DOCUMENT RESUME

ED 479 497 SE 067 937

AUTHOR	Novemsky, Lisa
TITLE	Second Teaching: A Study of Small Group Physics Learning.
PUB DATE	2003-08-07
NOTE	9p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (Philadelphia, PA, March, 2003).
PUB TYPE	Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS	Educational Improvement; *Group Instruction; Higher Education; *Physics; *Science Instruction; Summer Programs

ABSTRACT

Many students have not succeeded in traditional science education. Second teaching is a new pedagogical construct - a model of small group activity designed to follow initial instruction, or first teaching - developed after watching successful small groups at work. Following Vygotsky's ideas, second teaching works to facilitate individual learning processes in a diversity of students who find a new academic domain foreign. In the process of second teaching, the collective wisdom of a small group acts as a mentor to individual learners. Many non- traditional students do well in a learning environment where second teaching is fostered. (Author)

ABSTRACT:

Second Teaching: A Study of Small Group Physics Learning
Lisa Novemsky, Ed.D., Assistant Professor
Brooklyn College School of Education
Presented at NARST, 2003 in Philadelphia, PA

Many students have not succeeded in traditional science education. Second teaching is a new pedagogical construct – a model of small group activity designed to follow initial instruction, or first teaching – developed after watching successful small groups at work. Following Vygotsky's ideas, second teaching works to facilitate individual learning processes in a diversity of students who find a new academic domain foreign. In the process of second teaching, the collective wisdom of a small group acts as a mentor to individual learners. Many non-traditional students do well in a learning environment where second teaching is fostered.

Second Teaching: A Study of Small Group Physics Learning

Lisa Novemsky, Ed.D., Assistant Professor

Brooklyn College School of Education

"Second teaching" (Novemsky, 1994, 1998) is an idea that was developed after a long period of observation of participants in an educational opportunity preparatory program at a public technological university. These students were successful in a small group setting pedagogical format. "Second teaching," follows the initial presentation of new ideas in lecture and/or text, "first teaching." The students were learning introductory physics using Alan Van Heuvelen's Overview, Case Study Method (Van Heuvelen, 1991) which emphasizes conceptual learning and involves small group learning with guided materials with successive approximations and multiple representations.

Objectives of the Study

The discipline of physics has evolved into a culture of relatively homogeneous individuals who have developed their own established practice with characteristic behaviors and language. The nature of physics communication involves a very precise set of lexical items and linguistic structures that are particular to physicists and those in closely related disciplines.

To many students standard English enhanced with physics parlance presents severe difficulties similar to confusion encountered when confronted with a totally foreign language (Lemke, 1990; Orr, 1987). Formal and precise language structures and vocabulary of scientific discourse tend to be distant from non-traditional physics learners and distinct from the natural language of students' peer cultures. An intervening process seems to be important for non-traditional learners to comprehend and thereby gain access to physics content. An educational experiment at New Jersey Institute of Technology (Gautreau & Novemsky, 1997) provided strong evidence that a reform model of physics education with small group practice or "second teaching" appeared to contribute to significantly greater student success in introductory physics learning than conventional instruction (lecture, lab, and recitation), particularly for non-traditional students who would not have been admitted to the university under time-honored guidelines.

Traditional and non-traditional physics students

Until recently there was a custom in science education in the United States wherein students were labeled according to early identification of unchanging abilities, such as spatial visualization, reasoning, and computation. Students were systematically categorized as fit or unfit to learn physics. Introductory physics courses served as gatekeepers for eliminating or "weeding out" those who did not have these initial skills. Individuals who did not succeed in physics were summarily excluded and went on to other studies that were not so strictly protected.

The general rule seemed to involve identifying a potential physicist and cultivating that individual. Successful candidates tended to be those who were able to create an internal image from a verbal text and lecture. Candidates were expected to be adept at scientific perception and abstract reasoning, as well as advanced language usage skills for reading technically challenging texts with understanding. It was assumed that these prized students would develop the art of question formation and explanation as needed. Implicit problem-solving skills, including problem categorization, approaches, logic, and mathematics were also expected to be fully present as pre-requisites for entering the exclusive gates to the physics classroom.

Many students graduate from high schools and enter colleges with major deficiencies in understanding of the subject of physics, and disconnected from the subject as traditionally presented. Of the many possible causes of widespread failure of success in studies of physics are teachers inability to teach physics; lack of preparation of students from previous courses; poor motivation on the part of students; the subject itself, often seen as boring and bearing no relation to real life; and the difficult math that is involved. In particular persons from minority cultures, women, persons with disabilities, and poorly prepared students were essentially left out of the physics stream, pursuing other studies and careers (Matyas & Malcom, 1991).

Women are among those who are seriously underrepresented in physics, "the coldest science" (Brush, 1991, p. 404; Fehrs & Czujko, 1992). Tobias (1990), who explored exclusionary aspects of introductory physics courses, states that science courses are unnecessarily difficult, distasteful and even dull for many students. The emphasis on problem-solving, competition for grades and lack of community among students, lack of personalization of subject matter, combined with a perceived authoritarian teaching style, has extinguished motivation to learn for many students, particularly women. A sociological theory based on status in small groups versus status in classrooms in the presence of an authority of high status (a teacher) states that small group interaction can facilitate gains in self-esteem and self-efficacy (Meeker, 1981) so desperately needed in certain minority groups, as well as in females involved in physics and math. The underrepresentation of women in physics and physics-related subjects may be a more complex issue than previously described.

Theoretical Underpinnings

First teaching describes initial presentation of new subject matter and/or problem-solving techniques. A lecture, a laboratory experience, or a text reading are possible formats, although in the context observed, a semi-traditional lecture format (lecture with provocative discussion) was preserved.

Second teaching is a practice that is based on two of Vygotsky's (1978, 1986) ideas. The first of these ideas involves the relationship of language and visual representations to learning. Rather than considering language and drawing purely as a means of communicating ideas, Vygotsky saw language and drawing as tools and cultural instruments for developing logical and analytic thinking and learning.

The second idea concerns the "zone of proximal development." In a highly complex dynamic relations between developmental and learning processes, Vygotsky argued that learning is converted into individual internal developmental processes in a "zone of proximal development," which is the distance between the actual developmental level of an individual as determined by the person's independent problem solving and the level of potential development as determined through problem solving with guidance or in collaboration with more capable peers. (Vygotsky, 1978, p. 86)

Second teaching occurs when the collective wisdom of a collaborative group acts as a mentor to its individual members. . For peer groups in general, this collective wisdom is most likely to fall within the zone of proximal development for most of its individual members. This collective wisdom is created then recreated through group collaboration (Novemsky, 1998).

A Study

A study was conducted with NJIT's Educational Opportunity Program students in a summer program. Identical pre-and post-tests were administered at the beginning and end of a summer program. Forty four students were asked to give written explanations for each of their chosen answers for five multiple-choice questions. A carefully composed concept test on basic mechanics concepts was administered to the participating students. Each multiple-choice question had space provided for students to explain their thinking. Explanations provided by the students were the focus of this study. Independent random sorts of 440 explanations, (44 for each of 5 questions on each of the two tests) were printed with no identifying information.

Overall, students improved significantly in physics knowledge suggesting that Overview, Case Study methodology, including second teaching, was effective in producing an increase in physics knowledge. Changes in physics knowledge ratings were calculated for each student by subtracting post-test physics knowledge ratings from pre-test physics knowledge ratings. With the exception of one student, all physics knowledge difference ratings were positive. Overall, students' knowledge increased by 2.33 points (on a ten-point scale).

Language clarity ratings were determined for each student's pre- and post-test on a ten-point scale. Difference in average language change was marginally significant at roughly one half point, showing that overall language clarity gains were small.

In addressing the major research question of this study, language clarity change and physics knowledge change were compared. For the overall population, the finding of a significant correlation (correlation coefficient of $r = 0.34$, $p<0.05$.)

Significance

The findings in this study appear to confirm the hypothesis that one of the cognitive factors that accounts for the success of second teaching in physics learning for non-traditional learners is the development of explanatory language in the context of learning physics. This study also suggests that second teaching serves as a useful form of pedagogy for developing scientific and technical discourse while learning a given domain of science.

References:

Brush, S. G. (1991, September-October). Women in science and engineering. *American Scientist, 79*, 404-419.

Fehrs, M. & Czujko, R. (August, 1992). Women in physics: Reversing the exclusion. Physics Today, 45, (8), 33-40.

Gautreau, R., & Novemsky, L. (1997). Concepts first—A small group approach to physics learning. *American Journal of Physics 65*(5), 418–428.

Lemke, J. L. (1990). *Talking science: Language, learning, and values.* Norwood, NJ: Ablex.

Matyas, M. L., & Malcom, S. M. (Eds.), (1991). *Investing in human potential: Science and engineering at the crossroads*. Washington, DC: AAAS.

Meeker, B.F. (1981) Expectation States and Interpersonal Behavior, In M. Rosenberg and R.Turner (Eds.), *Social Psychology: Sociological Perspectives*, (pp. 290-319) New York: Basic Books.

Novemsky, L. (1994). *The second teaching: Exploring a new pedagogy.* Paper presented at the Northeastern Section Meeting of the American Association of Physics Teachers, Ogoontz, PA.

Novemsky, L. (1998). *Second teaching: Cognitive factors in small group physics learning.* Unpublished doctoral dissertation, Rutgers University.

Orr, E. W. (1987). *Twice as less: Black English and the performance of black students in math and science?* New York: Norton.

Tobias, S. (1990). *They're not dumb, they're different: Stalking the second tier.* Tucson, Arizona: Research Corporation.

Van Heuvelen, A. (1991). Overview, case study physics. *American Journal of Physics 59,* 898–907.

Vygotsky, L. S. (1978). Interaction between learning and development. In M. Cole, V. John-Steiner, S. Scribner, and E. Souberman (Eds.), *Mind in society: The development of higher psychological processes* (pp. 79–92). Cambridge, MA: Harvard University Press (Original work published in 1935)

Vygotsky, L. S. (1986). *Thought and language.* (E. Hanfmann & G. Vakar, Eds. & Trans.). Cambridge, MA: MIT Press. (Original work published in 1934)

SE067937

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

ERIC Educational Resources Information Center

Reproduction Release

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title:
Second Teaching: A Study of Small Group Physics Learning

Author(s): Lisa Novemsky, Ed. D.

Corporate Source: School of Education, Brooklyn College

Publication Date: August 7, 2003

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, Resources in Education (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign in the indicated space following.

The sample sticker shown below will be affixed to all Level 1 documents

The sample sticker shown below will be affixed to al

Level 1

Level 2A

X

Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g. electronic) *and* paper copy.

Check here for Level 2A release, permitting reproduction and dissemina for ERIC archival collection subscrib

Documents will be processed as indicated pro
If permission to reproduce is granted, but no box is che

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche, or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Signature: Lisa Novemsky

Printed Name/Position/Title:
Lisa Novemsky, Assistant Professor of Education

Organization/Address:
School of Education
Brooklyn College
2900 Bedford Ave
Brooklyn, NY 11210

Telephone:
718 951-5061

Fax:
718 951-3115

E-mail Address:
novemsky@brooklyn.cuny.edu

Date: August 7, 2003

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, or, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:

Address:

Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:

Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
4483-A Forbes Boulevard
Lanham, Maryland 20706
Telephone: 301-552-4200
Toll Free: 800-799-3742
e-mail: ericfac@inet.ed.gov
WWW: http://ericfacility.org

EFF-088 (Rev. 2/2001)