Shuman, Mary Besterfield-Sacre, Ronald Miller, Carl Mitcham, Barbara Olds, Rosa Pinkus, and Harvey Wolfe. 2003. "Assessing Engineering Students' Abilities to Resolve Ethical Dilemmas." In *Proceedings of the 33rd ASEE/IEEE Frontiers in Education Conference*, S2A-25 – S2A-31.

Spradling, Carol, Leen-Kiat Soh, and Charles Ansorge. 2008. "Ethics Training and Decision-Making: Do Computer Science Programs Need Help?" *ACM SIGCSE Bulletin* 40(1): 153–157. doi: 10.1145/1352322.1352188

Tavani, Herman T. 2004. *Ethics and Technology: Ethical Issues in an Age of Information and Communication Technology*. New York: Wiley.

Tucker, Allen B. 1991. "Computing Curricula 1991." *Communications of the ACM* 34(6): 68–84. doi: 10.1145/103701.103710

Ware, Mark E., and Charles L. Brewer, eds. 2013. *Handbook for Teaching Statistics and Research Methods*. New York: Psychology Press.

Wright, David R. 2006. "Research Ethics and Computer Science: An Unconsummated Marriage." *Proceedings of the 24th Annual ACM International Conference on Design of Communication*, 196–201. doi: 10.1145/1166324.1166369.

Appendix:

Case A

Analyze the case below *individually*. Do not consult other students. Do not consult any references.

At Colossus Corporation, vice president Kelly Kim has become concerned about the productivity of Colossus's office workers. According to personnel evaluation reports that Kelly has read, too many workers spend too much time using the Internet during office hours for personal tasks such as shopping on amazon.com and playing online games such as *World of Warcraft*. Kelly also worries that the office workers might divulge Colossus's proprietary information when they interact with customers.

Kelly asks Chris Patel, a software engineer in Colossus's information technology department, to monitor the Web accesses and the information transmitted by the office workers. To analyze this voluminous amount of data, Chris recommends that Colossus purchase a data mining program from Chris's domestic partner Robin Finelli. An independent software contractor, Robin had developed this program while previously employed by Banana Computers, without the awareness of anyone at Banana Computers.

Please answer all of the following questions. There is no limit on the length of your response; use as much space as you wish.

- What ethical issues does this case raise?
- Who is affected by this case? What are their perspectives on the case?
- What actions might the characters consider to resolve the ethical issues?
- Among these actions, which should the characters choose? For what reasons?

Case B

Analyze the case below individually. Do not consult other students. Do not consult any references.

The executive editor of the *Journal of Wondrous Technology Research* asks Professor Randy Gonzales to review a manuscript from the laboratory of Professor Morgan Nelson. Examining the manuscript, Randy discovers that although the theoretical ideas are novel and promising, the manuscript has numerous flaws: the literature review is incomplete, the description of the experimental method is internally inconsistent, the illustrations lack labels, and the statistical analysis is incorrect. Randy plans to refer the manuscript to a third-year doctoral student, Dana Wong, to enable Dana to learn from the manuscript's mistakes, and to give Dana experience in reviewing a manuscript, an important professional duty. In addition, Randy thinks that two theoretical ideas in the Nelson manuscript might help Dana overcome some obstacles that have blocked Dana's research progress for the last three months. One idea indicates that Dana's current approach is likely to be fruitless, and a second idea suggests a different path for Dana to take. Randy had previously speculated that the theoretical ideas might be true.

Please answer all of the following questions. There is no limit on the length of your response; use as much space as you wish.

- What ethical issues does this case raise?
- Who is affected by this case? What are their perspectives on the case?
- What actions might the characters consider to resolve the ethical issues?
- Among these actions, which should the characters choose? For what reasons?

Michael C. Loui
Purdue University and University of Illinois at Urbana-Champaign, mloui@purdue.edu

Michael C. Loui is the Dale and Suzi Gallagher Professor of Engineering Education at Purdue University. He was previously a professor of electrical and computer engineering and University Distinguished Teacher-Scholar at the University of Illinois at Urbana-Champaign. At Illinois he served as an associate dean of the Graduate College and as the campus's research integrity officer. He directed the theory of computing program at the National Science Foundation from 1990 to 1991. Loui currently serves as editor of the Journal of Engineering Education *and as a member of the editorial boards of* College Teaching *and* Accountability in Research. *He is a Carnegie Scholar and an IEEE Fellow.*

Renata A. Revelo recently completed the PhD in education policy, organization, and leadership at the University of Illinois at Urbana-Champaign, with a concentration in higher education. She also earned BS and MS degrees in electrical and computer engineering there. Her research interests include engineering education, experiences of underrepresented students, identity development, student engagement, and mentoring.