

***TECHNOLOGY
USES IN
VARIOUS
CURRICULA***

.....

The National Student Research Center and the Student Research Center Approach to Instruction

John I. Swang, Ph.D.

**THE NATIONAL
STUDENT
RESEARCH
CENTER (NSRC)**



The National Student Research Center (NSRC) envisions educating children around the world to become humanitarian and ecological 21st century citizens in an ultimately diverse and highly interdependent, science and technology based, global community.

The National Student Research Center's teaching philosophy is one of educating the mind, touching the heart, and creating an intelligent and caring future generation. The NSRC believes in education to produce scientifically and technologically literate students who possess a repertoire of socially relevant knowledge and critical problem solving skills. Young people must acquire the ability to apply scientific thought and technological skills in a creative and productive way towards the betterment of their personal lives and the society and environment in which they live. The bottom line reality of the NSRC's teaching effort is to create the future. Therefore, it is our teachers' responsibility to provide their students with the "twenty-first century" attitudes, values, beliefs, skills, and global perspectives which will help them grow up to be rational and loving adults who care about themselves, their fellow humans, the environment, and the world as a whole.

The National Student Research Center (NSRC) at Mandeville Middle School in Mandeville, Louisiana, U.S.A. facilitates the establishment of Student Research Centers in schools across the United States of America and around the world. The NSRC disseminates the innovative, highly effective, and empirically validated Student Research Center approach to instruction. The instructional approach is an interdisciplinary, student centered, and high technology program dedicated to promoting higher order thinking skills, language arts skills, scientific process skills, and technological literacy. It is based upon the constructivist learning model and emphasizes:

- hands-on and inquiry learning in cooperative research teams directed towards conceptual understanding,
- authentic instruction in higher order thinking and process skills via the use of the scientific methods in ongoing student research in all subject areas across the curriculum,
- problem solving within a societal context,
- the integration of science with all other curriculum areas,

**STUDENT
RESEARCH
CENTER
APPROACH TO
INSTRUCTION**

- the use of high technologies such as computers, CD-ROM and laserdisc players, telecomputing networks, and
- the regular publication and circulation of student research in printed and electronic journals of student research.

The Student Research Center approach to instruction is grounded in an extensive body of educational and humanistic knowledge related to the teaching of science, the scientific methods, the research process, and higher order thinking skills. It emphasizes discovery/inquiry learning, hands-on learning, cooperative learning, inter-disciplinary study, independent self-directed learning, whole language instruction, problem solving learning, contract learning, and the student-centered curriculum.

The Student Research Center approach to instruction focuses the learning process on discovering knowledge rather than the memorization and recall of facts and figures.

**THE STUDENT
RESEARCH AND
PUBLICATION
PROCESS**

The Student Research Center approach to instruction emphasizes the use of the experimental and descriptive research designs.

The basic learning process emphasized by the Student Research Center approach to instruction includes the following steps for experimental research projects. First, students form cooperative research teams at the local or national level utilizing the NSRC's electronic school district. Cooperative research teams usually have no more than four members. Next, students choose a topic of study in which they have a personal interest and complete a Scientific Research Contract. The topic is most often, but not always, related to the curriculum content or thematic unit being studied. Then the students complete a scientific method time-line contract for completion of the experimental research project. They then write a statement of purpose or research idea. Next, students complete a review of the literature related to the research topic. Afterward, students develop a hypothesis to be tested. Then students develop a methodology utilizing a control and experimental group in which they clearly identify the dependent and independent variables. A list of materials needed to conduct the research is also developed.

Students usually spend two to three weeks actually conducting the experiment, making observations, and recording data in a systematic way. Afterward, students compile and complete an analysis of all data using simple statistics and present the data in chart and graph form. Then students accept or reject their hypothesis and write a summary and conclusion. Next, students form a student action committee to apply the infor-

mation they have generated toward the amelioration or further explication of the concept, topic, issue, theme, or problem they studied.

Each step of the research process must be expressed in written form and edited until it is letter perfect, grammatically correct, and scientifically sound.

Students then make a formal presentation of the research project to an audience at their school which is videotaped for review at a later date by teacher and students. Next, students compose an abstract of the entire written research project for publication in their local scientific journal and/or the nationally circulated printed and electronic journals published by the NSRC. Students then complete desk-top publication of their school-based journals and circulate them throughout the school and local community. Journals are catalogued into the reference sections of all school libraries. The journals of student research are published on a regular basis during the school year.

The learning process is basically the same for survey research projects, except that students develop a methodology utilizing a “students questioning students” format. In this research, the measurement of attitudes and opinions, sound questionnaire development practices, and random sampling techniques are emphasized. Here the students construct a questionnaire about their research topic. Then they draw a random sample of the school’s student population to which they administer the questionnaires. Questionnaires can also be distributed to other students across the nation and around the world using the NSRC electronic school district. Once the questionnaires are completed and returned, the students score them and analyze the responses. Students then proceed with the research and publication process as explicated above for the experimental design.

It should be noted that all learning activities listed above are just as applicable to students who choose to work individually.

SCIENTIFIC RESEARCH PROJECTS

Each research project becomes the focus for the authentic use of language arts, quantitative, higher order thinking, and technological skills in productive and relevant activities of scientific inquiry and literary publication.

STUDENT WRITING, EDITING, AND ABSTRACTING SKILLS

Student work in each step of the scientific method must be expressed in written form. It is very important that peer and teacher editing of the written expression for each research step be completed before moving on to the next step of the process. All written work must be grammatically correct, letter perfect, and scientifically sound before it can be accepted by

the teacher for placement in the student's exhibit portfolio and later publication.

Editing of all written work is first done by students in cooperative learning groups. One-on-one teacher/student editing is done afterwards. Students should be taught and required to practice editing skills which will allow them to easily correct errors in spelling, punctuation, capitalization, grammar, vocabulary, sentence structure, order of presentation, organization of paper, and clarity of ideas.

After the entire research project has been completed and the research paper written, students must summarize their work into an abstract for publication in the local and/or national printed or electronic journals of student research. The abstract writers must include all the main ideas and supporting details, and reword and reorganize information in order to ensure that the abstract accurately reflects the text of the research paper.

QUANTITATIVE SKILLS

The Student Research Center approach to instruction emphasizes the application of mathematical skills by requiring students to use random sampling techniques in collecting survey data, and simple statistics, percents, averages, frequency counts, charts, and graphs in the analysis of data.

Students are also encouraged to scientifically investigate math concepts such as probability theory, number theory, the Pythagorean theorem, divisibility rules, magic squares, Pi, etc. Here students use the scientific methods to prove many of the math concepts which they have learned by rote from teacher lecture over the years and have taken for granted as being true without any real understanding.

HIGHER ORDER THINKING SKILLS

The Student Research Center approach to instruction teaches the four "R's" of education: Reading, Writing, Arithmetic, and Research. The research process utilizing the scientific methods is emphasized in order to develop higher order thinking skills (HOTS) in students. Bloom (1956), in his great work: A Taxonomy of Educational Objectives: The Classification of Educational Goals, and Brunner (1977), in his classic: The Process of Education, have clearly demonstrated that the scientific methods are some of the most objective, logical, rational, and highest forms of thought. Too often, the classroom curriculum is oriented to lower order thinking skills such as memorization and recall of facts and figures. The Student Research Center approach to instruction moves away from passive student drill and memorization of facts and figures. Instruction moves toward active, hands-on, problem solving, student-centered involvement in the

scientific research and publication process as a mechanism for learning higher order thinking skills, as well as broad concepts, facts, and figures.

The scientific methods and the research process are excellent vehicles with which to teach numerous higher order thinking skills in an interactive and enjoyable way. Each step of the research process affords meaningful opportunities for students to utilize the following critical thinking skills: comprehension, conceptualization, hypothesizing, designing plans, observation of detail, comparison, deriving relationships, analysis, evaluation, assessment, synthesis, interpretation, drawing conclusions, generalizing, application, composition, and abstracting. The scientific methods and research process are also emphasized to insure that scientific reasoning is an integral part of the hands-on experience which might otherwise become a thoughtless performance of routinized tasks.

SCIENTIFIC METHOD AND HIGHER ORDER THINKING SKILLS

SCIENTIFIC METHOD SKILLS	BLOOM'S HIGHER ORDER THINKING SKILLS
1. STATEMENT OF PURPOSE RESEARCH IDEA	1. CONCEPTUALIZATION
2. REVIEW OF LITERATURE	2. COMPREHENSION
3. DEVELOP HYPOTHESIS	3. APPLICATION HYPOTHESIZING
4. METHODOLOGY	4. DESIGNING PLANS
5. LIST OF MATERIALS	5. DESIGNING PLANS
6. OBSERVATION @ DATA COLLECTION FORM	6. DESIGNING PLANS
7. BEGIN EXPERIMENTATION/ OBSERVATION AND DATA COLLECTION	7. OBSERVATION MEASUREMENT
8. ANALYSIS OF DATA (SIMPLE STATISTICS/CHARTS/GRAPHS)	8. ANALYSIS DERIVING RELATIONSHIPS COMPARISON EVALUATION ASSESSMENT
9. SUMMARY AND CONCLUSIONS	9. SYNTHESIS INTERPRETATION DRAWING CONCLUSIONS GENERALIZING
10. APPLICATION	10. APPLICATION
11. COMPLETE REPORT DUE	11. COMPOSITION
12. ABSTRACT DUE	12. ABSTRACTING
13. SEND TO LOCAL/NATIONAL JOURNAL	13. PUBLICATION

This emphasis on the teaching of higher order thinking and process skills through the curriculum-wide utilization of the scientific methods and research process is targeted not only to gifted students, but to all students, with special emphasis directed toward at-risk, minority, female, and handicapped students who have traditionally lacked mastery of scientific and mathematical skills and are significantly under-represented in the scientific professions. With the Student Research Center approach to instruction, the teaching of the scientific methods and the research process is a creative art requiring teacher and students of all learning abilities to utilize the highest forms of rational and intuitive thought in all subject areas across the curriculum.

ELECTRONIC SCHOOL DISTRICT

The NSRC's telecomputing network on America OnLine and the Internet facilitates an international Electronic School District where students from distant schools have the opportunity to participate in cooperative student research teams and inter-school research projects, exchange scientific data, query a support team of professionals about their topics of study, and send research abstracts to the NSRC for publication in its printed and electronic journals and databases of student research.

THE NATIONAL DATABASE OF STUDENT RESEARCH

The national database of student research contains one-page abstracts of all student research projects published in the printed and electronic journals of student research. Research abstracts are stored in the database in small files which can be easily searched and retrieved by reviewing the Table of Contents attached to each. The Table of Contents lists the titles of the student research abstracts contained in the file. Files are catalogued into the database in chronological order. The subject area in which the research took place is also noted. For example:

E-Journal Vol. 1, No. 2 Nov., 1992
 NSRC Math Database Vol. 1, No. 3 Jan., 1993
 NSRC Science Database Vol. 2, No. 5 April, 1994
 NSRC Language Arts Database Vol. 3, No. 4 Sept., 1993
 NSRC Social Studies Database Vol. 1, No. 1 Aug., 1992
 NSRC Consumerism Database Vol. 3, No. 4 March, 1994

Students and teachers can browse through the listing of published abstracts and download files of interest. The abstracts contained therein can be used in several different ways. Teachers will find the abstracts to be a wonderful classroom resource for student use. Students can "piggy back" on the abstracts and replicate the research projects described. The abstracts may serve to stimulate original student ideas regarding topics of study. The abstracts provide excellent models for a sound scientific

ELECTRONIC AND PRINTED JOURNALS OF STUDENT RESEARCH

methodology. Students can also cite a published abstract as a reference in the Review of Literature section of their own research projects.

The National Student Research Center's scientific journal of student research in the printed format, THE STUDENT RESEARCHER, is published quarterly. It is freely distributed to students and schools which participate in the research and publication process. The Center has published 24 editions of THE STUDENT RESEARCHER which have contained over 2,000 abstracts of student research projects. The Center has circulated over 4,500 copies of THE STUDENT RESEARCHER to students, teachers, schools, and libraries in the St. Tammany Parish School System, the State of Louisiana, the nation, and around the world since its inception in 1988. The journal is permanently catalogued into the reference section of all school libraries in the St. Tammany Parish School System and elsewhere.

The National Student Research Center also publishes an electronic journal of student research, THE E-JOURNAL OF STUDENT RESEARCH. The electronic journal is published quarterly. Each issue of the electronic journal contains abstracts of exemplary student research from around the country. Current and past issues of the electronic journal are housed in the NSRC's Electronic Libraries

The NSRC's THE E-JOURNAL OF STUDENT RESEARCH is the first of its kind in the history of K-12 education.

ELECTRONIC LIBRARIES

Electronic journals and databases of student research are maintained in the NSRC's Electronic Libraries and are freely available to teachers and students for search and retrieval of information at three different locations.

The E-Journals and databases are housed in the NSRC's Electronic Library located in America Online's Electronic School House (KEYWORD: ESH). Once in the Electronic School House, Apple users should select PROJECT LIBRARIES AND EXCHANGES. PC and Mac users should select the SCHOOLHOUSE PROJECT LIBS icon in the lower right corner. Then highlight NATIONAL STUDENT RESEARCH CENTER for access to the Library. Users can then highlight journals or databases and get descriptions in order to review titles of research abstracts before down-loading.

The E-Journals and databases are also housed in the NSRC's Electronic Library located on the National Public Telecomputing Network. Telnet to nptn.org and sign on as VISITOR. Then select THE SCIENCE CENTER. Then select NATIONAL STUDENT RESEARCH CENTER

for access to the E-Library. Then select E-JOURNALS AND DATABASES. Users can then highlight journals or databases for perusal before downloading.

The Electronic Library is also housed on the Technology in Education Research Center (TERC)'s The Hub. Users should gopher to hub.terc.edu to access The Hub or follow this menu path when connected to a gopher: GOPHERS AROUND THE WORLD \ NORTH AMERICA \ USA \ MASSACHUSETTS \ THE HUB. Once in, select RESOURCES FOR MATH AND SCIENCE EDUCATION. Then select SCIENCE. Then select NATIONAL STUDENT RESEARCH CENTER ELECTRONIC LIBRARY to view e-journals and databases before downloading.

Students interested in submitting an abstract for possible publication in the scientific journals or inclusion in the national database may do so via the NSRC's Electronic School District. All submissions will be acknowledged by the editor.

The efficacy of the instructional approach has been empirically demonstrated in two studies conducted during the 1991-1992 and 1993-1994 school years.

The purpose of the first study entitled, "The Impact Of The Student Research Center Approach To Instruction Upon Cognitive Abilities", was to determine the effect of active student involvement in the Student Research Center approach to instruction upon overall cognitive abilities.

The Student Research Center approach to instruction emphasizes the scientific research and publication process in which students initiate and conduct research projects, utilizing one of the scientific methods, in all subject areas of the curriculum throughout the school year.

The year long emersion in the use of the scientific methods requires students to utilize numerous higher order and critical thinking skills. Each step of the research and publication process using the scientific method affords meaningful opportunities for students to utilize the following thinking skills: comprehension, conceptualization, hypothesizing, designing plans, observation of detail, measurement, comparison, deriving relationships, analysis, evaluation, assessment, synthesis, interpretation, drawing conclusions, generalizing, application, composition, and abstracting.

It was hypothesized that gifted students who master the scientific methods and actively participate in the research and publication process throughout the school year will have significantly larger increases in overall cognitive abilities than gifted students who do not.

EFFICACY OF THE INSTRUCTIONAL APPROACH

The methodology for testing the above hypothesis compared thirty-nine sixth grade gifted students who participate in the Student Research Center program at Mandeville Middle School (Treatment Group) with a similar group of thirty gifted students at comparable schools in the district who did not participate in the instructional approach (Control Group).

Pre- and post-measurement of selected cognitive abilities in the Control and Treatment Groups were performed at the beginning and end of the 1991-1992 school year. The Developing Cognitive Abilities Tests published by American Testronics, 8600 W. Bryn Mawr, Chicago, Illinois 60631, was used to measure cognitive abilities of knowledge acquisition, comprehension, application, analysis, and synthesis within the verbal, quantitative, and spatial content areas.

Because of the small number of gifted students in the sixth grade gifted program within the district, a random sampling of the students for placement in the control and treatment groups was not done. Therefore, an analysis of covariance was performed on the pre and post measurements for both groups. This statistical procedure equated the groups on their cognitive abilities scores so that any differences found after the study could be interpreted as a result of the instructional approach rather than any original difference in cognitive abilities which appeared due to the lack of a random sampling procedure when composing the control and treatment groups.

All students were in a gifted program utilizing a curriculum that is standardized by state and district requirements. All teachers were certified in gifted education and possess an M.Ed. degree. All gifted students in the study attended schools with similar populations, the majority of whom can be characterized as non-minority from the middle SES classes.

The Treatment Group of gifted students participated in Mandeville Middle School's Student Research Center program and received the Student Research Center approach to instruction. These students were actively involved in the student research and publication process in all subject areas of the curriculum and throughout the school year. These students conducted and published an average of 6.07 scientific research projects during the year in all subject areas of the curriculum. The Control Group of gifted students did not experience the Student Research Center approach to instruction. If a student in this group conducted scientific research during the school year, it was in the science area of the curriculum for the local Science Fair program. On average, these students conducted less than one research project during the year.

Findings of the study indicated that the treatment group of sixth grade gifted students receiving the Student Research Center approach to instruction emphasizing the research and publication process demonstrated significantly larger ($P=.01$) increases in overall cognitive abilities than the control group of sixth grade gifted students. Cognitive growth was most pronounced in the comprehension of knowledge including that of words, meanings, operations, numbers, relationships, and patterns ($P=.03$) and the ability to understand, apply, and transform mathematical operations, principles, and information in order to solve problems ($P=.01$).

The purpose of the second study entitled, "The Impact Of The Student Research Center Approach To Instruction Upon Language Arts Skills Achievement", was to determine the effect of active student involvement in the Student Research Center approach to instruction upon language arts skills achievement.

Students must express each step of the scientific method in written form. Each writing must be edited and rewritten until grammatically correct and letter perfect before acceptance for eventual publication in a journal of student research. Thus, in every subject area, language arts and writing skills are taught as an integral part of the research and publication process.

Consequently, students spend significant amounts of time in every subject area learning and using language arts skills. All students are capable of writing and publishing at least one research project in each subject area every semester. Many high achieving students are capable of publishing more. It was hypothesized that gifted students who master the scientific methods and actively participate in the research and publication process throughout the school year will have significantly larger increases in overall language arts skills achievement than gifted students who do not.

The methodology for testing the above hypothesis compared 26 sixth grade gifted students who participated in the Student Research Center program at Mandeville Middle School (Treatment Group) with a similar group of 34 gifted students in comparable classrooms at Mandeville Middle School who did not participate in the instructional approach (Control Group).

The California Achievement Test (CAT), published by CTB Macmillan/ McGraw-Hill, was used to measure language arts achievement. The California Achievement Test was administered to the students in the study at the end of the fifth grade (1992-1993 school year) and again at the end of the sixth grade (1993-1994 school year). Language mechanics such as punctuating sentences, phrases, and clauses; using standard writing conventions; and editing skills were measured. Language expres-

· sion such as recognizing standard grammatical usage; recognizing sen-
· tence parts and correct sentences; and identifying topic sentences and story
· structure in paragraphs were also measured.
·

· An analysis of covariance was performed on the 1992-1993 and
· 1993-1994 CAT Language Arts Scale Scores for both groups. This statis-
· tical procedure equated the groups on their language arts achievement
· scores so that any differences found after the study could be interpreted as
· a result of the instructional approach rather than any original difference in
· language arts achievement which might have appeared when composing
· the control and treatment groups (Elzey, 1985).
·

· All students were in the gifted program utilizing a curriculum that is
· standardized by state and district requirements. All teachers were certified
· in gifted education and possess an M.Ed. degree. All gifted students in the
· study attended classrooms with similar populations, the majority of whom
· can be characterized as non-minority from the middle SES classes.
·

· The Treatment Group of gifted students participated in Mandeville
· Middle School's National Student Research Center program and received
· the Student Research Center approach to instruction. These students were
· actively involved in the student research and publication process in all
· subject areas of the curriculum and throughout the school year. These
· students conducted, wrote, and published an average of 6.62 scientific
· research projects during the year in all subject areas of the curriculum.
·

· The Control Group of gifted students did not experience the Student
· Research Center approach to instruction. If a student in this group con-
· ducted scientific research during the school year, it was in the science area
· of the curriculum for the local Science Fair program. On average, these
· students conducted less than one research project during the year.
·

· The findings of the study indicated that the treatment group of sixth
· grade gifted students receiving the Student Research Center approach to
· instruction emphasizing the research and publication process demonstrated
· significantly larger ($P=.04$) increases in overall language arts skills
· achievement than the control group of sixth grade gifted students.
· Achievement was most pronounced in language mechanics such as punc-
· tuating sentences, phrases, and clauses; using standard writing conven-
· tions; and editing skills, and in language expression such as recognizing
· standard grammatical usage; recognizing sentence parts and correct
· sentences; and identifying topic sentences and story structure in para-
· graphs.
·

· It should be stressed that the Student Research Center approach to
· instruction can be used effectively with students of all learning abilities
·

and at all grade levels. The vast majority of students studying under the instructional approach are in the regular classroom in grades 1 through 12.

More information about the National Student Research Center and the Student Research Center approach to instruction and program development materials are available without cost via postal mailings. Requests should be sent to:

John I. Swang, Ph.D.

Teacher/Director

National Student Research Center

Mandeville Middle School

2525 Sout St.

Mandeville, Louisiana 70448

U.S.A.

Internet: nsrcmms@aol.com

America OnLine: NSRC MMS

FAX: 504-626-1640

Telephone: 1-504-626-5980 or 1-504-626-8778