

THE "UNKNOWN STUDENT" SURVEY

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The Pilot Study of Cross-Discipline Statistics Education is an NSF-funded project designed to investigate the feasibility of integrating fundamental statistics and probability ideas into various subjects taught in middle and secondary school. A small collection of vignettes has been developed, reviewed and piloted in the area of English. A poem, titled "The Unknown Citizen" by W.H. Auden, is the basis for a unit that addresses the meaning of the term, "average," and the process of conducting surveys. This particular vignette has been reviewed by five middle and high school English teachers; and the survey portion of the unit has been implemented in a fifth grade classroom by the regular self-contained classroom teacher.

#### THE UNIT

"The Unknown Citizen" describes one person using information about the U.S. population from the Bureau of Statistics. The poem strikes a humorous note by attributing many of the "average" features of the population to a single individual. The teaching unit that has been developed to go along with this poem is divided into five vignettes. The first one deals with an investigation into the meaning of "average." After discussing unfamiliar terms in the poem, the teacher asks students to describe the "Unknown Citizen" in one word. Terms like "typical," "normal," and "average" are expected to arise, which sets the stage for a discussion on lay and statistical meanings of "average." Questions to be pursued include: Do the terms "normal" and "average" mean the same thing? Does "average" mean the same thing to most people as it does to a statistician? Can most people be portrayed as average? How many people would exactly fit Auden's description? Students are also asked whether they, themselves, are average. Outside of class students are asked to compare the "Unknown Soldier" to the "Unknown Citizen."

The second vignette further investigates what is meant by "average." Assuming that students of this age are better able to understand new ideas when related to their own environment and peers, students are asked to create their own Bureau of Statistics in order to find out what the "average" student is like in their own school. A student-designed survey provides the same type of information that Auden was poking fun at, and also provides students with an opportunity to understand "average" and "normal" from a statistician's point of view. This second vignette focuses on two aspects of surveys. First, the students are to determine which characteristics should be used in defining the average student. Second, they learn to write effective survey questions. The instruction begins by administering a short survey to students which includes ambiguous, unclear,

misleading and open-ended questions. In attempting to summarize information, they discover as a class what qualities make questions "good" or "bad" for assessing various characteristics through survey questions. Then each student is given a characteristic to assess. They write their own question in class and submit it to peer review and piloting.

The third vignette deals with the selection of participants in the survey. Various scenarios for the selection of participating students are presented and the discussion following is meant to bring out problems in sampling bias and procedural difficulties. Students are then introduced to some effective random sampling and stratified sampling procedures. Small groups of students work on proposals for implementing the survey. After each group presents its ideas, the class jointly decides how to implement the survey.

The fourth vignette addresses gathering, organizing and interpreting information obtained. After students have already administered the surveys outside of class, the response forms are literally cut up and sorted into the individual questions. Students then receive the raw data for their own question and represent it in various forms. (Since this is written for eighth or ninth grade, an assumption is made that students have some familiarity with various data representations). Once the students have visually represented their data, they must go about the task of answering the original question: What is the average student like? This is done through a writing assignment where students are asked to write a two-part description of their information. The first part factually summarizes the data and discusses trends that seem to be apparent. In the second part students can form conclusions and make conjectures about the reasons for patterns in data. This writing assignment requires well-formed paragraphs and sentences as well as well-formed understanding about what data seems to say about "average" students.

The final vignette requires students to integrate all the data gathered in a poem or essay similar in spirit to Auden's, titled "The Unknown Citizen." This work is to be based on shared information about the characteristics of the "average" students as determined by the whole survey. So, students are asked to take statistical information and rewrite it for a literary purpose. In essence, this final vignette asks students to wrestle the larger questions which they started with: Who is the average student? In what sense does he or she exist? The students will have come full circle, integrating technical and interpretive skills, hopefully realizing both play a role in understanding the concept of average.

#### CLASSROOM TEACHER REVIEWS

Teacher reviewers were asked to answer various questions about this unit. The five English teachers answered the questions in terms of how they perceived most English teachers would respond. There was general consensus that this unit best fits into grades 8 to 10. There were very diverse feelings about how well the statistical aspects of the unit enhanced English curricular goals. Two teachers felt very positive about the use of a survey to help students better understand the literary aspects, while two felt very negative. One teacher was somewhat neutral. The reviewers were generally confident that English teachers could handle the statistical aspects and also felt that the unit could be incorporated into the curriculum. All the teachers felt that the first vignette of the unit was appropriate for an English class, but once the survey began, opinions were split. Two of the teachers felt that the survey part was more appropriate for a Social Studies class. One of these teachers said that most English teachers would question whether it was their job to teach students how to write effective questions or to address issues in sampling procedures. On the other hand, two teachers thought the survey process was an excellent means of attaining "English" instructional goals.

In general, all the teachers felt the units provided important and valuable instruction. The main concerns were whether the survey aspects would be perceived as important by English teachers, especially when high school curricular goals are already so full. Teachers who were in junior high school team teaching situations viewed the possibilities of implementing such a unit in a more positive light than high school teachers.

#### FIFTH GRADE PILOT

The teacher of a self-contained fourth-fifth grade classroom at the Baker Demonstration School (National College of Education) was introduced to the unit through one of the authors. She was quite excited about the opportunity to do an interdisciplinary unit. Upon analyzing the poem itself, she decided that "The Unknown Citizen" was too difficult for her level of students, but was intrigued with the idea that the term "average" in everyday life seems to have a different meaning than in statistics. She began by asking students in her class who thought they were "average," to please stand up. All but two students stood up and the unit began. They went through the second, third, fourth and fifth vignettes over a period of one month. The teacher embellished the unit greatly as she prepared students for the data organization, representation and summarization. Since the students were only in fourth and fifth grades, the teacher did not assume that they had a working knowledge of these areas. So, they covered many aspects during their math time and practiced their new skills by gathering and representing data for a social studies project.

Finally, the class was ready to create and conduct their own survey. Characteristics were decided upon and questions were written, reviewed and piloted. The plan for the selec-

tion of participants involved putting everyone's name into a hat, thoroughly mixing the names and then drawing fifty. They checked for a balanced representation of grade levels and sex. The survey was administered by the students and the data was gathered, organized and represented. Finally, the contact author spent one morning with the children to help them pull together all the information in order to answer the larger question: Who is the average student in the school? After writing their own summaries and conjectures, the author found the youngsters surprisingly able understand ways to combine and use large portions of the whole class data to answer their original question about the "average" student. They used sound reasoning and flexible thinking as they considered various ways one can interpret data for different purposes.

The assignment in the final vignette took on the form of a limerick (rather than a poem) about the "Average Baker Demonstration School Student." These were presented by the children in an all-school show. Two illustrations of the limericks are shown below:

My best friend has two point two cars.  
She says she comes from Mars.  
She hit a Mercedes Benz and  
Knocked in her front end, and  
That's why she has two point two cars.

My dog is both female and male.  
It likes to chase its tail.  
It is like the people at my school,  
'Cuz the mode is both female and male.

When the unit ended, the students were asked, who was the average Demonstration School student? Not one student claimed the honor. When asked why no one seemed to fit the description exactly, the students responded that no one is average in every way. They went on to explain that most of the students were close to average in most ways, so most students were "kind of" average. This intuitive understanding about the importance of distribution and clustering about the middle indicated that even these young children could develop some basic ideas about distribution.

After the unit was completed, the teacher and one of her students wrote companion articles about the survey project. They were submitted to The Arithmetic Teacher, which is the elementary school journal of the National Council of Teachers of Mathematics. After being reviewed by a panel of teachers and mathematics educators, the companion articles were accepted for publication during the 1987-1988 school year.

#### CONCLUSIONS

The purpose of the Pilot Study of Cross-Discipline Statistics has been to determine the feasibility of integrating statistics into middle school and high school English classes. Two major conclusions have resulted from work with this particular unit. The first conclusion is

related to teaching and learning processes. It appears that survey research at the level described in this unit can be taught by non-mathematics/non-statistics teachers and can be learned by children as young as fourth and fifth grade.

The second conclusion is that factors outside the teaching/learning processes in the school environment also affect the feasibility of implementation. First, the already existing curricula of a particular school can affect the feasibility of implementation. For example, at the high school level, it may be that the curriculum is so tight that teachers may feel they cannot afford to include a unit such as "The Unknown Student." However, at the junior high school level, the curriculum appears to be more flexible and teachers seem to find the unit more appealing. Another factor in the school environment is the underlying philosophical view

of interdisciplinary studies. Most high schools are highly departmentalized and teachers, as well as students, have strong ideas about what fits and what does not fit into an "English" class. It is likely that an interdisciplinary unit would not be perceived as exactly fitting into any particular department. At the middle school level, however, many teachers believe that interdisciplinary teaching is valuable. Further, there are often "team" situations where a group of specialist teachers are responsible for the same set of students. These two aspects make it more likely for a unit such as the one described here to be included in the middle school curriculum than in the high school.

It is encouraging to know that children can apparently understand some very basic ideas about survey research. But the issue of implementation is complex and highly influenced by the school environment.