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The effect of student journals on achievement in and attitudes toward science

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THE EFFECT OF STUDENT JOURNALS ON ACHIEVEMENT IN AND ATTITUDES TOWARD SCIENCE

by
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ABSTRACT

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THE EFFECT OF STUDENT JOURNALS ON ACHIEVEMENT IN AND ATTITUDES TOWARD SCIENCE
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The purpose of this action research project was to determine if: (a) writing in student journals affected the grades of my students, and (b) if student attitudes were affected by writing in journals and receiving teacher feedback. The research was conducted during the third semester at Triton Regional High School with a total of 49 tenth-grade students enrolled in two Laboratory Biology classes. Students in one class wrote in journals about teacher-posed topics for five minutes on average of once per week. The topics were written to encourage personalization of learning and further interaction with science. An attitude survey was administered to both classes in the beginning and again at the end of the semester. Responses from the pre- and post- test surveys for both classes were compared, as were each students' second and third semester grades. Data revealed no correlation between journal writing and achievement and a positive correlation between journal writing and student attitudes. Suggestions for further research and future use of journals in the classroom are discussed.

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Chapter 1: Introduction

Theoretical Perspective

Teachers constantly search for ways in which to engage their students in learning. This can be a difficult task if the students are not interested in the subject or if they do not understand the relationship between the subject and their own lives. It can also be a challenge if the classroom environment is not conducive to student input and the students are not aware of their impact in the classroom. Both the cognitive and affective needs of the students must be addressed in order to improve student learning and attitudes toward a subject (Cruickshank, Bainer, & Metcalf, 1999; Chiappetta & Koballa, 1994). One way to meet these needs and to give a student a voice in the classroom is to incorporate writing activities. Several writing strategies have been used to create learning environments which encourage student input and emphasize the role of the student in the classroom. These strategies include informal writing activities, KWL journals, student journals, dialogue journals, and learning logs (Steffens, 1991; Cantrell, Fusaro & Dougherty, 2000; Prain & Hand, 1998; Fulwiler, 1982; Hanrahan, 1999; Buehl, 1996).

According to Cruickshank et al. (1999), the psychological environment of a classroom includes "the emotional tone and how students feel about the teacher, learning tasks, and one another as a social group" (p. 464). Learning and motivation are both affected by the nature of the classroom environment. Several factors, including the needs of the students, must be considered in order to create a positive learning environment. Maslow's hierarchy of human needs places the need for safety and security as the most basic of human needs. Next, the need for acceptance, belonging, and recognition must be

met. The basic needs must be met before it is possible to continue through the hierarchy. Therefore, the students must feel safe and accepted in the classroom in order for learning to take place (Cruickshank et al.). Prain and Hand (1999) found that students who were allowed to express concerns, ideas and problems in the classroom demonstrated increased learning. Sometimes, however, not all of these can be addressed during class due to time constraints.

The cognitive, humanistic, and behavioral philosophies of education emphasize the importance of associating new information with past experiences in order to improve learning (Cruickshank, Bainer, & Metcalf, 1999). Students who are able to see a link between their own lives and the material they are presented with are more likely to become engaged with the material and remember it later. Cognitivists, who are interested in how material is processed, believe teachers should utilize techniques which incorporate student interests and use these interests as a springboard for future learning. The humanistic approach to teaching includes personalization of education by allowing students to make choices based on their interests. Behaviorists focus on external and environmental stimuli, including a students' past experiences, which change a person's behavior. Writing is one way to promote the formation of these associations with interests and experience, however it is a teaching strategy that can be easily overlooked in the science classroom.

Journals have been used in a variety of instructional settings with generally positive results. Both the research-based studies and the personal accounts by educators provide evidence for writing in student journals as a means for increasing learning and improving student attitudes about many subjects, including science (Cantrell, Fusaro, &

Dougherty, 2000; Jurdak & Zein, 1998; Fulwiler, 1982; Steffens, 1991; Hanrahan, 1999; Trombulak & Sheldon, 1989; Buehl, 1996). Journals may exist in many forms ranging from personal diaries to class notebooks and can provide students with a guided forum within which they relate was learned during a lesson to personal experience (Fulwiler, 1982). Journals also allow students to communicate personally with the teacher while conserving instructional time. Feedback from the teacher encourages the students to further explore what they wrote and take on a more active role in learning (Prain & Hand, 1999; Burniske, 1994). The journals also provide the teacher with feedback about student comprehension.

Current Research

My motivation for conducting this action research project was that I wanted to experiment with a teaching technique that I could eventually use in my own classroom. I wanted to find a way to incorporate affective learning by addressing student interests and encouraging my students to bring their own experiences into the classroom. I also felt it was important for the students to practice writing and communicating with others beyond English class. State and National Science Education Standards address the need to incorporate communication across all content areas, including mathematics and science. The New Jersey State Core Curriculum Content Standards for Science integrate communication to facilitate inquiry and problem solving. Writing can also be used to help students "recognize that curiosity, skepticism, open-mindedness, and honesty are attributes of scientists", which is a component of New Jersey Science Standard 5.1 (2002). The National Science Education Standards (1996) emphasize the need for

students to "formulate and revise scientific explanations" and "communicate and defend a scientific argument" as key components of scientific inquiry.

After reading several articles about student journals, I felt the journals would be an appropriate outlet to encourage student personalization of learning, improve communication between myself and the students, and as a result, increase student achievement. This action research is the first step of many as I fine-tune how journals are used in my classroom, learn how students respond to the writing topics, and incorporate new ideas into the project.

Based on past research with student journals, it seems reasonable to believe that achievement and attitudes may improve because students are encouraged to interact with and personalize the subject matter. The purpose of this action research project was to examine the effectiveness of science journal writing on improving student attitudes toward science and increasing student achievement in my science classroom. The following research questions guided this action research project: (a) Will the use of writing in student journals in my science classroom affect the grades of my students? and (b) What effect does keeping a student journal and receiving teacher feedback have on student attitudes about science?

In response to these research questions, I implemented writing in science journals with one of my tenth-grade biology classes. For the purposes of this study, the journal served as an outlet for the students to answer teacher-posed questions relating to the material being studied in class. The questions were used to allow the students to think about their learning, how it relates to their own lives, and to further interact with the

subject matter on a personal level. I responded to every journal entry and posed questions within my response to further stimulate interaction with science.

The variables affecting this research were kept constant as much as was reasonably possible in a classroom setting. The two classes involved in the research were similar in demographic and instructional level. I used the same curriculum to teach the classes, with the exception of the journals. All surveys were administered on the same day. The randomly chosen non-journal writing class was the control group in the study, while the journal-writing class was the action group. I feel these variables were reasonably controlled in a regular classroom setting and had minimal impact on the outcome of this project.

The following chapter discusses how my project relates to prior research about the effect of writing on student achievement in and attitudes toward a subject. In the beginning stages of my research, I used this literature to revise my idea based on what other researchers had tried and concluded. I designed my project to incorporate past research while tailoring it to my own classroom situation and time constraints. Chapter 3 provides information about the subjects, procedure, and instrumentation used in this study. The results are presented in Chapter 4, along with a discussion about the meaning of the data the extent to which the data answers the research questions. There are many things I learned throughout the course of the project that will have an impact on how I implement journals in my classroom in the future. These are discussed in Chapter 5.

Chapter 2: Literature Review

The role of teachers in today's society extends far beyond simply addressing the cognitive needs of the students. Most teachers not only want their students to learn, but also to experience some enjoyment from the material and subject. While it may be easy to consider cognitive and affective learning outcomes as separate entities, the two are actually strongly interconnected. Attitudes and values about a subject affect knowledge acquisition, and learning affects one's feelings toward the material (Chiappetta & Koballa, 1994). Literature reveals that writing exercises which encourage personalization of material creates a positive learning environment affecting achievement and attitudes toward many subjects, including science.

Many studies have addressed the impact of allowing students to use prior knowledge to construct meaning from new material. Allowing students to become actively involved in their own learning affects their ability to learn (Hanrahan, 1999). Writing across content areas, including in history (Steffens, 1991), social studies (Cantrell, Fusaro, & Dougherty, 2000), mathematics (Jurdak & Zein, 1998), and science (Prain & Hand, 1999; Hanrahan, 1999; Trombulak & Sheldon, 1989; Buehl, 1996) has been a commonly used teaching strategy to encourage student participation. Teacher feedback to writing helps emphasize the value the teacher places on student writing and helps to further improve the classroom environment (Fulwiler, 1982; Burniske, 1994).

Studies have shown that a critical component for improving learning is that students should be able to personalize the material by relating it to their own lives. Several psychological perspectives, including the cognitive, humanistic, and behavioral

schools of thought, emphasize the importance of internalization of information through associations with past experiences (Cruickshank, Bainer, & Metcalf, 1999). Lemke found that, unfortunately, many students have learned that science is authoritarian because in their experience only teacher-given information is important and valuable, while student input or feedback is unnecessary (as cited in Hanrahan, 1999). Students are accustomed to being passive learners and they accept teacher information unquestioningly as fact, even if their own personal experience does not concur. The question then remains: How can teachers begin to incorporate student experience with new learning to encourage student participation? There are many techniques teachers can use to facilitate the integration of student experiences with the subject matter. The incorporation of writing across content areas is a common strategy used to meet this objective, and it is strongly emphasized in state and national education standards.

Research has been conducted to discover writing strategies that encourage personalization of learning. Steffens (1991) incorporated informal writing activities into his college-level history classes by encouraging students to write. His students became more active and responsive as a result of writing what they already knew about history. Brainstorming was used to create lists of items related to a topic, then the lists were analyzed to create associations between the items. Each student chose one item and wrote why the item belonged on the list. Students had a very positive response to these activities because they realized they actually knew more about the topic than originally thought and were allowed to communicate feelings with classmates and the teacher. Steffens allowed students to interact with previous knowledge and construct new meanings without concern of immediate evaluation.

Cantrell, Fusaro, and Dougherty (2000) also studied the effect of writing on achievement in seventh-grade social studies through the use of KWL journals. While these journals were in a more formal design than what Steffens used, students were still encouraged to reflect upon what they knew about a certain topic (K), what they wanted to learn (W), and what they learned after reading a textbook passage (L). The results showed increased achievement for the students who used prior knowledge to learn new material in comparison to students who simply wrote summaries of the text. Writing is commonly incorporated into English, history, and social studies classes to improve student attitudes and learning, but it is a strategy that can also be used in mathematics and science classes to achieve similar results.

Journal writing in mathematics has many research-supported benefits. Borasi and Rose (1989) asserted that journals positively affect student feelings and attitudes and also improve problem solving skills and learning of mathematical concepts. The authors also point out the formation of a "beneficial supportive class atmosphere" as a result of the increased interaction between the students and the teacher (as cited in Jurdak & Zein, 1998, p. 412).

Jurdak and Zein also researched the effects of writing on achievement in and attitudes toward mathematics with 104 students ranging in age from 11 to 13 years. The teacher provided the students with cognitive and affective prompts to address in journal entries. An example of an affectively oriented prompt was: "How do you feel you did in your last math test? What concepts do you still find difficulty in? What did you do to overcome these difficulties?" (p. 415). The researchers found that journal writing positively affected achievement in some areas of mathematics, including conceptual

understanding, procedural knowledge, and mathematical communication. Journal writing did not have a positive impact on problem solving. A questionnaire was used to measure student attitudes toward mathematics. The 25-item Likert questionnaire assessed feelings when solving math problems, and the meaning and importance of doing mathematics. The questionnaire was administered as both a pre-test and post-test. Data from the questionnaire revealed no improvement in attitudes toward mathematics. This is in contrast to the positive responses from the same students about journal writing and its benefits in the classroom. Jurdak and Zein's qualitative data supported Borasi and Rose's (1989) conclusion about the formation of a positive learning atmosphere as a result of the writing activities. Students found journal writing to be enjoyable and "a vehicle for learning and self expression" while the teacher felt "journal writing provided a window to how the students thought and felt" (p. 418). These are indications that the benefits of writing in different content areas extend far beyond knowledge acquisition.

Prain and Hand (1998) studied the effects of various writing-for-learning strategies in the science classroom, including brochures, creative stories, rap songs, and concept and story maps. Interviews with students revealed that they "preferred writing tasks that involved them actively and personally in science learning, as compared with passive writing tasks" including coping notes off the board (p. 155). The writing tasks encouraged the use of metacognitive processes which resulted in increased learning, understanding, and retention of science concepts. The writing strategies helped to create a positive learning environment which lessened the authoritative nature of science, as discussed by Lemke (as cited in Hanrahan, 1999). These strategies, as used by the researcher, gave the students an "opportunity to develop their thoughts before

encountering authorized views" (p. 156). Student views and feedback were accepted and the students felt safe in expressing their ideas. Student comments also revealed an increased sense of ownership in the classroom and a general feeling that they had some control over their learning. One student wrote, "...usually [the teacher] writes things on the board...and it's very boring, it's not really our own work" (p. 158). A positive learning environment had been created by allowing the students to become active in the learning process, by diminishing the teacher-centered approach to science, and creating student ownership in the classroom.

Hanrahan (1999) also emphasized the concept that psychological factors in the classroom influence student learning. Before students can understand science and construct it in their own terms, they need to feel a sense of empowerment in the classroom. She stressed the "need to find new ways of teaching and learning...which take into account how students feel about participating in science learning, rather than concentrating most of our attention on intellectual factors in learning" (p. 701). One possible teaching strategy that has been utilized to address these issues is student journals. These journals can be used as a means of meeting student needs and allowing them to personalize their learning and improve their attitudes about science.

Fulwiler (1982) described student journals as an "interdisciplinary learning tool with a place in every academic classroom" (p. 15). Student journals come in a variety of forms and can have diverse uses depending upon the classroom situation and teacher goals. Writing in journals falls along a continuum between very personal student diaries and objective class notebooks as students incorporate their feelings and thoughts into specific topics of the academic subject at hand. Regardless of the format used by the

teacher, Fulwiler emphasizes that writing in journals works "because every time a person writes an entry, instruction is individualized" (p. 16) and the "act of writing/thinking helps students synthesize material for themselves, and so increases its value" (p. 19). Sometimes students will write what comes to mind at the time, with phrases including "I think" and "I guess". This type of writing is important as the student attempts to put the material into their own language and relate it to personal experience. Journals can encourage students to problem-solve by allowing stream of consciousness writing without worrying about grammar and sentence structure.

Value is increased because students think more deeply about the material as they summarize thoughts, pose and solve problems, personalize the material, reflect on their learning, and create an open line of communication with the teacher. Students can safely synthesize their experiences, thoughts, ideas, and concerns with the material in order to learn. Fulwiler stresses that "the value of coupling personal with academic learning should not be overlooked; self-knowledge provides the motivation for whatever other knowledge an individual seeks" (p. 30). Students can use journals as a metacognitive tool to learn more about how they learn. This self-knowledge then be used in other classrooms.

Fulwiler also outlines strategies for reading and evaluating student journals. While some teachers opt to not read student journals, Fulwiler feels that teacher review of student writing will help give the journals a sense of worth. A compromise between recognizing the potential personal nature of the journal and addressing the academic use of the journal would be to allow students to exclude any entry they do not want the teacher to read. The teacher can then decide to grade the journal based on quantity of

writing or use a credit/no credit arrangement. Of particular importance is that any feedback from the teacher should be positive in nature and free of negativity and criticism.

Another benefit of student journals, besides in the academic sense, is that student journals contribute to the creation of the safe and accepting learning environment stressed by Maslow. Expression of student thoughts and ideas is welcomed, not discouraged. As Steffens (1991) found, students responded very positively when they were allowed to express their knowledge without fear of immediate evaluation. Burniske (1994) stresses that this form of writing should be used to "encourage writing and thinking, not the acquisition of grades" (p. 85). Teachers should respond to student writing because while writing may be personal, "anyone engaged in it ultimately craves a response" (p. 85). Teacher feedback increases the lines of communication between student and teacher, enhancing the student's perception of their role in the classroom and in learning. Perhaps, then, students' attitudes toward science will improve due to the creation of a personal learning environment and a willingness to examine how science relates to individual lives.

A review of the literature reveals several studies that have been done to determine the value of student journal writing in and of itself and how the use of student journals relates to student learning and also student attitudes towards science (Hanrahan, 1999; Trombulak & Sheldon, 1989; Buehl, 1996; Jurdak & Zein, 1998). Hanrahan (1999) used action research to study the use of dialogue journals with first year high school students. While the students were given topics upon which to write, they were free to write anything they wished, and the answers were not judged for correctness. Over the course

of most of a school year, data were collected from the journals, students' exams, school meetings, and interviews with the cooperating teacher and the students. Hanrahan found that because of the increased communication between the teacher and students, the curriculum shifted "from being a teacher and text-centered one... to being one in which both the teacher and students thought the students' needs were being better understood and accommodated" (p. 707). Students also became more engaged in their learning as the classroom changed from a being teacher-centered to more student-centered. Interviews with the students revealed the students enjoyed writing in the journals because they were allowed to express opinions, make mistakes, take risks, contribute to the class, and think about learning. The use of student journals in this study seems to be "a likely contributor to a positive learning environment in science" (p. 713). The researcher does admit, however, that although the journals were very successful in this study, other strategies which personalize science concepts could be used to attain similar results.

Trombulak and Sheldon (1989) utilized journal-writing in two college level classes: a freshman-level general ecology course and a sophomore-level vertebrate biology course. The researchers used the journals as "a tool to encourage reflective observation" (p. 384) to see if journals could "influence a student's attitude about a subject or course" (p. 384). The courses were taught normally through the first half of the semester, then midway through the semester, the students were separated into writing and non-writing groups. A survey was administered to determine student attitudes about the course. For the remainder of the semester, the writing students were asked to write for at least five minutes at the end of each lecture about the suggestions provided. At the end of the course, the attitude survey was again administered to both groups.

At the end of the semester, the attitude survey data and grades were compared to determine if there was a correlation between attitudes, achievement, and journal writing. The researchers found no change in attitude between either group in either class, a finding similar to Jurdak and Zein (1998). The first survey revealed the attitudes of the students were relatively high anyway. Trombulak and Sheldon found it noteworthy, however, that "the additional work requested of the students in the writing group did not *decrease* their positive feelings about the subject" (p. 386). They also looked at the influence of journal writing on student grades. In the vertebrate biology class, the writing group's grades were two-thirds of a grade higher than the grades of the non-writing group. There was no difference in grades between the two groups in the general ecology class. The researchers attributed the difference between the two classes to the type of students enrolled in each class. The researchers concluded that simple journals have the potential to improve learning, but they must be customized to the class and students involved.

An action research project by Buehl (1996) investigated the use of learning logs as a strategy to encourage student internalization of learning. A learning log is the same as a student journal in that informal writing is used for reflection and thinking. Throughout the research, "students are encouraged to use learning logs to think about what they learn, and they practice using writing to internalize what they are studying" (Buehl, 1996, Research Question section, ¶5). The learning logs were collected and the teacher responded to what was written. Students found this aspect of the project very favorable. The researcher reported he "needed to let them know I valued their reflective comments so that they might value them as well" (Buehl, 1996, Discussion section, ¶16).

The journals helped to create a positive environment for the students while encouraging them to think about learning.

Several educators have written about their personal experiences with using student journals in the classroom. Jones (1991) used learning logs with ninth-grade earth science students and reports an improvement in lab report writing and an increase in opportunities to share their knowledge with their peers. Stanesco (1991) used student journals during a Geology field-trip course. He found the journals to be extremely useful because "it encompasses virtually every facet of the learning experience and also reveals the processes of questioning and problem solving undertaken by the student" (p. 205). Journals were implemented in an introductory geology course by Coles (1991) and were beneficial to both the students and the teacher. The journals led "to more active involvement of the students in the learning process" (p. 187).

The benefits of writing in science are supported by a solid research base. A common theme running through the research is the use of writing to encourage students to incorporate past experiences and learning into new material. Teacher feedback can help create a positive, safe learning environment and thus improve student attitudes. The current research incorporates many aspects of previous research discussed above.

Chapter 3: Methodological Approach

This action research project was designed to be conducted in conjunction with my student teaching assignment. I felt it was important that the two were not designated as separate entities, but that the information I gathered throughout the course of the research actually helped me improve my teaching while at Triton Regional High School and in the future. I plan to utilize journals as a teaching tool and this research helped me learn more about the possible relationship between writing in journals and student achievement and attitudes toward science. The sophomore-level students I taught during the semester were the subjects of the study and were representative of the school population, however I feel journals can be used with any combination or level of students. The procedure for the study was catered to the time restrictions involved and the needs of the students and myself, but could easily be altered to fit future needs. A student science attitude survey was administered to gather information about student attitudes both before and after the journals were implemented. I feel the survey was a useful tool to gather quantitative data about student attitudes.

Subjects

This study took place during the Spring of 2003 at Triton Regional High School in Runnemede, New Jersey where I completed my student teaching requirement. The subjects of the study were a total of 49 students in two tenth-grade college preparatory Laboratory Biology classes for which I assumed responsibility at the beginning of Triton's third marking period. Each class was a heterogeneous mix of students in terms of achievement, motivation, and personality. The students in the two classes were

comparable in terms of gender distribution and ethnic diversity. The journal-writing class consisted of a total of 25 students with 11 males and 14 females. The majority of the students were Caucasian, while one student was African-American and one was Indian. The non-journal class consisted of a total of 24 students with 11 males and 13 females. Two students were African-American and the remainder were Caucasian.

The curriculum taught during the study to both of the classes was identical as was the material taught prior to the third semester. The students participated in the same activities, labs, and discussions covering the same content, with the exception of the journals. Cooperative learning activities, group work, discussion, and lecture were all types of teaching strategies used to teach the material. Student grades were calculated based on the same assignments and grading rubrics.

Procedure

This action research study began during the second week of Triton's third marking period. This week was selected to begin the research because it was my first week of assuming full teaching responsibilities for both classes involved in the study. The subject sample was a sample of convenience and reduced the variables between groups. One of the two Laboratory Biology classes was chosen at random to be the journal-writing class, or action group, while the other class, the control group, did not write in journals.

This study was in the form of a non-random pretest/posttest control group design. The individual subjects were not randomly assigned to a group, therefore the data cannot be statistically generalized to the general population of biology students. After the action and control classes were designated, the second marking period grades were recorded for

all students. A pre-test science attitude survey was distributed to both classes on the same day (Appendix A). Journal-writing was then implemented with the action class for a total of nine weeks. The control class did not write in journals. At the end of the third marking period, student grades were recorded for both classes. The post-test attitude survey was identical to the pre-test survey and was distributed to all students in both classes. Quantitative data, the student grades and survey results, were collected to answer the research questions. The student grades were used to answer the first question and determine if writing in student journals affected the grades of my students during the semester. The data from the survey were used to determine if writing in journals and receiving teacher feedback affected student attitudes toward science. Qualitative data in the form of the sample journal entries were used to further answer the research questions.

In order to measure student achievement in both classes, the students' third marking period grades were recorded and compared to their second marking period grades. Numerical student marking period grades of both classes were recorded prior to implementation of the student journals and at the end of the study. The change in grade for each student was calculated and an average change in grade was determined for the entire class. The action group's average was compared to the control group's average. No test of statistical significance was done because of the limited generalizability of the data due to lack of randomization. This data were more appropriately subject to an analysis of practical significance.

The two classes chosen to be involved in the study were given the attitude survey during the beginning of class on the same day in the beginning of the third marking period. I instructed the students to read each item thoroughly and honestly answer the

questions based on how they felt about science. Several measures were taken to help ensure respondent truthfulness in the student attitude survey. In order to guarantee anonymity, I informed the students that they need not put their name on their survey. Honesty was critical and the student answers had no impact on their grades. Data from the student attitude surveys were compiled by item number and an average rating on a Likert scale was calculated. Data from the five questions in the survey that were worded negatively were adjusted to facilitate a comparison with the other questions. Pre-action averages for each item were compared to post-action averages for each class. Then the change in averages for the control group was compared to the change in averages for the journal-writing group. The statements on the survey could be grouped into three categories based on their similarities. Four statements addressed how students feel in science class: I am always under a terrible strain in class, I have a good feeling toward science, I am happy in science class, and I feel relaxed in science class. Three statements focused on personalization of science: I think science is important only at school, The things we study in science are not useful to me, and We learn about important things in class. The remaining five questions concentrated on student enjoyment of science: I enjoy science class, Science is fun, I really like science, Science is the subject I dislike the most, and Science activities are boring.

The students from the designated journal-writing class began writing in their journals one week after the pre-test attitude survey. Prior to implementing the journals, the students were informed of the guidelines for the journals. The journals were not intended to be used as personal diaries. The journals would not be graded based on content, which I hoped would help increase the likelihood the student wrote their

feelings, not what they thought I wanted them to write. There was no required response length.

The journals were in the form of several pieces of lined paper stapled together with a plain, white piece of paper on the top to act as a cover. The students were asked to write their names only on the front, not on the inside of the journal. The journals were kept in the classroom in a designated area. On journal-writing days, I wrote the journal question on the board prior to class (Appendix B). Upon entering the classroom, the students retrieved their journals and began to write for approximately five minutes while I took attendance and prepared for the day's lesson. The questions guiding the students' journal entries were open-ended and encouraged thought and personalization of learning. I chose the journal topics based on my desire to stimulate the students' cognitive and affective domains of learning. I hoped to encourage the students to spend more time interacting with the material on a personal level in order to increase achievement. I also wanted to stimulate thought about the importance of science and how it is involved in everyone's lives. The students returned the journals to a table by the door as they left class at the end of the period.

I read and responded to every entry. The responding time per entry was three to five minutes. The students were not judged based on the correctness of their responses. Rather, I provided comments intended to stimulate further thinking about the subject, offer alternate viewpoints, and promote personalization of the content area. I also posed questions and the students were encouraged to respond. All comments were constructive in nature and never negative. The journal exercises continued until the last week of my student teaching experience, which was two weeks after the end of the third marking

period. At the end of the study, the students were allowed to keep their journals. Sample entries were photocopied and used as examples of student writing in this final report.

Instrumentation

The attitude survey used in this study contained a list of 12 close-ended statements that the students answered on a five-point Likert scale. The range of answers were "strongly disagree" (1) to "strongly agree" (5). The statements in the survey were chosen from a survey the researcher obtained from Dr. Cinaglia of Rowan University. Additional statements were chosen from the *Student Science Attitude Survey* used by the GK – 12 Fellows Program sponsored by Southwest Missouri State University and the National Science Foundation (http://www.gk-12fellows.smsu.edu/formsandreports.htm). The posttest was exactly the same as the pretest.

The data obtained from the student attitude survey was in the form of forced choice responses. Seven of the questions were worded such that positive attitudes toward science were indicated by higher number responses. Five questions were opposite in that a low response number by the student indicated a positive attitude toward science. Upon analyzing the data, the scale was reversed for these questions in order to facilitate a comparison of the data. A student response of "strongly disagree" with a value of one indicated a highly positive attitude toward science. Consequently, all ones were changed to fives and all twos were changed to fours to agree with the scale for the positively worded questions.

These surveys have been used in other forums and are considered to be reliable and valid. The final statistics from the attitude survey were reported as pre-test means

versus post-test means per statement for each group. The average change in response per question was also calculated to further compare the two classes.

Chapter 4: Results and Discussion

The goal of this research project was to determine if: (a) writing in student journals affected the grades of the students, and (b) if student attitudes are affected by writing in journals and receiving teacher feedback. Both cognitive and affective domains of learning, which are important aspects of teaching, were addressed in this study,. Student needs and prior experiences are factors which affect new learning. If students are given the opportunity to interact more with these experiences and link them with new experiences, perhaps in a journal, increased achievement may result. This achievement was measured in this study by comparing each students' second semester grade in Laboratory Biology class with their third semester grade. Additionally, if students are given the opportunity to have more of a voice in the classroom and their feedback is considered to be important and valued, then attitudes about the subject may improve. A pre- and post-test attitude survey was administered to determine if writing in journals had any correlation between changes in attitude and journal-writing. The data were able to answer the research questions to an extent, but more importantly the information gathered during the study can be used to shape future studies.

Results of Grade Comparison

Student grades were recorded both before the journals were implemented and at the end of the project in order to measure student achievement during the study. The grades were recorded the same way and at the same time for both classes. Each student's second semester grade in the class was compared to their third semester grade in the class. All grades were rounded to the nearest whole number and were expressed as a

percentage out of a possible 100%. For each student, the two grades were compared and the change in grade from the second semester to the third semester was recorded. An improvement in the grade was expressed as a positive number, while a grade decrease was expressed as a negative number (Table 1). For example, a student who earned a 75% for the second semester and an 81% for the third semester had a change in grade of +6. The average change in grade for each class was calculated and the non-journal class was compared to the journal class (Figure 1).

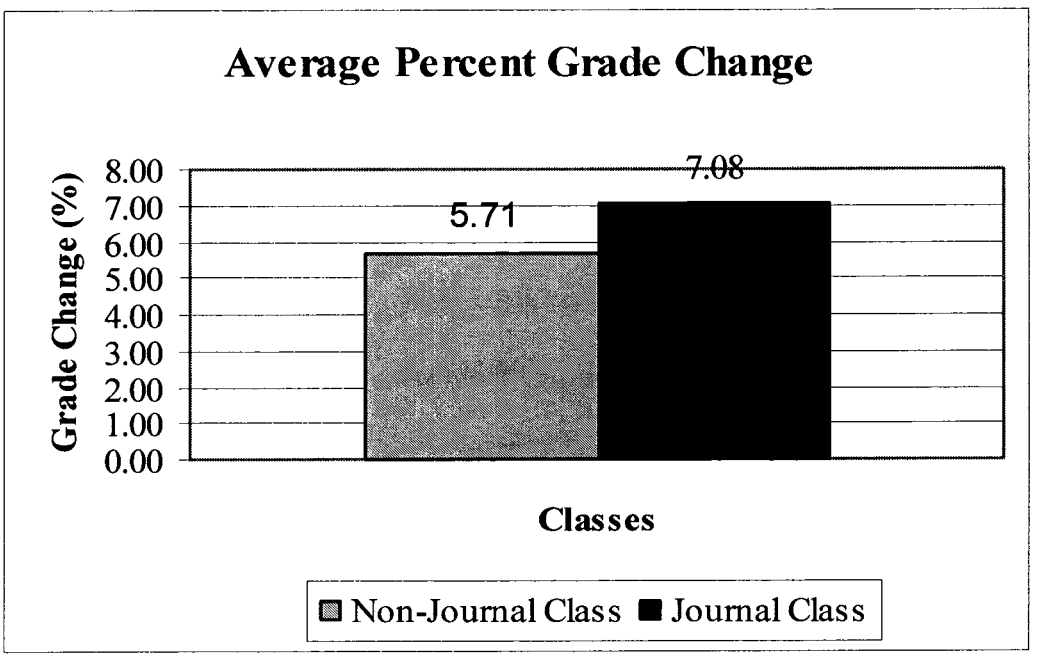
Both classes showed a positive average grade change. The students in the non-journal class (n=24) showed a change in grade ranging from -8 to +19 (Table 1). The average change in grade was +5.71%. Four students' grades decreased, three students did not show a change in grade, and seventeen students improved their grade in the class. The students in the journal class (n=25) showed a change in grade ranging from zero to +17 (Table 1). Two of the twenty-five students did not change their grade, while the remaining students improved their grade to some degree. The average change in grade was +7.08%.

Results of Survey

Both classes completed the Student Science Survey on the same day in the beginning of the third marking period. The answers from each question were compiled and the average response for each question was calculated. At the end of the third marking period, the students in both classes again completed the survey. The average response for each statement was calculated and compared to the results from the first survey. The change in response was calculated by subtracting the first survey average from the second survey average.

Figure 1: Average Percent Grade Change

A comparison between the average percent grade change from second semester to third semester for the non-journal class and the journal class.*



*The change in grade for each student in a class was added, then divided by the total number of students in the class.

Table 1: Non-Journal Class Grades vs. Journal Class Grades

Difference between each students' third semester cumulative grade and second semester cumulative grade.**

Non-Journal Class	
Student #	Change in Grade
1	+15
2	+3
3	+2
4	+11
5	+8
6	+6
7	+1
8	+7
9	+13
10	+19
11	+14
12	0
13	+17
14	0
15	-4
16	0
17	+9
18	+5
19	+12
20	-1
21	-8
22	+4
23	+7
24	-3
Average Change	+5.71

Journal Class	
Student #	Change in Grade
1	+2
2	+16
3	+5
4	+4
5	+3
6	+1
7	+7
8	+6
9	+14
10	+4
11	+8
12	+15
13	+13
14	+4
15	+2
16	0
17	+5
18	+13
19	+8
20	+5
21	+2
22	+17
23	+11
24	0
25	+12
Average Change	+7.08

**Positive number indicates a grade increase from second to third semester. Negative number indicates grade decrease from second to third semester.

Five of the items on the survey were written as negative statements. A response of a high number to these items indicated agreement to the statement and thus, a more negative attitude toward science. In order to facilitate a comparison between all statements on the survey, the data compiled for these five questions (#1, 6, 9, 10, 12) were adjusted to reflect a positive statement. All answers of 5 were changed to 1, while all answers of 4 were changed to 2, and vice versa. The average response for each statement was calculated based on these changes. In the remainder of this paper, when I refer to one of these statements it will be reworded into its positive form. For example, question #12 on the survey reads "Science class activities are boring". If a student answered with a 5 "Strongly Agree", then the student thinks the activities are boring. After rewording the statement, #12 reads "Science class activities are not boring" and the students answer would be changed to a 1 "Strongly Disagree". The changes in wording and response number do not alter the meaning of the students' responses.

The twelve statements in the survey were grouped into three categories based on the focus of each statement. The affective domain of learning was addressed with four statements focusing on how students feel in science class, and five statements used to learn more about student enjoyment of science. The remaining three statements concentrate on cognitive aspects of science and were used to determine the extent to which students relate science to their own lives.

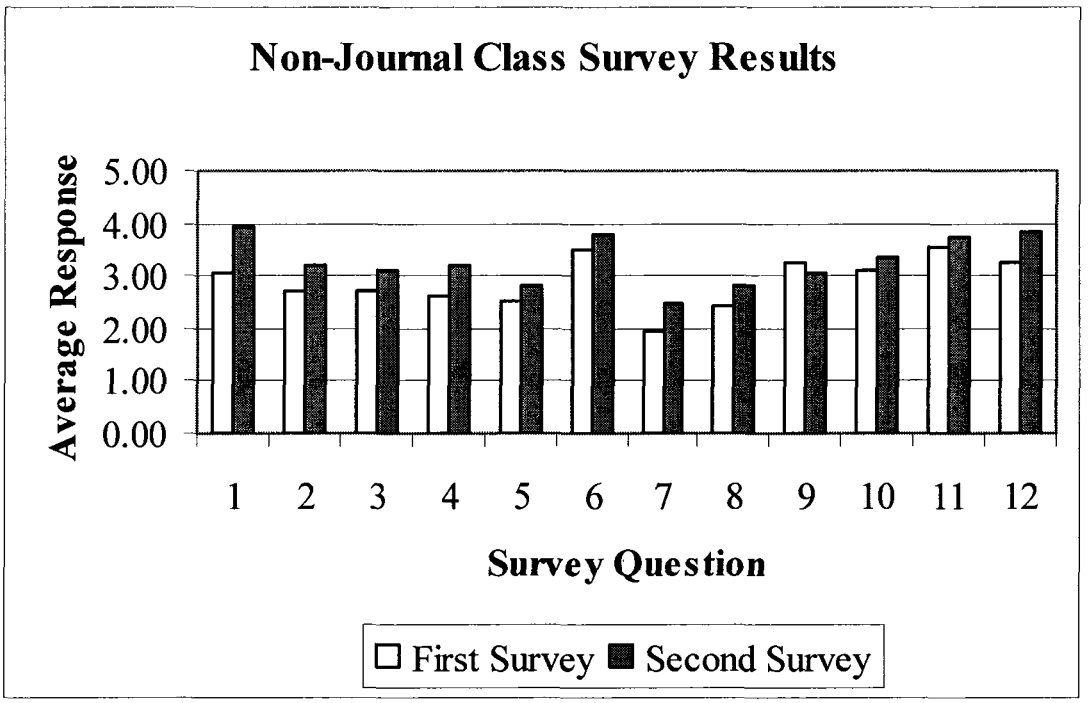
The data from the two classes were compiled separately then compared. As seen in Table 2, the non-journal class showed a range in responses (n=23) on the first survey from 1.96 (#7: I am happy in science class) to 3.57 (#11: We learn about important things in class). For the second survey (n=24), the range was 2.48 (#7: I am happy in

science class) to 3.92 (#1: I am never under strain in science class). The change in score when the first survey was compared to the second, ranged from -0.19 for "Science is not important only in school" (#9) to 0.88 for Statement #1 "I am never under strain in science class" (Table 2). Statements "I like science the most" (#6) and "We learn about important things in class" (#11) had consistently high scores, while the score for "I am happy in science class" (#7) was relatively low (Figure 2). "Science is not important only in school" (#9) was the only statement that had a negative change in response. Five statements had a greater than 0.50 change in response (Table 2).

As shown in Table 3, the journal class' first survey had a range of responses (n=22) from 2.05 (#7: I am happy in science class) to 3.50 (#6: Science is the subject I like the most). The range of responses (n=25) for the second survey was 2.84 to 4.20 (#7: "I am happy in science class" and #1: "I am never under strain in science class" respectively). All statements showed a positive change in response from the first survey to the second, with a range of 0.05 to 1.08 (#9: "Science is not important only at school" and #2: "I enjoy science class" respectively). Two statements had a greater than 1.00 change in response. "I like science the most" (#6) had a relatively high first survey average (3.50) and the second survey average was the second highest at 4.08 (Figure 3). A total of nine questions showed a greater than 0.50 change in response.

The change in response for each statement for each class was then compared (Table 4). For two of the statements (#2: "I enjoy science class" and # 5: "I really like science") there was more than 0.50 point difference between the two classes. There was very little difference between #1 "I am never under strain in science class" (0.03) and #10 "The things we study are useful to me" (0.07). The journal class consistently showed a

Figure 2: Comparison of Average of Initial vs. Final Attitude Survey Scores of Non-Journal Class



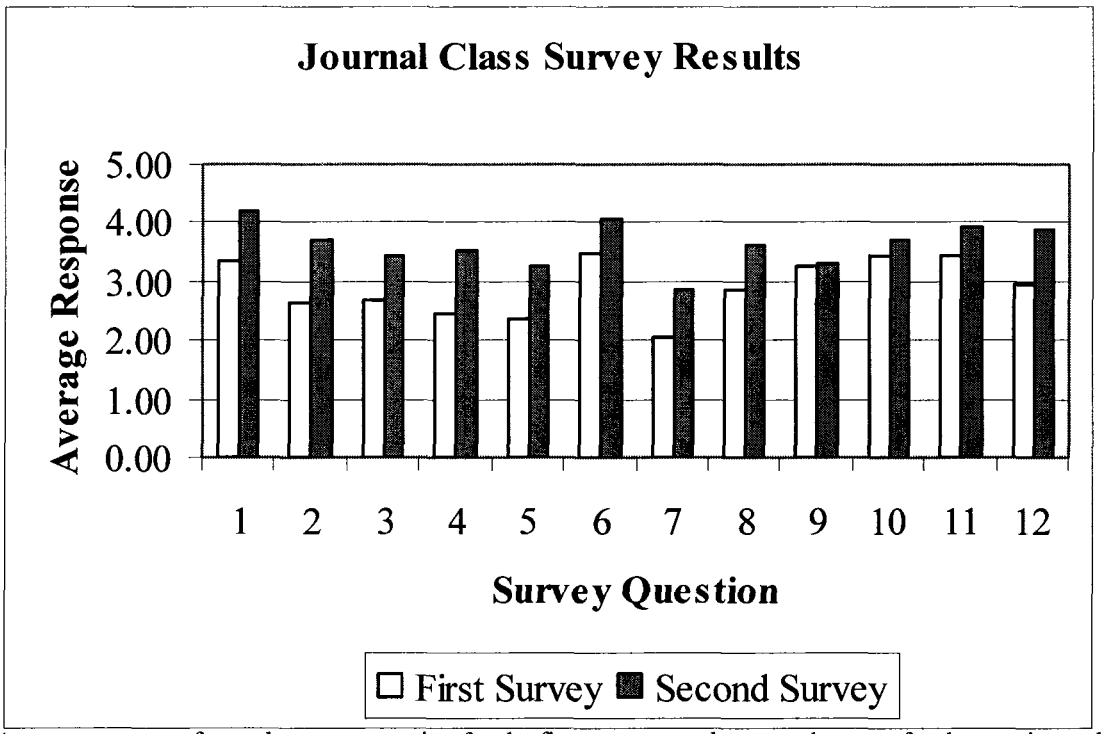
Responses range from "Strongly Agree" (5) to "Strongly Disagree" (1). A response of 3 was "Undecided". High average responses indicate a more positive attitude. Low average responses indicate a less positive attitude.

Table 2: Comparison of Initial vs. Final Attitude Survey Scores of Non-Journal Class

Statement Number	Statement Content	First Survey Average n=23	Second Survey Average n=24	Change in Response
1	Not under strain	3.04	3.92	0.88
2	Enjoy science class	2.70	3.21	0.51
3	Science is fun	2.74	3.13	0.39
4	Good feeling	2.61	3.21	0.60
5	Really like science	2.52	2.79	0.27
6	Like sci. the most	3.48	3.79	0.31
7	Happy in class	1.96	2.48	0.52
8	Relaxed in class	2.41	2.83	0.42
9	Not impt. only in school	3.27	3.08	-0.19
10	Useful to me	3.13	3.33	0.20
11	Learn impt. things	3.57	3.74	0.17
12	Activities are not boring	3.26	3.83	0.57

For each statement, all student responses were added then divided by the total number of students who answered the question to calculate the average for that survey. The change in response indicates the difference between the second survey average and the first survey average. The negatively worded statements have been changed to reflect the positive wording (#1, 6, 9, 10, 12).

Figure 3: Comparison of Average of Initial vs. Final Attitude Survey Scores of Journal Class



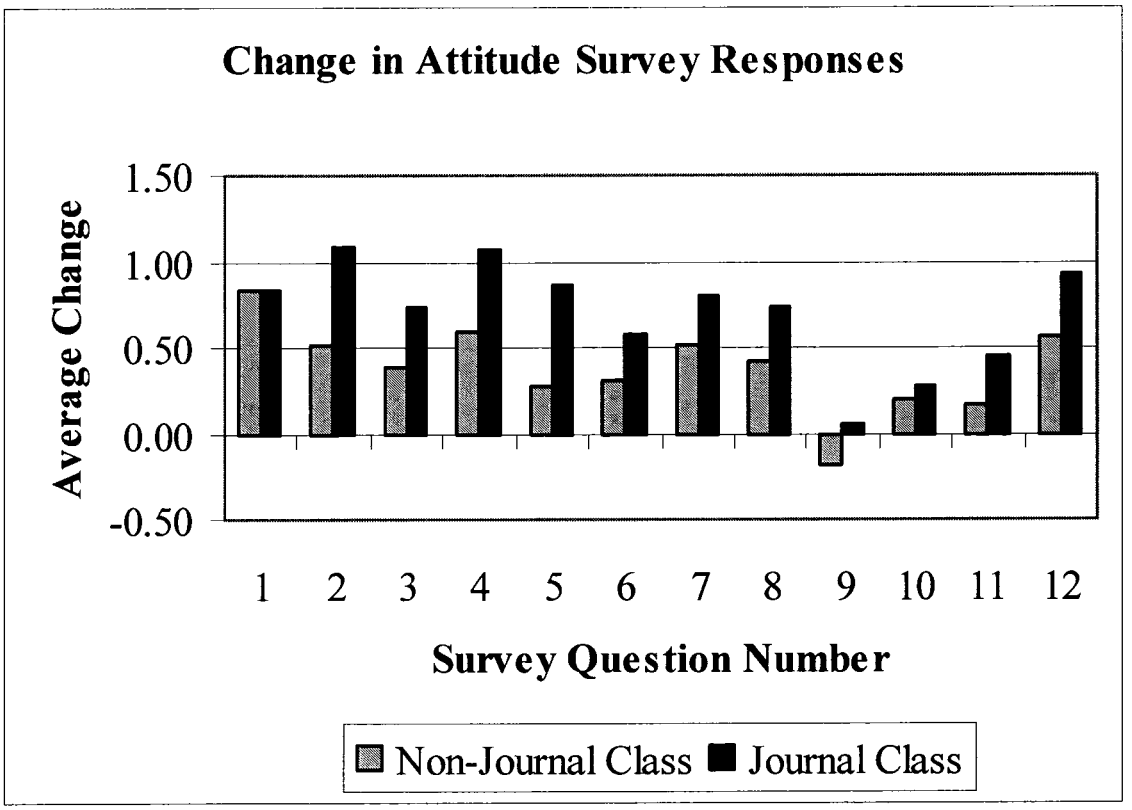
Average response for each survey question for the first survey vs. the second survey for the non-journal class. Responses range from "Strongly Agree" (5) to "Strongly Disagree" (1). A response of 3 was "Undecided". High average responses indicate a more positive attitude. Low average responses indicate a less positive attitude.

Table 3: Comparison of Initial vs. Final Attitude Survey Scores of Journal Class

Question Number	Statement Content	First Survey Average n=22	Second Survey Average n=25	Change in Response
1	Not under strain	3.36	4.20	0.84
2	Enjoy science class	2.64	3.72	1.08
3	Science is fun	2.68	3.42	0.73
4	Good feeling	2.45	3.52	1.07
5	Really like science	2.38	3.24	0.86
6	Like sci. the most	3.50	4.08	0.58
7	Happy in class	2.05	2.84	0.79
8	Relaxed in class	2.86	3.60	0.74
9	Not impt. only in school	3.27	3.32	0.05
10	Useful to me	3.45	3.72	0.27
11	Learn impt. things	3.45	3.91	0.46
12	Activities are not boring	2.95	3.88	0.93

For each statement, all student responses were added then divided by the total number of students who answered the question to calculate the average for that survey. The change in response indicates the difference between the second survey average and the first survey average.

Figure 4: Comparison of Change in Attitude Survey Responses Between Journal and Non-Journal Classes



Positive numbers indicate the change between the first survey and the second survey was positive. A negative average change indicates a negative change between the first survey and the second survey.

Table 4: Comparison of Average Change in Response Data Between Journal and Non-Journal Classes

Question Number	Statement Content	**Non-Journal Class** Average Change in Response	**Journal Class** Average Change in Response	**Difference**
1	Not under strain	0.88	0.84	0.03
2	Enjoy science class	0.51	1.08	0.57
3	Science is fun	0.39	0.73	0.34
4	Good feeling	0.60	1.07	0.47
5	Really like science	0.27	0.86	0.59
6	Like sci. the most	0.31	0.58	0.27
7	Happy in class	0.52	0.79	0.27
8	Relaxed in class	0.42	0.74	0.32
9	Not impt. only in school	-0.19	0.05	0.24
10	Useful to me	0.20	0.27	0.07
11	Learn impt. things	0.17	0.46	0.29
12	Activities are not boring	0.57	0.93	0.36

higher average change in response than the non-journal class, except for Statement #1 "I am never under strain in science class" (Figure 4).

Discussion

Upon review of the data, there seems to be little correlation between writing in science journals and student achievement. The average percent grade change for both classes increased during the third semester, and there was little difference between the two classes. If the four students in the non-journal class whose grades decreased were not included in the data, the non-journal class' average change in grade would increase to +7.7%, very close to the journal class' average change in grade. This is similar to Trombulak and Sheldon's (1989) finding that there was no difference in grades between writers and non-writers in a general ecology class. The data from my study does not conclusively support or reject a positive effect of writing in journals on student achievement in science. My study simply measured student achievement in a broad sense by comparing only two grades to each other. Jurdak and Zein (1998) found that journals in mathematics increased achievement in some areas of mathematics and not others. It is possible that students in my study improved in some areas and not others and this was not reflected in the semester grade comparison.

There are many factors that may have attributed to the increase in achievement for the students in both classes. The material covered in the second semester of the Laboratory Biology course was much different from the material covered during the third semester. The topics covered during the study may have been easier for the students to comprehend, thus resulting in grade improvements. Also, I began my student teaching experience soon before the onset of the study. The students may have related to me and

my teaching style differently than their regular science teacher. It is also possible that any change in the normal routine would have revitalized class interest in the subject. Both of the above variables were in place for both classes, thus the effect of the variables on the study were minimized as much as possible.

There are many aspects of this project which lead to further questions and possibilities for further exploration of the relationship between student achievement in science and writing in journals. It would be interesting to see if there is any change in the grades of the students for different types of assessment, including tests, labs, and projects. Perhaps writing in journals would positively correlate with student grades on assignments that require more written communication. Sub-dividing the semester grades into different assessment categories may help answer this question. The content and amount of writing each student offers in their journals may also have a link with student achievement. I did not keep a record of how much each student wrote and if the amount each student wrote changed during the semester. While these changes may not be apparent over one semester, they may be more obvious over an entire school year. Writing may not be the only aspect of communication that is affected by the use of journals in science. It is also possible that oral communication with the teacher may improve as a result of the written dialog in the journals. If the student gains confidence in expressing themselves in writing, they may be more inclined to participate and become more vocal. This increased participation may positively affect their grade in the class.

While increasing student achievement was a goal of this action research project, it was not the only motivating factor in implementing journal-writing in my classroom. I also hoped student attitudes would improve. The attitude survey data revealed a

generally positive correlation between journal writing and student attitudes toward science over the marking period. The journal class showed markedly improved attitudes for the statements "I enjoy science class" and "I have a good feeling toward science" as their average response improved by over one whole point. The same statements for the non-journal writing class showed a 0.51 and 0.60 point improvement. The biggest difference between the two classes was in the statements "I enjoy science class" (0.57 difference) and "I really like science" (0.59 difference). This data seem to indicate that writing in journals in my science class had a positive correlation with improving the attitudes of my students.

The findings from this research differs from both Jurdak and Zein (1998) and Trombulak and Sheldon (1989). Neither of these studies had any quantitative data to support a difference in attitude between writers and non-writers. It is possible that the variables mentioned above affected the students in the two classes differently and this difference was reflected in the attitude surveys. While the classes were randomly designated as writing or non-writing, the actual students in the classes did have differences. The journal-writing class seemed much more receptive to learning in general, and had more overtly positive attitudes.

One aspect of the study that I anticipated would affect student attitudes was the ability for the students to relate what they were learning to their own lives. Personalization of learning is something that I thought would be facilitated through journal writing. Three of the statements on the student survey addressed the students' perceptions of the importance of studying biology. The statements were: "I think science is important only at school" (#9); "The things we study in science are useful to

me in daily living"(10); and "We learn about important things in science class" (#11). The data revealed less than 0.50 point difference between the two surveys for both classes over the semester. It is possible that this data would change if the study were conducted for a longer period of time.

Writing in journals did not seem to positively affect the students ability to relate biology to their own lives. However, the average student response to these statements for both classes was above the median of 3.0, or undecided. The average answer was generally high at the beginning of the study, and only changed slightly by the end of the study. The low average change for these statements should not be misinterpreted as a lack of understanding of the importance of learning biology. It simply shows that the journals did not greatly affect this understanding. At the end of the semester, I informally surveyed the students to learn more about their career aspirations. Very few students in either class hoped to pursue a career in science at this time, yet the data shows they still understood and appreciated its role in school.

While the quantitative survey data did not show a correlation between journal-writing and linking science to student lives, students commented about using the journals to further their understanding about biology. Some students indicated a positive response to being able to interact with the material and personalize it to their own lives. When asked to write about how he/she had studied for a test, one student wrote, "I studied the review test over and remembered the scientists and aerobic and anaerobic by using sports and words about sports that would make me remember what they are" (emphasis in original). This student was able to relate what we were learning in class to something that was important in his or her own life. As the project progressed, I was able to

anticipate how students would interpret the journal questions I posed. One of the first questions I asked the students to write about referred to how the student would explain the previous day's lesson to a friend. I hoped the students would explain how they remembered what we had covered and explain the material on a personal level. However, many students responded by saying they would share their notes with the classmate and answer any questions they had. As a result of this project, I was able to reword and rephrase some journal topics to increase the chances that the questions I pose result in the type of answer I hope to receive (Appendix B).

Writing in journals was not a one-sided activity. I also found that my responses to what the students wrote were an important part of the journal-writing exercises. When I returned the journals to the students after the first writing activity, they were surprised to learn that I "actually read" what they had written. Some students responded to my comments, even though they were not specifically instructed to do so. In the future, I would like to place more emphasis on student response to my comments about their journal entries. During this study, the students were given five minutes to read my response, respond if they desired, and answer the new journal question. I found the students spent very little time revisiting past entries and interacting further with past topics. The next time I integrate student journals in my classroom, I plan to give the students more time to respond to my comments. One day per week will be set aside for new topics, while a second day will be reserved for responding to me or writing more about the topic.

I was also surprised by how much I learned as a result of reading the student journals. I was able to adjust my lessons in response to how the students answered

certain questions. For example, I asked the students to tell me what they hoped to learn during the evolution unit. Many students indicated they would like to learn more about human evolution and "how we came from monkeys". I adjusted my unit plan to include an activity that helped the students answer the questions they had. The students knew they were permitted to write what they wished, and as a result, I learned what the students thought about different activities, tests, and labs. It also gave me the opportunity to learn more about how each student personally and how their experiences relate (or didn't relate) to the material. I used this information to help the students create associations between their lives and biology.

While student achievement and attitudes toward science were the primary focus of my study, I also felt it was important to determine how the students felt about the journals and my feedback to their writing. Past research indicated that the students enjoyed writing in journals and valued teacher feedback (Burniske, 1994; Hanrahan, 1999; Buehl, 1996). I asked the journal-writing class to write what they thought about the journals and have included some samples of what they wrote.

> "It was a good way to understand a person's point of view and it allows the students to express their opinions." (emphasis in original)
>
> "I think that the journals were a good idea because it got students, at least me, to think and write about things in science that were important."
>
> "I liked the journals because they make you think about what you learned and they let you (Mrs. Cowell) know how we feel about biology."
>
> "I liked the journals. You could explain what you felt about a certain topic without saying it out loud. It was a good idea!"
>
> "I like keeping the journals in this class. They give me a chance to express my opinions on topic to do with biology. They give me the chance to see what someone else thinks about my insights."

I was able to answer the research questions with the data obtained during this study. This study was not conducted with a random sample of students, therefore the results cannot be generalized to populations of students different from the study subjects. However, the results may be useful to inspire further study. My research showed no direct correlation between an improvement in student grades and writing in science journals. While the grades may not have increased as a result of writing in journals, the research shows that attitudes of the students in the journal-writing class did improve. Students enjoyed using the journals to personalize their learning, communicate with me, and receive feedback about their thoughts and writing.

Chapter 5: Conclusions

The purpose of this study is to determine if there is any correlation between writing in student journals and achievement in and attitudes toward science. Two research questions guide this action research project and the data answers these questions to a certain extent. The first question asks: Will the use of writing in student journals in my science classroom affect the grades of my students? The data shows no correlation between journal writing and grade improvement. Therefore, my hypothesis that journals would increase student achievement as measured by an improvement in student grades is not verified. However, limitations to this study, including time constraints may have impacted the results. Additionally, there are many ways to measure student achievement beyond comparing two semester grades. An improvement in one area may not be reflected in a comprehensive summative grade.

The second research question asks: What effect does keeping a student journal and receiving teacher feedback have on student attitudes about science? A comparison between pre- and post-test student attitude surveys reveals a general trend toward an improvement in attitudes for students in the journal-writing class. The results were not tested for statistical significance because the sample was non-random and because there may be other mitigating differences between the two classes. For practical purposes in the classroom however, journal-writing has a positive correlation with student attitudes about science.

This study is the first step in a progressive project to improve and expand upon the teaching techniques I use in my science classroom. The data collected during this

project help me understand the potential benefits of journal-writing in science, while the process of implementing the journals provided me with valuable information about how journals could be used in my classroom in the future.

There were many aspects of the way journals were used during the study that worked well, including their use as a time management tool. Students wrote in the journals in the very beginning of class while I took attendance and prepared for the day's lesson. This helped maximize instructional time because as soon as the students walked into the classroom they began to write and think about science. In the future, I would probably continue this practice, however, I would place more emphasis on the fact that students should be using the time to think and write about the topic in their journals. Some students tended to write as soon as they walked in the room, but then stop and socialize with classmates. Perhaps requiring that each entry be a certain length would help this problem. I have also reworded some of the questions I used in order to encourage the type of response for which I am looking (Appendix B). The journal topics I used this semester were written to promote further thought about a topic, to help students make connections between their lives and science, and to encourage students to think about how they learn. Some of the responses I received did not meet these goals and I hope the reworded and new topics will produce more of the desired types of responses.

I would also like to use the journals to more directly meet the New Jersey Core Curriculum Content Standards for Science (2002) and the National Science Education Standards (1996). I mostly used the journals to promote thought about a topic that had already been covered in class. In the future, I will incorporate questions to address

scientific inquiry about material that hasn't been covered. Brainstorming could also be integrated into the journal entries to allow students to ask questions they hope to answer in an activity and gather their thoughts about how an investigation could be conducted. In the beginning of a unit, students could write in the journals to explain scientific phenomena based on prior knowledge, then at the end of the unit compare these ideas with what they have learned. All of these ideas could be used in my future classrooms to more effectively integrate scientific inquiry into journal-writing activities.

Throughout the duration of the study, the journals were kept in the classroom. Students had time during class to write, and would return their journals to be by the end of the class period. I liked this idea because I never had to worry about students leaving their journals elsewhere or losing them altogether. However, I feel it would have been nice to periodically allow the students to take their journals home and write on their own time. This would have given the parents or guardians an opportunity to see what their student had been doing in class. It would also allow the students to think about a topic in more depth before writing their entry. In the future, I would like to include some overnight homework journal topics and see if there is any change in the length or quality of student responses. While it was not possible during my study, computers could also be used for journal writing. If there were enough computers in the classroom for each student, or if all students had access to the Internet, entries could be submitted electronically via email. This would help reduce paper usage and would be easier on me to read and respond to, instead of transporting notebooks to and from the classroom.

From a classroom management standpoint, journal-writing was an invaluable tool. However, it did require a time commitment on my part to read and thoughtfully respond

to each entry. If I were to use journals with more than one class, I would stagger the day of the week the journals were collected in order to spread out the amount of work for myself. Responding to the entries was an aspect of journal-writing the students and I really enjoyed. The students eventually learned that they truly were permitted to write what they wanted, and I learned information about the students that helped me become a better teacher. In the beginning of an evolution unit, I asked the students to write what they hoped to learn in the upcoming weeks. One student wrote, "I don't know what I want to learn about in the evolution unit because I don't think evolution is true." In my response I told the student that we would learn about the scientific explanation of evolution, but his beliefs were important and the purpose of the unit was not to change his thoughts.

I was able to monitor for misunderstandings and misconceptions, incorporate student interests into lessons, offer alternate viewpoints, and encourage critical thinking. I frequently posed additional questions for the students to consider in response to their writing, however most students did not answer. This may be due, in part, to the short amount of time the students were given to write. They had five minutes to read my response to the previous question, read the new topic on the board, and write their new response. I would like the students to spend more time to revisit previous topics and further interact with them. The next time I use journals in my classroom, I would set aside at least one journal session for students to use to respond to my comments or write more about a topic. I would also give them more time to write or change the writing time to the end of the period, if possible.

I was able to answer my research questions during my study, to an extent, however I would like to repeat the study in a different classroom after I make some of the changes mentioned above. I was able to learn a great deal from the way this study was conducted and the results I obtained, especially with regard to revising my journal topics and encouraging longer entries. In addition, many more questions have come to surface that I feel would be interesting to pursue. How does the student response length and language used in the journal responses change over the course of a school year? Do journals affect achievement for different types of assessment in biology? Does teacher feedback in journals affect student participation in class? These questions could be answered through future action research projects in real-life classrooms.

Overall, I feel journal-writing has many positive aspects that make it a favorable technique to use in the classroom. Writing across the curriculum can encourage student interaction with material and help students personalize their learning. The potential cognitive benefits on the students are great, as are its influence on the students' affective needs in the classroom. Journal writing benefits the teacher by improving time-management, creating a more personalized classroom, increasing communication between student and teacher, identifying student interests and needs, and helping students bridge the gap between science and everyday life. Journal-writing can be tailored to the needs of the teacher and students, making them ideal tools for use in any classroom.

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Appendix A

Period_____

STUDENT SCIENCE SURVEY

This is a survey being administered as part of a master's degree research project. While your participation is voluntary and you are not required to answer any of the questions herein, your cooperation and participation are important to the success of the project and are greatly appreciated. If you choose to participate, please understand that all responses are strictly confidential and no personally identifiable information is being requested.

Put an X over the number that most closely matches your feelings. Be honest! Please answer every question.

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. I am always under a terrible strain in science class.	5	4	3	2	1
2. I enjoy science class.	5	4	3	2	1
3. Science is fun.	5	4	3	2	1
4. I have a good feeling toward science.	5	4	3	2	1
5. I really like science.	5	4	3	2	1
6. Science is the subject that I dislike the most.	5	4	3	2	1
7. I am happier in science class than in any other class.	5	4	3	2	1
8. I feel more relaxed in science class than in any other class.	5	4	3	2	1
9. I think science is important only at school.	5	4	3	2	1
10. The things we study in science are not useful to me in daily living.	5	4	3	2	1
11. We learn about important things in science class.	5	4	3	2	1
12. Science class activities are boring.	5	4	3	2	1

Appendix B

Journal Questions

Why do you think the puzzle in yesterday's lesson had no edges?

What do you want to learn about in the evolution unit? Why?

Is there anything we have covered so far that you don't understand? What? What could you do to fix this? Is there anything you really understand? What do you think helped you?

Suppose a friend of yours from class was absent yesterday. How would you explain to him or her what you learned in class yesterday so they are caught up today?

What did you do to study for today's test? Now that you've taken the test, is there anything you would have done differently?

Where on TV have you seen science in action? Is science always portrayed accurately? Explain.

Free day – write about whatever you would like.

What do you want to do when you "grow-up"? How will science affect your career? Do you think science is important to learn in school? Why or why not?

What did you think about writing in the journals? Did you like or dislike them? Why or why not?

Revised and Additional Journal Questions

Imagine you have a friend who was absent today. You call him/her and you do a summary of today's lesson, assuming that your friend will rely on you and your explanation. Be as clear as possible, and do not miss any important point that was mentioned. (Jurdak & Zein, 1998, p. 415)

What is the most interesting thing you learned today?

Choose a scientist we have discussed so far in this class. What three questions would you like to ask him or her and why?

What does "biology" mean to you?

What science classes have you taken so far in middle school or high school? What do you remember the most from these classes? What did you like the best? The least?

How do you feel you did on the biology test? What concepts do you still find difficulty in? What did you do to overcome these difficulties? (Jurdak & Zein, 1998, p. 415)

Suppose you could travel back in time to the year 1850. Use what you have learned so far in class to write what you think the students might learn about in a science lesson.

Suppose you could travel to the future to the year 2100. Describe in as much detail as you can what you think 15- and 16- year olds will learn about in biology class.

Go back in your journal and read some of the journal entries from the beginning of the year. Would you respond differently to any of the questions? Explain.

Many people think that humans evolved from monkeys. Why do you think this is a common thought? What does scientific evidence say?