

THE SOCIAL OUTCOMES OF WHOLE CLASS INQUIRY ON STUDENTS
IN A HIGH SCHOOL BIOLOGY CLASSROOM

by

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ABSTRACT

The purpose of this study was to better understand the impact that an inquiry-based instructional model, called whole class inquiry (WCI), had on students in the general education classroom at Clinton High School. The students were divided into three ability groups: *high*, *medium*, and *low*. The students participated in at least three full WCI assessments and smaller WCI activities over the course of three months. The researcher used surveys, questionnaires, interviews, and observations to collect data and draw conclusions. Results showed that all students developed social and emotional life skills. Not all classes showed similar results however, with certain conditions contributing to greater overall achievement. Factors that may negatively impact success of WCI implementation include students' previous experience with WCI, attitude, and number of students with learning and behavioral disabilities. The study also suggests that students with learning disabilities may need greater teacher direction and support during WCI assessments than other students. In conclusion, the study suggests that WCI is an effective tool for not only teaching science through inquiry, but also teaching students valuable life skills, particularly collaboration and teamwork.

INTRODUCTION AND BACKGROUND

Ever since the National Science Education Standards (NSES) wrote about science inquiry in 1996, considerable educational research efforts have been made to test its effectiveness. Generally accepted, teaching through inquiry has been shown to have positive results, in that it supports the objectives laid out by the NSES. Specifically, inquiry has shown improvements in “conceptual understanding of science principles, comprehension of the nature of scientific inquiry and a grasp of applications of science knowledge to societal and personal issues” (Anderson, 2002, p.6).

At Clinton High School, located in Clinton, Iowa, science teachers are expected to regularly use a method of inquiry. The method is called whole class inquiry (WCI) and requires students to work together to solve a science related challenge. Having students work together in a real-life situation helps prepare them for employment, improves their communication and problem solving skills, while simultaneously teaching them the content (Smithenry & Gallagher-Bolos, 2009).

Teachers who have attempted to use WCI have confirmed its ability to produce positive results (Song, Ahlswede, Clausen, Herbig & Oliver, 2010). However, like most research done on inquiry-based learning, fewer studies have been done on students with learning disabilities. The studies done on WCI are no different.

The study was conducted at Clinton High School, which is the single public high school located in Clinton, Iowa. The school educates 1,257 adolescents (City of Clinton, 2011) from a city of 26,885 people (U.S. Census Bureau, 2011). Like the community, the school is ethnically homogenous composed of 89.5% white students. The remaining ethnic groups are Black (7.1%), Hispanic (1.9%), Asian (1.1%), and American Indian

(0.4%). The majority of students at Clinton High School are considered to be from low-income families as defined by Title 1 of the Elementary and Secondary Education Act (ESEA).

Ninety-five tenth grade students initially participated in this study. There were more males (61%) that participated than females (39%). For the study, students were placed into three nearly equal groups based on achievement (Table 1). Student G.P.A. determined achievement. Student proficiency scores from state examinations also support this method of grouping. The high-ability group contained fewer special needs and at-risk students. The medium-ability group had slightly more special needs and at-risk students. The low-achieving group contained the largest number of special needs and at-risk students.

Table 1
Student Demographics for Each Ability Group

	Ability Group			Total
	High	Medium	Low	
Special Needs	5	7	10	22
At-Risk	2	9	8	19
Both	1	1	8	10
Neither	23	16	5	44
G.P.A.	3.302	2.172	1.085	2.186
Proficiency (%)	54.6	43.4	29.6	42.5

The purpose of this study was to examine the social and content-specific outcomes that an inquiry-based curriculum, namely whole class inquiry, can have on students in an inclusive classroom. Specifically, the study wanted to answer these sub-questions:

1. What effect does a diverse classroom of high, medium and low-achieving students have on the outcomes of WCI?

2. Can WCI produce the development of social skills and content knowledge in the inclusive classroom?
3. As a new science teacher, am I able to successfully implement an inquiry-based curriculum?

CONCEPTUAL FRAMEWORK

Although inquiry should be the primary method of instruction in science, a traditional model of lecture, discussion, textbooks and worksheets still dominate the science classroom (Smithenry, 2010; Anderson, 2002). Certainly it cannot be for lack of evidence to support inquiry's effectiveness. Research studies have suggested that teaching through inquiry is effective (Bolos, 1996; Song, 2007). In fact, it appears as though the community of educational researchers have come to accept this. Today, the focus is less about testing if inquiry works and more about ways to help teachers implement it in their classrooms (Anderson, 2002).

Many teachers may think that they are doing inquiry because their students are doing labs that make them follow the scientific method. As Llewellyn (2005) points out, these characteristics don't necessary qualify as inquiry. He presents a diagram that shows how he defines the inquiry process (Figure 1).

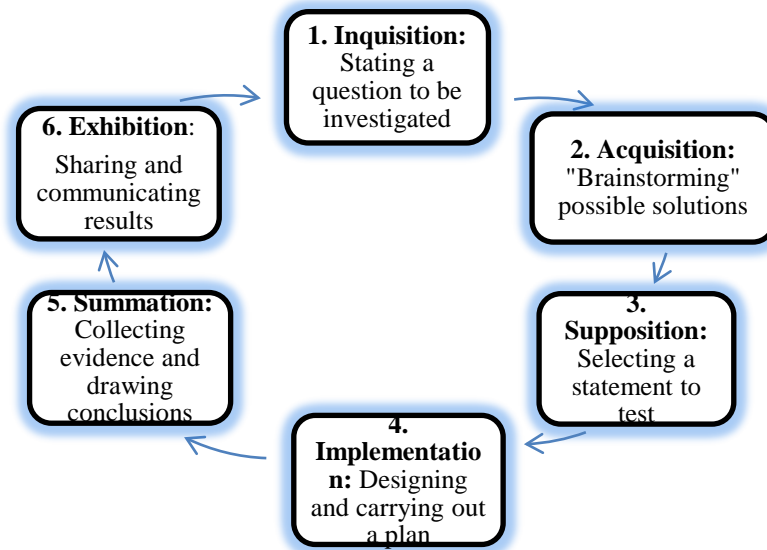


Figure 1. The inquiry cycle (Adapted from Llewellyn, 2005, p. 21).

The inquiry cycle must begin with a question. Once a student has a question, which is usually generated by some observation that causes cognitive disequilibrium or wonder, then the process of experimentation begins. The student determines what the best method is to answer his or her question. After finding a potential answer, he or she shares that information with others (the class). It may follow that further questions may arise after this stage. If this happens, then the cycle will continue. What makes the inquiry cycle different from traditional learning is that the *student* is generating the questions, not the teacher. The cycle is student driven (Llewellyn, 2005).

The National Research Council (NRC) says something similar. In July 2011, the NRC published the Science Framework to clarify the meaning of science inquiry. What was important to inquiry, they said, was that “students will themselves engage in the practices and not merely learn about them secondhand. Students cannot comprehend scientific practices, nor fully appreciate the nature of scientific knowledge itself, without directly experiencing those practices for themselves” (NRC, 2011, p. 33).

In short, science inquiry requires students to do authentic investigations of their choice. Students ask their own questions and find ways of seeking those answers through the scientific process and experimentation. Students doing inquiry are actively engaged and using higher-order thinking. Under these circumstances, the classroom becomes less teacher-centered and more student-centered, whereby the student is acting as the researcher and the teacher is the guide (Llewellyn, 2005).

There are several skills that are required before a teacher can be successful at using inquiry. A teacher should have (1) a strong knowledge of the subject matter, (2) a clear understanding of the process behind the scientific method, (3) formulated beliefs about teaching that match his or her practice, (4) an understanding of how students learn (Davis, Petish, & Smithey, 2006) and (5) access to materials demonstrating exemplary teachers implementing inquiry (Smithenry, 2010). Many of these necessary components to good inquiry-based teaching take years to acquire and cannot be taught through pre-service training alone.

Aside from these prerequisites, a potential barrier that keeps most science teachers from attempting to use inquiry in their classrooms is the notion of depth versus breadth. The term breadth refers to a view that students need exposure to a wide variety of topics in science (Schwartz, Sadler, Sonnert, & Tai, 2009). This paradigm is often associated with standardized, high-stakes testing, which has become the predominant way of measuring student achievement since the enacting of the Elementary and Secondary Education Act of 1965 (ESEA), whose purpose was to raise achievement and close achievement gaps. Teachers tend to believe the best way to prepare students for the tests are to expose them to the many potential topics covered on the tests.

In contrast, inquiry-based learning places less emphasis on breadth and more on depth of learning. Teaching for depth upholds the view that certain fundamental concepts need to be taught and given greater attention, even if it means less time spent on other topics. Students that have a deeper understanding of fewer scientific concepts in high school have actually shown greater success in college science coursework. This supports that teaching science for depth does have substantial benefits (Schwartz et al., 2009).

Despite this common misconception, inquiry *can* help student scores on standardized tests. One possible reason for this is that inquiry activities help students attain the content knowledge and critical thinking skills needed to be successful on standardized testing. It may also have something to do with the positive relationship between student attitude and achievement. Despite current findings, some suggest that further research is needed, particularly with diverse groups of students, to better understand how effective inquiry-based units are in preparing students for standardized tests (Anderson, 2002; Bianchini, Johnston, Oram, & Cavazos, 2003; Turner & Rios, 2008).

Another challenge to any teacher, but especially new teachers, is locating a single unified definition of science inquiry. Borrowing from *The Nature of Scientific Enquiry* by Herron (1971), Smithenry (2010) defines guided-inquiry as meaning that students are given the question, but must design their own procedure and find the answer themselves. This is different from other types, which fall on opposite sides of the spectrum: structured and open-ended inquiry.

Like the definitions, there are many different forms of inquiry available to teach from, some more effective than others. One model called whole class inquiry (WCI)

developed by Dennis Smithenry and Joan Gallagher-Bolos (2009) meets many of the requirements set forth by the NSES. One study has shown how a teacher using WCI reduced the time she spent on lecture and discussion by nearly 20% while still showing high student achievement (Smithenry, 2010). When students engaged in a WCI activity they had the opportunity to (1) improve communication skills, (2) operate in a scientific community, (3) experience a real-life, authentic endeavor, and (4) understand what scientists do (Bolos & Smithenry, 1996, 2008; Song et al., 2007).

The reason it has been called whole class inquiry is that students work as a class to figure out a problem together. The teacher uses a four-step approach to enacting the WCI curriculum (Figure 2).

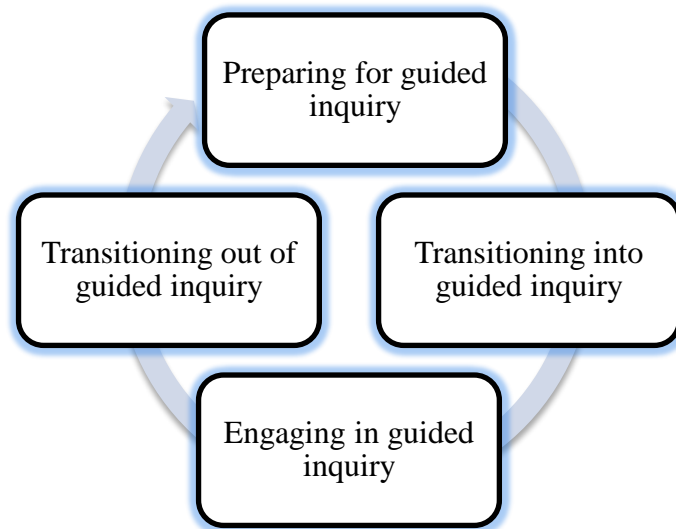


Figure 2. Whole class inquiry cycle (Adapted from Smithenry, 2010, p. 1700).

In the first step, students participate in traditional activities to learn the content and skills that will be used in the upcoming WCI assessment. In the second and third steps, the teacher begins to role-play. This is an essential component of the WCI process because it allows the teacher to remove him or herself from the traditional role of helper or guide. The students are now on their own to apply what they have just learned to solve

the problem. In the last step, the teacher exits the role-play character and becomes the teacher again. The teacher now guides the students toward self-reflection of their experiences. The teacher also provides the students with feedback on their performance. The goal is to improve on each subsequent WCI assessment, which simultaneously becomes more difficult over time (Smithenry & Gallagher-Bolos, 2009).

If the WCI model is implemented successfully, it will have the following characteristics:

1. The teacher assumes another identity through the use of teacher role-play
2. The teacher poses a carefully designed problem
3. The teacher informs the students that it is their job to work together as a whole class to solve the problem
4. The teacher tells the students what and when the products are expected
5. The teacher provides the students with feedback after the delivery of the products (Smithenry & Gallagher Bolos, 2009, p. 164)

The outcomes from this form of instruction are quite positive. Smithenry and Gallagher-Bolos (2009) report that students are able to learn a similar level of content knowledge as students that do not engage in WCI assessments. An added benefit from doing WCI is the social aspect. Students can learn a new set of skills that normally do not come from traditional instruction. Some of these social outcomes are listed below.

1. Students learn how to better listen to other people's ideas
2. Students learn to communicate better
3. Students learn to be better team players
4. Students learn to work more effectively with other people

(Smithenry & Gallagher Bolos 2009, p. 184)

Clearly, positive benefits of WCI with students have been reported. However, most of the studies done have been with advanced courses, such as honors chemistry and physics, which usually do not contain high numbers of students with learning disabilities. Since the inception of No Child Left Behind (NCLB), all students, even those with learning disabilities, are required to be fully included in the general education classroom with their non-disabled peers. Teachers working in a public school, where full inclusion is required, should understand the impact that guided-inquiry activities, such as WCI, have on *all* types of students.

Students with learning disabilities have struggled in traditional science classrooms compared to their peers with no identified disabilities (Lynch et al., 2007). A possible reason for this is that science teaching has been, and continues to be taught through textbooks and worksheets. This type of learning involves memorization of numerous vocabulary terms that can be challenging for students that have difficulties in verbal learning, literacy and text comprehension, and independent study strategies (Scruggs, Mastropieri & Okolo, 2008). With the simultaneous push for inquiry and inclusion, it has been shown that all students, even those with disabilities, can benefit from a student-centered, activity-based approach (Bianchini et al., 2003; Scruggs et al., 1993).

Although no specific research has been conducted on the effects of WCI on students with learning disabilities, there are studies that have examined the impact that inquiry-based curriculum can have on these students. These results are positive and encouraging. Students with learning disabilities (1) learned more, (2) remembered more, (3) enjoyed learning more (Scruggs et al., 1993), (4) experienced conceptual change

(Lynch et al., 2007), and (5) even outperformed normally achieving students taught through text-based learning (Scruggs et al., 2008).

Teachers who have used the WCI instructional strategy have always placed emphasis on the development of social skills that come with it (Bolos & Smithenry, 1996, 2008; Song et al., 2007). Whole class inquiry activities do have positive social outcomes that are important for all students, especially students with learning and behavioral disabilities. Not so long ago, these students were recently excluded from interacting with their peers in the general education classroom.

Despite the clear benefits of teaching students with learning disabilities through guided-inquiry, this form of instruction must still be highly structured and supportive in order to be effective (Scruggs et al., 2008). Students with learning disabilities are known to have potential challenges in less structured problem-solving activities and following procedures involved in scientific experimentation (Scruggs et al., 1993). These are challenges that must be considered when using WCI, which can lack structure and support, at least from a teacher-centered perspective (Llewellyn, 2005).

Sampson (2004) reports some negative student behaviors that can be expected when teaching students with learning disabilities through inquiry. These include a lack of student participation, talking at inappropriate times and not listening to instructions. To mitigate these behaviors, a teacher should establish classroom routines and characteristics early on, set time frames for student work and be visible during working time to keep students on task and give students the opportunity to share ideas, raise questions, design investigations and create knowledge. Classroom management is essential to successful implementation of guided-inquiry.

METHODOLOGY

Project Design

The investigation involved four high school classes and spanned the course of a single trimester from November to February, a total of 59 days. During this time, I taught two different sections of biology, Biology 304 and 305. To reduce the amount of variation between them, I tried to follow a similar instructional plan. Figure 3 shows a timeline of when students engaged in whole class inquiry (WCI) activities (red) and when I provided WCI feedback (black). Although the content being taught was different, the amount of time spent on WCI and when it occurred was similar for both classes. In the end, the students engaged in at least three large WCI assessments (yellow), which served as the primary source of data collection. Several smaller activities happened in between, but were not used to collect any data.

To receive IRB approval for this study, I administered a consent and assent form to all students on the second day of the course. I requested students to return them with their parent or guardian's signature within the next three days. Only 31% of the forms were returned. Since the research was considered as normal classroom practice, the principal signed the Exemption Regarding Informed Consent form (Appendix A) allowing me to include all students as subject participants.

The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

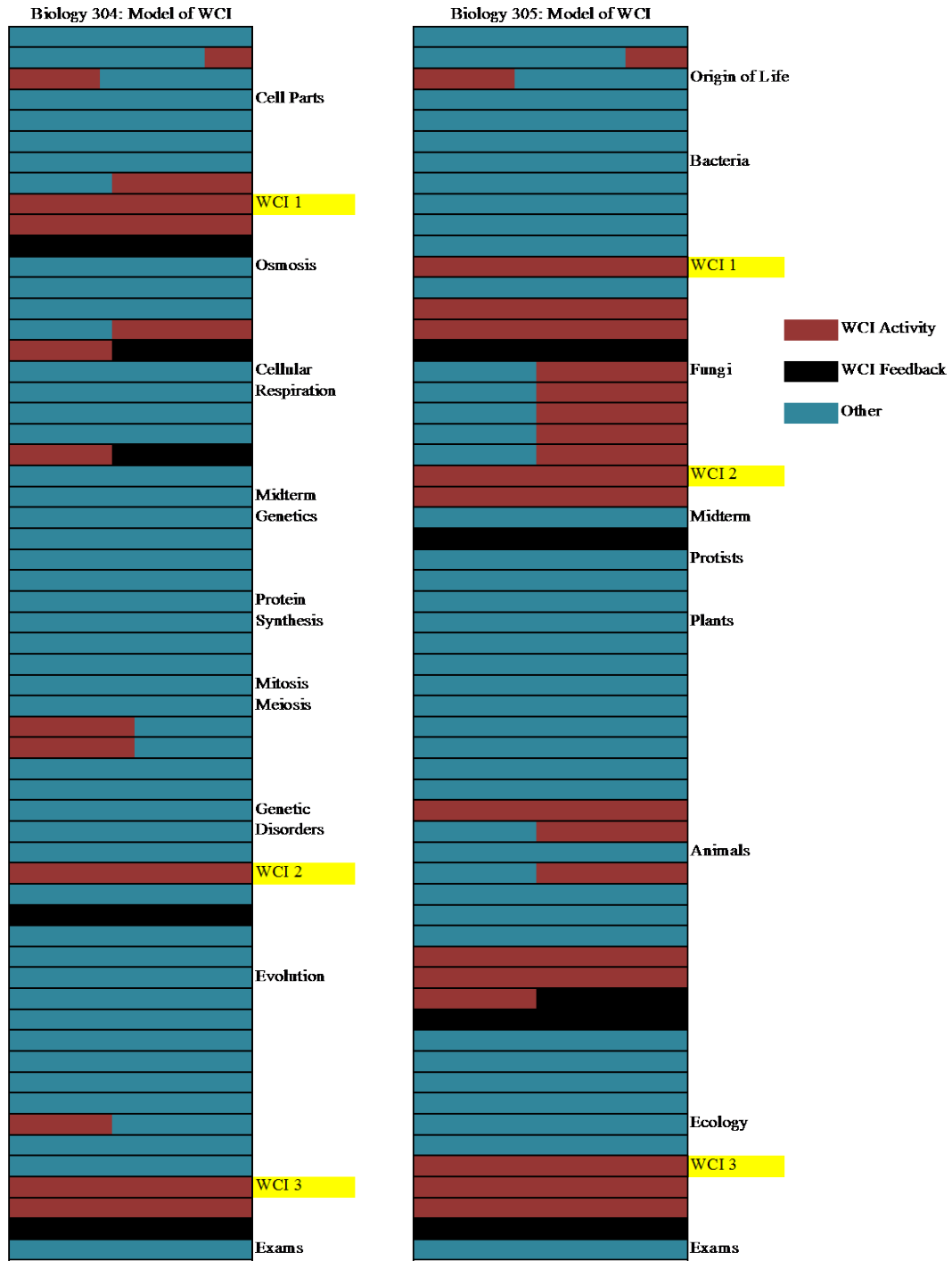


Figure 3. WCI timeline for two biology courses (red = WCI activity; black = WCI feedback; blue = other).

Data Collection

To determine the impact WCI had on students' attitude toward cooperative learning in a general education classroom, I established a baseline before implementing the WCI cycle using surveys and interviews. To do this, I had each student complete the Student Learning Preference Questionnaire (Appendix B) on the second day of the course. This instrument was considerably modified from the Grasha-Reichmann Learning Style Scale. The purpose was to determine whether or not the students preferred to learn socially or independently. The students ranked themselves using a Likert-Scale (*1 = strongly agree, 2 = agree, 3 = disagree, 4 = strongly disagree, 5 = not sure*) on 14 different statements. I compared these results with similar post-treatment data to determine if WCI had any effect on students' attitude toward group learning.

Also on the second day of class, I wanted to determine what previous experience students had with WCI, what their attitude was toward it and what they found challenging about it. Since WCI is used throughout the district, I knew all students, except for transfer students, would have experienced it before. I had each student complete the Student WCI Attitude Survey (Appendix C). For each statement, the student had to report whether or not it was *1 -always true, 2 - mostly true, 3 - sometimes true, 4 - rarely true or 5- never true*. With both pre-treatment surveys, I assigned a numerical value to each rating and the data was analyzed using the "mode." I used the mode for statistical analysis because a Likert-Scale is ordinal in nature, meaning an average would not be a true reflection of the results.

During the treatment phase, I collected data during and after each WCI assessment. On three separate occasions during the trimester, the students completed a WCI assessment. While students were working as a whole class to complete the assessment, a co-teacher and I were collectively gathering data on the students' performance. While one of us was taking video and audio recordings of the students, the other was documenting in writing what students were saying and doing. These observations were used to later grade the class on their ability to work together and solve the problem. Using the WCI Individual Performance Rubric (Appendix D) and WCI Whole Class Performance Rubric (Appendix E), I was able to quantify the whole class's and individual students' ability to collaborate and work effectively as a team. These scores were used to track any changes (*positive, negative, no change*) that occurred from the first to third WCI assessment. I also looked to see if there were any differences within sub-groups. This data allowed me to determine whether or not WCI was more effective with certain types of students.

Following each WCI assessment, I had each student complete a Perceptions of Whole Class Work reflection sheet (Appendix F). The purpose of this instrument was to have students reflect on the most recent WCI assessment as a way to foster growth for improvement on future WCI assessments. It also gave me an opportunity to continually assess what the students' disposition and feelings were toward their class's ability to work together. I had each student rate himself on a scale of 1-4 (a-d) for each statement. Like the pre-treatment surveys that used a Likert-Scale, I analyzed the data by recording the mode for each response for each statement. This allowed me to determine if a *positive, negative or no change* was occurring throughout the treatment period.

A post-treatment survey called Sense of Community Survey (Appendix G) was given at the end of the course to determine what impact the WCI model had in creating a sense of community in the classroom. Like the pre-treatment surveys, this survey used a Likert-Scale to measure student response.

Another pre-treatment data instrument was the Individual Interview Questionnaire (Appendix H). As a way to gather further evidence and avoid the potential student error of misreading a question on the survey, I individually interviewed 15 students to find out what their preferred learning style was and their attitude perception of learning through WCI. To select students, I randomly chose students who had parental permission to participate in the study. The interviews were carried out during the first week of class. I compared the interview responses to the data from the surveys to see if I was getting consistent information from the students. I also used the direct quotes to support the results from the surveys, if applicable.

According to Smithenry (2010) and Llewellyn (2005), successful implementation of the science inquiry model should result in a decrease in class time spent on lecture and discussion. After each instructional day, I estimated the time spent on five different types of instruction: lecture and discussion, lab work (non-WCI), group work, WCI projects, assessment and other. These categories were chosen to be consistent with the studies done by Smithenry (2010). I also kept track of what was done each day in order to construct a WCI timeline of the structure and sequence of the enacted curriculum. This model was based off the one developed by Smithenry (2010). The results from this analysis confirmed whether or not I successfully enacted the inquiry-based curriculum.

Table 2 shows all the different data collection techniques I used to answer each action research sub-question.

Table 2
Triangulation Matrix

Sub-Questions	Data Sources			
	1	2	3	4
What is student attitude toward science inquiry based learning?	Pre-Student Learning Preference Questionnaire	Pre-Student WCI Attitude Survey	Pre-Individual Interviews	Post-Sense of Community Survey
Does whole class inquiry impact students' learning of science content and new social skills?	Whole Class WCI Rubric (social)	Individual WCI Rubric (social)	Whole Class WCI Product Rubric (content)	
What challenges or frustrations exist for students during WCI assessments?	Perceptions of WCI Work Survey	Observations during WCI Assessments (written and video taped)	Co-Teacher Observations of WCI performance	
Did I successfully implement the whole class inquiry model?	Administrator walk-through/ observation data	Timeline of Enacted Curriculum	Percentage of time spent on Instruction	

DATA ANALYSIS

Collectively, the social-emotional aspect of whole class performance for all four classes improved over the course of the trimester. The average score on the first WCI assessment was a 66% ($N=81$). There was a 19% increase from the first to second assessment. There was a slight decrease in score percentage from the second to last WCI

assessment. However, the final score was still 12% higher compared to the first assessment (Figure 4).

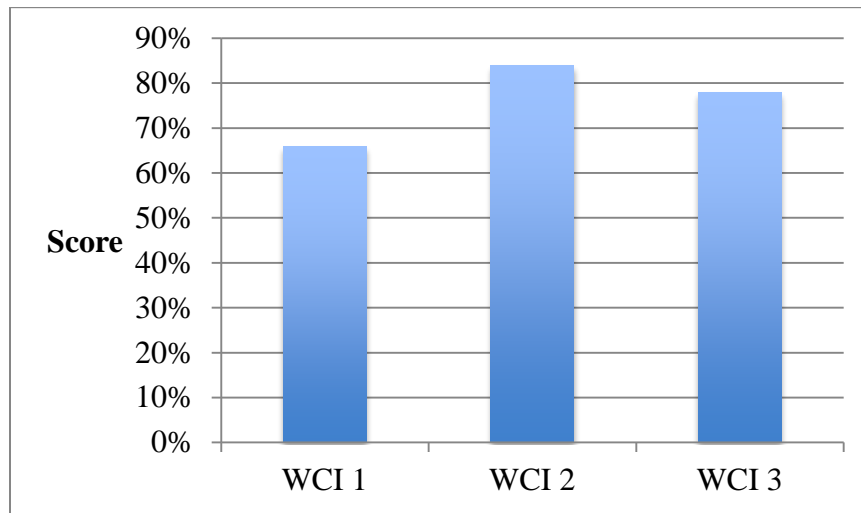


Figure 4. Social and emotional development for each WCI project.

Unlike the social-emotional aspect of WCI, the quality of the class product decreased from the first to third WCI assessment. From the first to second WCI, the product score increased by less than 2% while a 25% decrease occurred from the second to third WCI assessment (Figure 5).

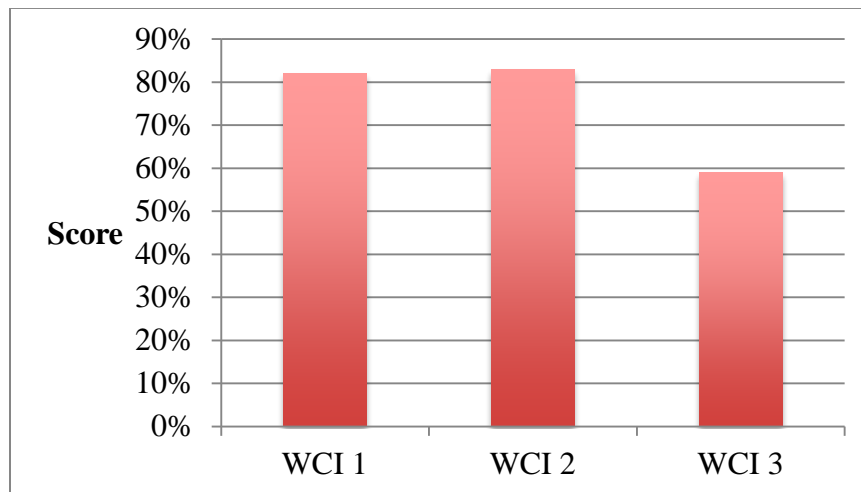


Figure 5. WCI product score for each WCI project.

When sorting students into three ability groups, individual performance was quite different. High-achieving students had the highest average (91%) over the course of three WCI assessments. Middle-achieving students were next with 73% and low-achieving averaged 64%. Figure 6 shows high-achieving students scoring similarly for all three WCI assessments with low-achieving students being the least consistent. All student groups showed some improvement from the first to second WCI assessment. Middle and low-achieving students were the only two groups that decreased from the second to third, with a combined average decrease of 21%. Low-achieving students accounted for most of this decrease, showing a 27% decline from the second to third WCI.

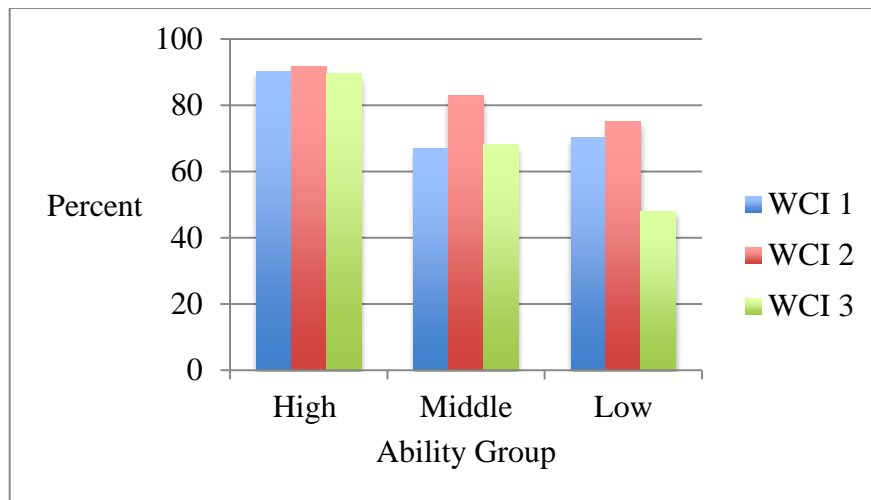


Figure 6. Individual performance assessment scores by ability group.

According to student self-perception, student contribution increased from the first to third WCI assessment (Figure 7). On the WCI survey given at the end of each WCI assessment, the number of students that said they contributed a lot to the WCI project increased from 25% on the first WCI to 55% on the third.

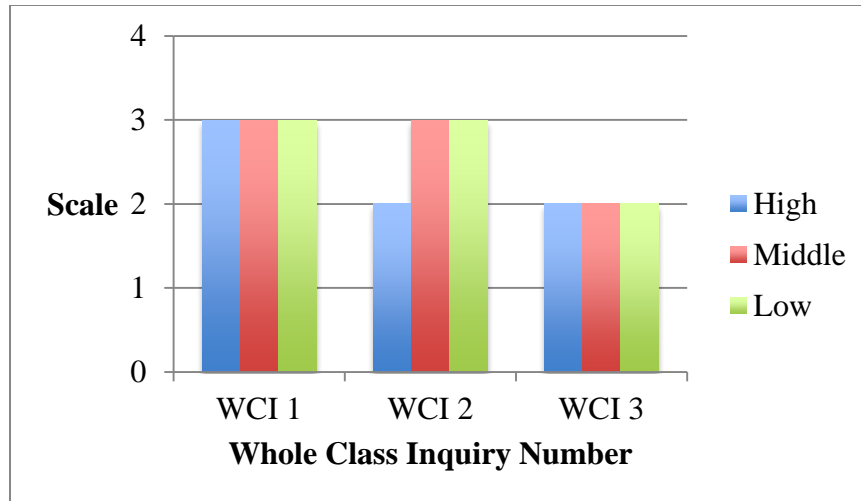


Figure 7. WCI survey results for student contribution (1=couldn't have done it without me, 2=a lot, 3=could have done more, 4=nothing).

Based on ability groups, high-achieving students were faster to change and respond to feedback than the other two groups. From the first to second WCI assessment, the number of high-achieving students that said they contributed a lot increased by 9%, compared to middle and low-achieving students that increased by 2% and 0% respectively. From the second to third WCI, high-achieving students increased again, but only by 3%, whereas middle and low-achieving students increased by 5% and 9% respectively.

Similar to their perception of contribution, students also felt that their class was able to work better as a team after the third WCI assessment. After the 1st WCI, 32% of the students felt that most of their classmates worked as a team. By the second WCI this percentage increased by 14% and after the third WCI assessment, 61% of the students said most worked as a team.

Each WCI assessment continued to teach the students about teamwork. According to the students' perception, the percentage of students that learned something about teamwork increased from 80% after the first WCI assessment to 94% after the last

WCI. The majority of students after each WCI said they learned “a little” about teamwork, with slightly fewer reporting they learned “a lot.”

Before beginning the treatment, the majority of students had experienced doing whole class inquires. Twenty-eight percent could not remember if they had done a WCI before. Of the remaining students, 69% percent of students had done them on at least three occasions with 33% of students doing seven or more. Of the students who had experienced WCI before, 20% of them said that WCI *always* helped them to work with others. Another 65% said this was *mostly or sometimes true* for them. Low-achieving students, however, felt less confident that WCI could teach them to work with others.

At the end of the course, all groups of students had the same feeling about WCI and what they had learned from it. Of all the students, 78% said the WCI assessments had taught them how to work more effectively with other people and be a better team player. Ninety-seven percent said it was important to listen to others’ ideas and 84% said they had learned how to listen to others’ ideas. Fifty-seven percent said they had developed new life skills and 65% of students said they would apply these life-skills to their future careers.

Eighty-eight percent of the students said their teacher expected them to learn. Fifty-two percent felt like they were part of a community while 34% did not feel this way. Seventy-nine percent of the students said they knew every one of their classmates by name.

INTERPRETATION AND CONCLUSIONS

To measure the development of life skills, each class was scored on their ability to work collectively as a team. This score was based on five characteristics: communication, organization, ownership, interaction and inclusion. When all four classes were combined, the results suggest that WCI was effective at developing these five characteristics in students. As the first research study done on WCI at Clinton High School, this study supports its continued use as a method for teaching students life skills.

Aside from the teacher assessment, the student attitude surveys also support the learning of new life skills. These skills included how to be a better team player, listen to others' ideas and work with others. Over half of these students also felt like they would use these life skills in their future careers. When interviewing students following the first WCI assessment, some students reported learning about teamwork, which matches the data. One student said, "WCI helped me to learn to work with a team." A second student said, "I learned leadership skills and that I am not good at communication."

Surprisingly, from the second to last WCI assessment, all but three classes showed a tremendous decline in product performance, where one might expect the opposite. This study suggests that multiple forms of assessment should be given to measure student learning of science content and process skills through WCI assessments. Also, WCI products should be designed to get more challenging and involved over time however keeping in mind not to go beyond the scaffolding. Lastly, student performance on a product may be tied to organization, perception and enjoyment rather than what they actually know.

This study suggests that when assessing students based on social skills, students with learning disabilities may score lower than their peers. This is not surprising since students with learning disabilities can struggle in social situations. The nature of WCI assessments is very social. The two teachers observed that students with identified learning disabilities, but not typically those with both learning and behavioral disabilities, struggled to interact during the WCI assessments. Since their performance grades were largely dependent upon social involvement, it is no surprise that they struggled the most of the three achievement groups.

One method that was found to improve student involvement of students with learning disabilities was for the teacher to step out of the role-play and provide guidance. However, further studies are needed to determine what strategies can be effectively used during WCI activities to support low-achieving students. A teacher should also keep in mind that not all students are the same with some being more introverted than others. Introverted students may struggle in WCI assessments. Teachers need to recognize that these students may need more guidance than others on how to interact with their peers and be given time to think and work in isolation.

This study found that the teacher spent more time on student-centered activities (WCI projects, lab work and group work) than on teacher-centered activities (lecture and discussion) (Figure 8).

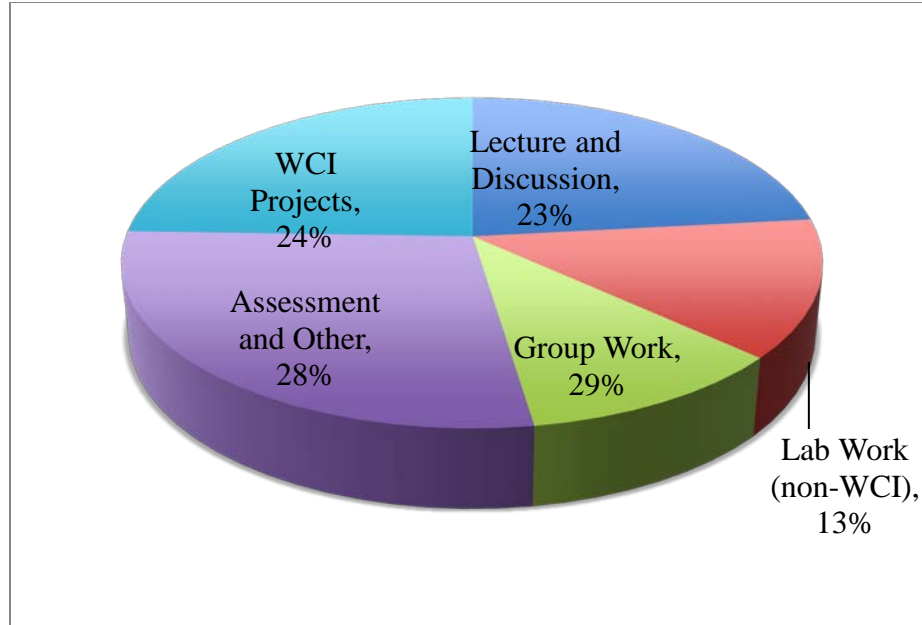


Figure 8. Amount of time spent on each type of instruction.

It can be concluded that the teacher-researcher successfully implemented an inquiry-based curriculum. In this case, success was determined by the amount of time spent on teacher-centered learning. Whole class inquiry was effective at reducing the amount of time spent on teacher-centered instruction compared to a traditional science classroom.

VALUE

This study demonstrated WCI's ability to improve students' social and emotional skills or life skills over the course of the treatment period. Teacher assessment of class collaboration showed improvement from the first to last WCI assessment. However, when looking at each class separately, I noticed that some classes performed quite well where others did not (figure 9).

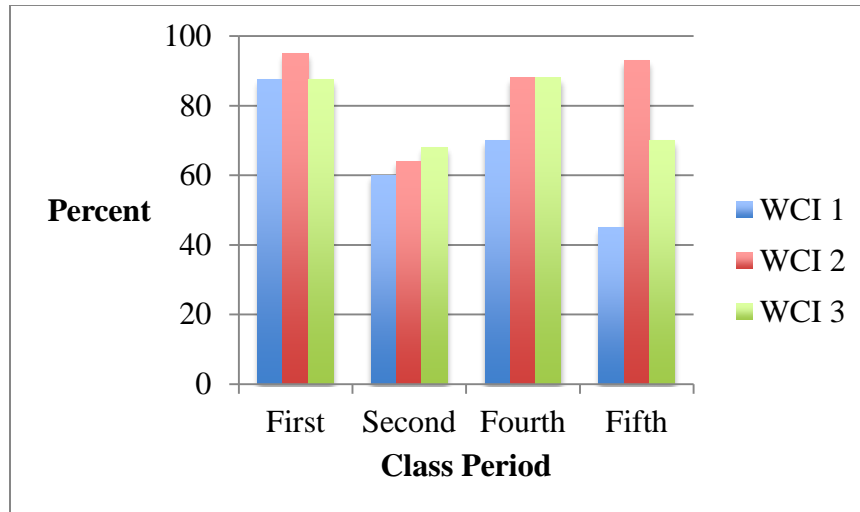


Figure 9. Social-emotional assessment scores by class period.

Taking a look at the first and fifth hour whole class performance, there are some striking differences. The average social-emotional score for first hour was 90% whereas fifth hour averaged 69%. Since these two courses were taught nearly the same (first and fifth hour were taught Biology 305 and second and fourth hour were taught Biology 304), one might assume the results to be similar. To find out why there was such a difference, I first looked at classroom demographics.

I assumed that a class with a higher percentage of students with learning and behavioral disabilities would struggle to work together, at least in the beginning when social cohesion is lower. The fifth hour class did have a high percentage of these students, 46% Special Ed/At-risk compared to 54% neither. However, first hour had an even higher number of students with disabilities. This class contained 67% Special Ed/At-risk and only 33% neither. Comparing the whole class performance between the two classes, first hour nearly doubled the score received by fifth. If the reason for fifth hour's low performance cannot be attributed to the number of low-achieving students or the type of course, what can?

There are two other possible reasons for the difference between first hour and fifth hour. Even though first hour had a greater percentage of students with learning and behavioral disabilities, they had a lower percentage of students listed as *both* special education and at-risk. Except for two students, every student with an IEP in fifth hour was also listed as being at-risk. This is unlike first hour, which had only one student listed as special education and at-risk. I concluded from this that a high number of students labeled as having learning *and* behavioral disabilities may initially struggle more than other classes on WCI assessments. However, as the results show, improvements can be made. In fact, once this type of group can build social cohesion, they may outperform other classes. This happened with fifth hour, which improved by more than 40% from the first to second WCI assessment.

From my classroom observations, another possible reason for the difference in performance between first and fifth hour had to do with leadership. From the very beginning, first hour elected three leaders that had done several WCI assessments before. One of these students had actually failed the course and was retaking it for a second time. This student already had a clear sense of my expectations, which helped the class outperform other classes. Fifth hour, on the other hand, did not have as strong of leaders. It took them until the second and third WCI assessment to elect leaders that were effective.

What is promising from this study is that classrooms, like first and fifth hour that have a high number of low-achieving students, can perform just as well as other classes and in some cases, even better. This study would also suggest that a certain level of

quality student leadership and understanding teacher expectations is necessary for this success to take place.

Another promising outcome from this study is that it shows that success on WCI assessment is not contingent upon initial success. The case between first and fifth hour shows that fifth hour was able to match that of first hour on the second WCI assessment. Reasons for this 48% increase from the first to second WCI assessment can be attributed to improved social cohesion and understanding teacher expectations, as mentioned above.

The best way for a teacher to communicate his or her expectations is with feedback. Immediately following the presentation of WCI assessment #1, I spent one full 70-minute class period giving students feedback. Since fifth hour performed so poor initially, I promised them that if they did significantly better on WCI 2 that I would throw out their performance grade on WCI 1. Due to time constraints, I had to begin WCI 2 the next day following the feedback.

It is likely that the combination of communicating my expectations through feedback, providing a grade incentive and giving students the opportunity to immediately implement what they had learned from the feedback caused fifth hour students to improve so drastically and nearly match the performance of their first hour peers.

Another possible reason why fifth hour did so much better on the second and third WCI assessments may have to do with changes in student demographics. Although it didn't change much after the first WCI assessment (46% Special Ed./At-Risk compared to 43% Special Ed./At-Risk), the few students that were not present for subsequent WCI assessments made a big difference. There were three students from this class that were not present for later WCI assessments because they were sent to an alternative school due

to poor behavior and attendance. When these three students were present the whole dynamic of the classroom was changed in a negative way. On November 19, 2011 following a class period with fifth hour I wrote:

I was surprised with how well the class did on Thursday, but that was without Student A and Student B. On Friday (yesterday) I got to see the full potential of the class, and it was not pretty. Between the two of us [teachers], we were not able to maintain control. Udder chaos ensued.

It is obvious from my journal reflection that the absence or presence of student A and B had a profound impact on classroom management and thus overall learning. These students were later removed from the classroom. It is possible that the absence of these students also contributed to fifth hour's better performance on WCI 2 and 3.

In conclusion, I learned the WCI model can promote student development of social and emotional skills. Even though some classes scored lower than others, all classes showed improvement from the beginning to end. This can most likely be attributed to teacher feedback following each WCI assessment. Other factors that seem to play a role in class success are 1. student demographics, particularly the number of students listed as having *both* learning and behavioral disabilities, 2. students' prior experience with WCI, 3. student leadership skills, and 4. overall classroom environment, which can be largely influenced by the presence or absence of a few students.

Whole class inquiry is not only about developing students social and emotional life skills. The primary purpose of WCI is still to teach students about science through

hands-on, student-centered learning. The way that WCI measures student knowledge of the scientific method is through a product. As shown in figure 10, all but three classes scored the lowest on the last WCI, where I had expected to see the opposite.

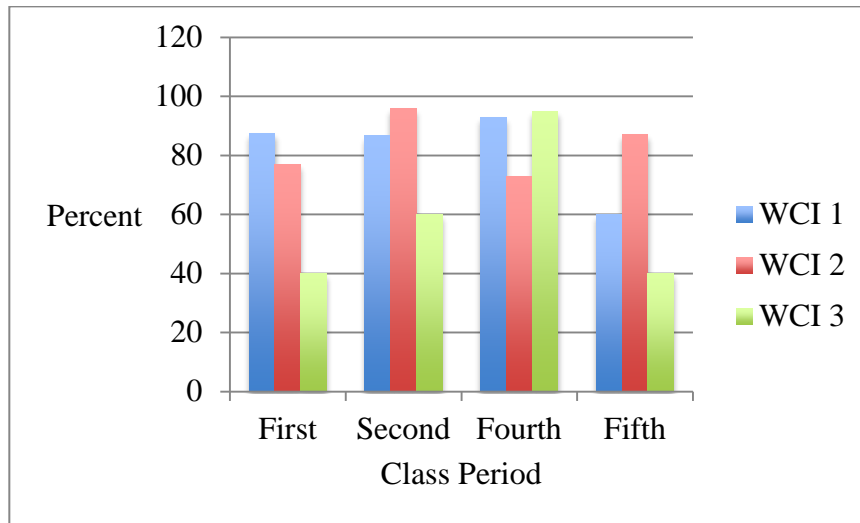


Figure 10. Product assessment scores by class period.

Aside from fourth hour, all other classes showed a decrease from the second to third WCI, with an average score of 40% less on the final WCI. This resulted in fourth hour being the only class to show an improvement from the first to last WCI. On average, fourth hour consistently produced the best product (87%) with second hour nearly just as good (81%). First and fifth hour scored much lower, 68% and 62% respectively. Even though first hour scored high on social-emotional, they were the only class that never demonstrated any improvement in their ability to produce a quality product. All other classes improved at least once between the WCI assessments, with the most common improvement occurring between the first and second WCI.

Obviously, I wanted to know why students' product did not improve like the social-emotional skills did. One possible reason may have to do with student attitude

toward the project. Students were asked at the end of the trimester to choose their favorite WCI assessment. It was found that with all classes, the majority of students preferred the second WCI assessment. It could be possible that the students liked the project more because they performed well on it, thus impacting their perception of it. Likewise, fewer students may have liked the last WCI assessment because of their poor performance. However, the reverse could also be the case. Students that enjoyed the project may have worked harder on it and thus produced a better product.

Related to attitude, another reason why most classes did not perform well on their last product may have to do with timing. The final WCI assessment came at the end of the trimester. At this point the students were anticipating the end of the course, which contributed to a greater sense of apathy.

One of the recommendations for WCI assessments is that they get successfully more challenging, requiring the students to apply what they have learned from previous WCI assessments (Smithenry, 2009). When implementing the WCI curriculum, I tried to follow this recommendation and make the WCI product requirements more challenging. It may be that the final WCI was too challenging and caused classes, especially for Biology 305, to drop significantly from the second to last WCI assessment.

Using the product as a way to measure student learning of scientific concepts and process skills may not be sufficient by itself. As suggested by Gallagher-Bolos and Smithenry (2009), an individual content assessment in the form of a traditional multiple-choice quiz or test can be given at the end of the WCI project as well. This would be a good way of measuring what students had learned and might give more accurate data. In this study, students were given quizzes and tests, but the content on these were not

always taught through the WCI assessments. For this reason, I did not include individual quiz scores as viable data.

Aside from the reasons mentioned above, another factor for the drop in product performance on the third WCI assessment may have to do with the high success on WCI #2. In my observations I have noticed that WCI performance growth is not always linear. Often students do poor initially, which causes them to be more engaged in the feedback, which they internalize more deeply thus contributing to greater success on the following WCI assessment. When students do well, they don't listen to the feedback as well because they have a "we're already good" attitude. This may be why first hour declined after their stunning performance on WCI #1 and why fourth hour did well on the final WCI.

One requirement of WCI is that all students receive the same grade. Although 59% of the students agreed they don't like this aspect of WCI, with it, the "whole-class" nature of WCI would be lost. It also teaches the students a fact of reality. With any job, how many projects are solely dependent upon one individual? Students need to learn that their success does depend on others. Although WCI requires students to be graded collectively, it is still possible to grade students individually as well.

When analyzing average individual performance by class, performance scores looked similar to product scores. All classes showed a decrease from the second to third WCI assessment except for fourth hour, which demonstrated consistency and slight improvement over time (Figure 11).

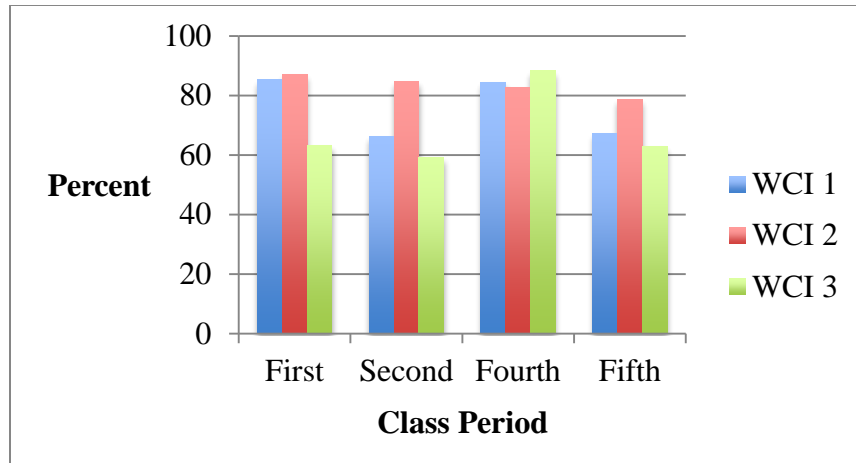


Figure 11. Individual performance assessment scores by class period.

This action research study showed that on the second WCI assessment when the product scores were the highest, both whole class and individual performances were also the highest. Although it does not sound revolutionary, it confirms the obvious: the amount of learning that took place increased when more students were involved and engaged.

The benefit of WCI over traditional styles of teaching is that it is concerned with improving overall student involvement. As the number of students that contribute, get involved, put forth effort and hold themselves accountable increases, then the overall success of the class also increases. In contrast with most perspectives on education, WCI seeks to build student skills before knowledge of the content. Once those skills are laid down and students know how to contribute, communicate, and problem solve, then greater learning does take place for all types of students.

It was also important to me to know what impact WCI had on different groups of students. The study found high-achieving students consistently outperformed the other two groups, averaging 91%. Medium had the next highest average at 73% and low was at 64%.

Initially, this is what a person would expect, that students who have a higher G.P.A. will always outperform those who don't. However, some studies that looked at the impact of inquiry-based learning and students with learning disabilities, found that students with learning disabilities would equal or outperform higher achieving students when learning through inquiry (Bianchini et al., 2003; Scruggs et al., 1993).

The most likely difference between those studies and this one has to do with the form of assessment. In the previous studies, the student's content knowledge was assessed using a standardized test. This proved that inquiry helped low-achieving students master the content better than with traditional methods of teaching.

In my study, I assessed individual students primarily based on their skills, not content knowledge. I concluded that the social nature of WCI compared to other inquiry-based methods might present challenges for low-achieving students. As observed, some students with learning disabilities lack the self-confidence or content knowledge to proactively engage in the class activities. Also, these students may be knowledgeable but be more introverted than their peers. This causes them to feel uncomfortable working in large group settings causing them to disengage rather than engage.

One method that was found to improve student involvement of students with learning disabilities was for the teacher to step out of the role-play and provide guidance. The original WCI model requires that the teacher role play, or step out of his or her role as a teacher and into another character. The reason for this is that it allows the teacher to put more responsibility on the students and take away the dependence that students often have on teachers to give them the answers. One outcome of this is that the teacher should

not intervene, unless absolutely necessary, in the students' learning. If something needs to be addressed, it is addressed in the feedback session following the WCI presentation.

If a teacher follows this WCI model, then he or she may not want to step in and offer students help. This becomes alarming for those students with learning disabilities. Since this study suggests that students with such learning disabilities may struggle with social involvement or participation, it may be acceptable under these circumstances for a teacher to step out of a role-play character and offer guidance for the student. In fact, research studies done on students with learning disabilities showed that guided-inquiry can be effective as long as it is highly structured (Scruggs et al., 2008). Although Dennis Smithenry describes WCI as a form of guided-inquiry, it appears that more teacher guidance may be needed when working with special needs students during WCI.

Take this as one example. During one WCI assessment, a low-achieving student was standing around a group of peers working on the project, but didn't know how to approach them to ask how he could help. Later on, some students noticed him and asked him to help by writing an analogy. He was eager to help but showed his lack of competency when he came to ask me for help; he didn't know what an analogy was. Although WCI, like any inquiry-based model, requires greater doing by the student, this study shows once again that some level of teacher intervention, guidance and modification is needed for low-achieving students.

There are challenges to implementing WCI, as there are with anything that is new. Whole class inquiry will be new to students, just like it will be for a teacher. When interviewing students following their first WCI assessment of the trimester, frustration was expressed. One student said, "I don't like it [WCI] because it ends up with certain

people doing all the work. I would rather do it myself or in groups because it causes frustrations.” As a teacher, it is important to communicate with students the reason for doing WCI, which is primarily to develop life skills. Most students will soon realize and acknowledge its importance, despite its frustrations.

As teachers in the 21st century we need to reevaluate the purpose of why we teach. Before WCI I was like many other science teachers. I felt the most important thing for students to know was the content and my success as a teacher depended on how well students performed on standardized tests.

Whole class inquiry has taught me that although knowledge of the content is important, the skills that students learn are even more important. As the saying goes, “Give a man a fish and he will eat for a day. Teach a man to fish and he will eat for a lifetime.” Which one of these are we doing for the youth of this country? If you can give the student the skill, then they will be set for life.

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APPENDICES

APPENDIX A

EXEMPTION REGARDING INFORMED CONSENT

Exemption Regarding Informed Consent

I, Karinne Tharaldson-Jones, Principal of Clinton High School, verify that the classroom research conducted by Adam Bohach is in accordance with established or commonly accepted educational settings involving normal educational practices. To maintain the established culture of our school and not cause disruption to our school climate, I have granted an exemption to Adam Bohach regarding informed consent.

Karinne M. Tharaldson

(Signed Name)

Karinne M. Tharaldson

(Printed Name)

11-9-11

(Date)

APPENDIX B

STUDENT LEARNING PREFERENCE QUESTIONNAIRE

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

Student ID Number _____

For each statement, fill in the circle that best describes you.

Strongly Agree = SA Agree = A Disagree = D Strongly Disagree = SD Not sure = N

	Statement	SA	A	D	SD	N
1	Working with other students on class activities is something I enjoy doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	I would prefer the teacher just tell me what I need to know for the test.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	Paying attention during class sessions is difficult for me to do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	I like to develop my own ideas about what to learn.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	Class activities make me feel like part of a team where people help each other learn.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	I try to participate in as much as I can in all aspects of a course.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	An important part of taking courses is learning to get along with other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	If I like a topic, I try to find out more about it on my own.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	I prefer class sessions that are highly organized.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	I prefer to work on class projects and assignments by myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	I am willing to help other students out when they do not understand something.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	When I am confused, I ask my teacher for help first before trying to figure it out myself or ask a classmate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	You must participate in class if you want to understand.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	You have to understand the material before you can participate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Modified from the Grasha-Reichmann Learning Style Scales: <http://www.longleaf.net/teachingstyle.html>

APPENDIX C

STUDENT WCI ATTITUDE SURVEY

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

Student ID Number _____

Male _____ **Female** _____ **Age** _____ **Grade** _____

For each statement or question, circle the one that applies to you.

**Approximately how many whole class inquiry activities have you done?
(Include middle school and high school)**

0 – 2 3 – 4 4-5 5 – 6 7+ Not sure

I enjoy doing whole class inquiry activities.

Always true Mostly true Sometimes true Rarely true
Never true

Doing whole class inquiry activities frustrate me.

Always true Mostly true Sometimes true Rarely true
Never true

During a whole class inquiry I am the student who does most of the work.

Always true Mostly true Sometimes true Rarely true
Never true

During a whole class inquiry I am usually elected to be a leader.

Always true Mostly true Sometimes true Rarely true
Never true

Whole class inquiries help me learn to work with others.

Always true Mostly true Sometimes true Rarely true
Never true

I would like whole class inquiries better if my grade didn't depend on other students.

Always true Mostly true Sometimes true Rarely true
Never true

APPENDIX D

WCI INDIVIDUAL PERFORMANCE RUBRIC

	Distinguished (5)	Proficient (4)	Apprentice (3) 45	Novice (2)	Total (20)
Contribution	<ul style="list-style-type: none"> You contributed a great amount to the success of the group You showed leadership, professionalism, and took the project seriously 	<ul style="list-style-type: none"> You contributed a great amount to the success of the group You “followed the leader” to be sure the group was successful You were willing to do more than just your part to insure the success of the group 	<ul style="list-style-type: none"> You contributed what was assigned You completed your duties and responsibilities that were assigned – no more, no less. 	<ul style="list-style-type: none"> Your contribution (if any) was minimal Your role was unclear and/or you relied completely on the people in your group to do what you could have done You were unable to state what your job was and/or your job reflected minimal effort on your part 	
Knowledge	<ul style="list-style-type: none"> You made sure to know everything that was going on in your group. You not only knew your job, but were aware of what the others were reporting as well 	<ul style="list-style-type: none"> When assigned, you finished what you were supposed to. You knew of all the jobs in your group, but were most familiar with your own 	<ul style="list-style-type: none"> You knew what you reported on/what you were responsible for You assumed the rest of the group did their part without checking first 	<ul style="list-style-type: none"> You knew very little of what was going on with the entire project You did not do what you were supposed to do or the quality of your work/knowledge was evident with your presentation 	
Effort	<ul style="list-style-type: none"> You were actively engaged throughout the entire experiment You took this project seriously You were a motivator for your group/class Your performance is something your group, your teachers, and you can be proud of 	<ul style="list-style-type: none"> You were actively engaged during most of the experiment You demonstrated a visible amount of care and interest in this project Your motivation to do well/care for your grade was a driving force for you in this project 	<ul style="list-style-type: none"> You were actively engaged during your part of the experiment and passively engaged through the other parts of the experiment Your effort was enough to get your job done and to keep your interest When you were finished with your work, you assumed you had done enough 	<ul style="list-style-type: none"> Passively engaged You waited for someone to tell you what to do instead of taking the initiative independently You were apathetic or indifferent to the result of this project. 	

Personal Responsibility	<ul style="list-style-type: none"> • Came prepared and ready for each day • Was accountable and reliable and showed ownership for the project • Led the group; defined roles and responsibilities • You set high standards for your group and for yourself 	<ul style="list-style-type: none"> • Group could count on you to do your part • You were willing to help out if someone wouldn't or couldn't • You had high standards for yourself 	<ul style="list-style-type: none"> • You did your part most of the days by coming with what you needed. • You completed your task and were ready for each day but did not take the initiative or interest in the rest of the project. 	<ul style="list-style-type: none"> • Your performance reflects a lack of responsibility for yourself. • You were unprepared and reliant on your group to complete the task • It did not appear by your performance that you took this project seriously 	
	A = points	B =	C =	D =	

APPENDIX E

WCI WHOLE CLASS PERFORMANCE RUBRIC

	Distinguished (5)	Proficient (4)	Apprentice (3)	Novice (2)	Total (30)
Communication	<ul style="list-style-type: none"> Everyone in the class knew what was going on and what to do even if they were absent Used directors as a source of communication and information Every person was able to share ideas and class listened to their ideas 	<ul style="list-style-type: none"> Most people knew what was going on and communicated it to those who didn't When problems came up, groups discussed and solved the problems 	<ul style="list-style-type: none"> About 50% of the class knew what was going on/had the criteria communicated to them The group solved their problems independently and sometimes relied on the teachers 	<ul style="list-style-type: none"> Most of the class did not know what was going on There was a climate of chaos Class did not effectively deal with absences Directors were not used as a means of getting information Class was not receptive to other peoples' ideas 	
Organization	<ul style="list-style-type: none"> Class took notes, cleaned up, and restored the classroom the way they found it Each person knew where their materials were and how to access them 	<ul style="list-style-type: none"> Most groups/people documented their projects Materials were put back in a place where they could find it next time Most groups presented their complete presentations 	<ul style="list-style-type: none"> A few students took notes/documentated their projects A few students took the initiative to clean up the materials Few groups were organized enough to be ready to present 	<ul style="list-style-type: none"> Class was unprepared by not having materials Presentations were incomplete 	
Ownership	<ul style="list-style-type: none"> The class collectively showed interest and ownership of the project and showed up daily There was a visible level of pride and professionalism involved in the experimental process 	<ul style="list-style-type: none"> The majority of the class showed interest and ownership on a daily basis Most people were professional and able to produce something we all were proud of 	<ul style="list-style-type: none"> Some members of the class were interested and showed ownership of the project Some of the members of the group treated this project with professionalism 	<ul style="list-style-type: none"> Class was apathetic or indifferent to the project Showed little leadership, care, or ownership in the process of developing the experiment Attendance was a major issue 	

Interaction	<ul style="list-style-type: none"> • Interactions were positive, respectful, purposeful, and produced good results • Students accepted feedback by continuing what worked and changing what didn't 	<ul style="list-style-type: none"> • Most interactions were positive, respectful and purposeful • Students accepted feedback and most of them changed their path for the better 	<ul style="list-style-type: none"> • Interactions were positive, respectful, purposeful about 50% of the time. • Some students accepted feedback, some did not make any changes as a result of feedback 	<ul style="list-style-type: none"> • Students did not treat one another with respect and dignity. • Interactions were not always positive or purposeful and distracted the group from the goal • Did not respect their elected directors 	
Inclusion	<ul style="list-style-type: none"> • Every person in the class participated • Class leaders and members motivated one another to complete the task • Groups assigned roles to each member so everyone was included 	<ul style="list-style-type: none"> • There were only a few students that didn't participate 100% of the time • Directors were motivating and able to help groups get done • Most of the kids were included, but roles and jobs changes as they were not assigned 	<ul style="list-style-type: none"> • About 50% of the class participated • In groups it was visible who was working and who was not. • The groups did little to motivate and include others • The group was reliant on the leaders 	<ul style="list-style-type: none"> • More than 5 students were not included or engaged in the project • Class did not attempt to motivate one another to complete their tasks • It was apparent that few people were working and others were allowing them to do all the work 	
	A = 27-30 points	B = 24-26	C = 21-23	D = 18-20	

APPENDIX F

PERCEPTIONS OF WHOLE-CLASS WORK

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

Student ID Number: _____

- 1. How much would you rate your contribution during the whole class inquiry project?**
 - a. Couldn't have done it without me
 - b. A lot
 - c. Could have done more
 - d. Not much
- 2. How would you rate your class on their ability to work collectively as a group?**
 - a. Example of perfect team work
 - b. Most worked as a team
 - c. Some parts did work, some parts did not
 - d. Can't work collectively at all
- 3. Rate your level of frustration**
 - a. None
 - b. A little
 - c. Mostly frustrated
 - d. Always frustrated
- 4. Rate what you learned about science from this project**
 - a. Nothing
 - b. A little
 - c. A lot
 - d. This was extremely teachable!
- 5. Rate what you learned about teamwork from this project**
 - a. Nothing
 - b. A little
 - c. A lot
 - d. This was extremely teachable!
- 6. What impact did your attitude have on the outcome of this whole class inquiry project?**
 - a. My attitude doesn't affect others
 - b. A little
 - c. A lot
 - d. Attitude has everything to do with it

Answer the following questions on the backside of the paper:

1. What went well in this project?
2. What did not go well in this project?
3. What will I do differently as an individual to improve the class' performance?
4. What should the class do differently next time to improve?

APPENDIX G

SENSE OF COMMUNITY SURVEY (POST-TREATMENT)

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Student ID Number _____

For each statement, fill in the circle that best describes you.

Strongly Agree = SA Agree = A Disagree = D Strongly Disagree = SD Not sure = N

Statement	SA	A	D	SD	N
I wish the teacher had offered more help during the whole class inquiry activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I did not like it when the teacher did not answer our questions during a whole class inquiry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is important to listen to other students' thoughts and ideas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know the names of all my classmates.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In this class, I felt as though I were part of a community.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My classmates felt comfortable participating in the whole class inquiries.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My classmates felt comfortable sharing ideas in the whole class inquiries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our teacher expected us to learn from one another.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I developed life skills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will use these life skills in my future career.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I learned how to listen to other people's ideas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whole class inquiry did not help me learn how to communicate better.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whole class inquiry taught me how to be a better team player.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whole class inquiry taught me how to work more effectively with other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

APPENDIX H

INDIVIDUAL INTERVIEW QUESTIONNAIRE

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

Student ID Number _____

Proposed Questions:

(Note: students will have recently completed an inquiry activity *prior* to this interview)

1. Do you prefer learning on your own, listening to class lectures, or working with others?
2. Is there anything you can learn when working with others that you can't learn on your own?
3. What are your feelings about learning through group work and hands-on-activities?
4. How did working on this project with the whole class affect your learning? This includes anything, not just biology.
 - a. If it was helpful...why do you think that working with the whole class was helpful for you?
 - b. If it was not helpful...what were some of the challenges that you experienced?
5. Do you feel that what you learn in school will help you in your future career?

6. How do you think teachers can prepare students for the real world outside of school?

Is there anything else you would like me to know?