

**A MODEL INFECTIOUS DISEASE CURRICULUM FOR FOURTH GRADE
STUDENTS: INTEGRATING PREVENTION AND EDUCATION CONCEPTS IN
THE CLASSROOM**

by

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ABSTRACT

Despite the significant need for prevention education and updated disease curricula in elementary schools, there is a deficit of model units, lesson plans, and activities at the fourth grade level. An infectious disease and prevention teaching unit has been developed, following guidelines specified by the Centers for Disease Control and Prevention and a format consistent with proven pedagogical methods. This curriculum was tested in five classrooms with a total of 94 students.

Prior to implementation, an assessment of all fourth grade teachers in the district examined their perceived knowledge of infectious diseases and their perceived self-efficacy in teaching such content. Evaluation of student progress included student pre and post-tests to assess changes in knowledge. Upon completion of the unit, teachers evaluated the unit to determine its relevance, effectiveness, and ease of implementation, and completed a post-test on their own knowledge and efficacy.

Results indicate that the unit was effective in increasing student comprehension and interest in infectious disease prevention, and teacher efficacy in delivery of the material. This model curriculum can serve as a foundation to increase school health education in critical public health areas such as infectious diseases and preparedness, and provide an early introduction to public health careers.

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INTRODUCTION

Despite the significant need for prevention and education concepts and updated infectious disease curriculum in elementary schools, there is a deficit of model units, lesson plans, and activities at the fourth grade level. In spite of significant improvements in public health, such as increased use of immunizations and treatment with antibiotics, infectious diseases still exist. However, new dimensions of infectious disease have created a need for increased attention. The school setting presents a prime location for the spread of pathogens, with school-aged children coming in contact with pathogens in classrooms, playgrounds, restrooms, and cafeterias.¹ School health educators must provide children with the knowledge and skills to prevent infectious diseases.

Unfortunately, many school districts have failed to develop updated and comprehensive programs of health instruction for implementation in local elementary schools. Primary factors have been shown to contribute to this omission include teacher reported discomfort in dealing with sensitive or potentially controversial health issues and lack of available and effective health education curricula and resources.²

Elementary school students are particularly eager to learn and teach others and it has been shown that health instruction during early school years can have a powerful influence on the quality of the lifestyle each child develops.³ Educational institutions are in a unique position to improve health outcomes for youth. In the United States, 53 million students are enrolled in approximately 117,500 elementary and secondary schools.⁴ Each school day, over 95 percent of all 5-to 17-year-olds have approximately six hours of instruction. Thus, schools represent the only public institution that can reach almost all young people.⁵

Unfortunately, in schools where some health education has been provided at primary and intermediate levels, the subject matter has tended to focus on grooming standards of personal care and watered-down study of anatomy and physiology of selected body systems.⁶ Often, lessons have been limited to the practice of tooth brushing or meal planning based on model meals that may or may not reflect realities of economics or cultural eating patterns.⁷ There was a time when the only consideration when planning for instruction was the named subject matter. As a global society, health education needs to be updated to include health topics affecting the world.

Historically, whenever new health problems have seemed uncontrollable through medical means, health education begins to be appreciated for its potential in solving the seemingly unsolvable. The current HIV/AIDS epidemic and the potential avian influenza pandemic bring attention to education and boost public recognition of its value as a weapon for disease control and prevention.⁸ Teaching activities have tended to emphasize the acquisition of health-related facts as ends themselves rather than a foundation for the ability to choose sensibly among alternative actions affecting general health. The emphasis has been almost entirely given to provision of bits of information about health, rather than ways to promote and protect health.⁹

Instead of telling children what to do and believe about their health, the concepts and skills children learn should promote acceptance of responsibility for their own actions and choices as these affect their health and safety.¹⁰ In this way, each elementary student will understand not only that they should cover their mouth when they cough, but what could happen if they did not cover it. Thus, they are participating effectively in self-care procedures appropriate to their age group's abilities and understandings, while

using thinking skills about their personal health, which have been fostered in their classroom.

Findings have confirmed that the individual classroom teacher has the potential to make a significant impact on student achievement. Specifically, research has revealed that effective teachers are successful with students of all ability levels and can make the single largest contribution of any professional group.^{11,12} Unlike secondary school teachers, who are often content specialists, elementary classroom teachers are often expected to deliver the entire health education program.¹³ This often requires teachers to go beyond the text-based curriculum, researching various kinds of appropriate activities for each science or health unit. A busy elementary school teacher, already burdened with teaching many subjects, may not have time to do the special planning this requires.¹⁴ Topics with which the teacher has little interest or experience may also be slighted. Additionally, few teachers are given much, if any, preparation for the health instruction for which they are the primary source during the vital first years of school.¹⁵

Compounding this problem is the fact that for many elementary classroom teachers there has been little or no health education included as part of their undergraduate teacher preparation. As a result, they lack knowledge and confidence in teaching many of the health content areas.¹⁶ Teachers need not be experts in curriculum design, but they do need to be comfortable in their grasp of its language and relevant data sources.¹⁷ An effective teacher has the potential to foster development of a healthy lifestyle among school children, which can be crucial, not just to the child's present well-being, but also to that of their families, friends, and their communities.¹⁸

Children do not wait until they are in their teens to establish their values and health habits.¹⁹ The elementary years of school are the years during which most health-affecting habits and attitudes are being learned and can be shaped or reinforced most easily.²⁰ Whatever other forces impact childrens' beliefs and actions, the schools are potentially among the most influential. Infectious disease information, including basic science and preventative education, should be gradually taught in elementary school, along with traditional science topics, rather than being delayed until the ninth or tenth grade.

To this end, an infectious disease and prevention teaching unit has been developed, following guidelines specified by the Centers for Disease Control and Prevention. The format used for the unit was consistent with proven pedagogical methods in order to allow it to be easily implemented into current curriculum. Five teachers, in different schools, taught the unit with fourth grade classrooms totaling ninety-four students. Prior to implementation, an assessment of all fourth grade teachers in the district examined their knowledge of infectious diseases and their perceived self-efficacy in teaching such content. Evaluation of student progress included student pre- and post-tests to assess changes in knowledge in basic science concepts of infectious disease and methods of infectious disease prevention.

Upon completion of the unit, teachers evaluated the unit to determine its relevance, effectiveness, and ease of implementation, and completed a post-test on their own knowledge and efficacy. The purpose of this was to determine whether this unit of infectious disease curriculum was effective in increasing student comprehension and interest in infectious disease prevention, and teacher efficacy in delivery of the material.

The objective for this model curriculum is to serve as a foundation for increased school health education in critical public health areas such as infectious diseases and preparedness, and provide an early introduction to public health careers.

The teaching methods used in the unit were set up to address different learning styles and modalities and thus incorporated several optional hands-on activities. The relevance of this conceptual and activity-based approach to science and health is covered in the review of related literature section. The methods section outlines the information provided students and teachers, as well as the learning objectives. The results section will illustrate the performance of the fourth grade students on both the pre- and post-tests for the infectious disease unit, as well as their performance compared with pre- and post-test performance in a pre-existing dental health unit. The discussion section will contain a review of the infectious disease unit's strengths, limitations, and future directions.

REVIEW OF RELATED LITERATURE

While there is a lack of infectious disease curricula at the elementary level, there is also a deficiency of studies and related literature. The only infectious disease-based education that has been significantly promoted has been concerning HIV/AIDS. In the absence of a cure for AIDS, and the likelihood of a safe and effective vaccine being perhaps decades away, education has been recommended as the major, if not the only strategy for preventing future cases of HIV infection.²¹ U.S. Surgeon General Koop recommended AIDS education take place in elementary school so that children will grow up knowing how to protect themselves from exposure to the AIDS virus.²² In addition, a study of over 1,825 students indicated that students exposed to early AIDS education expressed more accurate and appropriate beliefs about the transmission of AIDS.²³

AIDS information often occurs without placement in a relevant context in the classroom. Therefore, traditional AIDS education approaches for teaching adolescents about the dangers of AIDS are insufficient because adolescents' knowledge of proper prevention does not always translate into responsible behavior.^{24,25} A 1990 study of adolescents who knew that condoms reduce the risk of AIDS, revealed that over 70% admitted they were still uncertain as to which preventative actions they would take to reduce their own transmission of contracting the AIDS virus.²⁶ This then led the researchers to conclude that these and other such responses reflect adolescent apathy, denial, and confusion regarding AIDS prevention.²⁷

Beginning AIDS education during pre-adolescence, prior to onset of sexual activity, may be one way to offset the effects of these negative attitudes. Bush and Iannotti's longitudinal research suggests that attitudes regarding personal risk and

perceived vulnerability begin to stabilize *prior* to adolescence.²⁸ This evidence supports the presentation of AIDS education to pre-adolescents. In addition, early education regarding disease information and processes may result in more effective education regarding AIDS prevention as the children approach adolescence.²⁹

Although many methods for incorporating AIDS education into the curriculum have been suggested for the middle school level, including behavioral or sexual education curriculum, it may be more appropriate to place it in a science or health unit at the elementary level.³⁰ HIV/AIDS can naturally be included when dealing with the concept that some diseases are infectious. In this way, the elementary students can learn about HIV transmission methods along with other viral transmission methods.

With increased media coverage and general openness about HIV/AIDS, it is safe to say that most children in elementary school have acquired some knowledge. However, the level and accuracy of their information is limited.³¹ Without knowing and understanding the whole story, this topic can be very scary for children. It is important to stress that HIV infection is preventable and that they can play an active role in its prevention. In fact, AIDS education for young children may need to emphasize the ways in which HIV is not transmitted.³² It is important for children to know that they can not get infected through casual contact, and that people with AIDS need compassion and care just like any other person with an illness.³³

When teaching about HIV and AIDS, it is not only important to identify teaching activities that are useful to elementary teachers, but also to provide teachers with accurate information that they can use as a knowledge base to answer student questions. Because children hear about HIV and AIDS so often, many children will have questions about the

disease. It is important to answer these questions as directly as possible. If questions are delayed, the children's fear and misunderstanding will only increase.³⁴ Questioning as a process skill is an important part of the scientific process. As Smith and Peacock state, 'learning to ask good questions is an essential ingredient for science.'³⁵ In the long term, a scientifically literate person needs to be an effective questioner, someone who uses their knowledge and understanding alongside ability and confidence to ask the right question at the right time.³⁶

Emphasizing rote memory from lectures is not as effective as teachers using a variety of teaching methods, in order to address multiple learning styles. Health and safety are very serious societal issues, but this should not be used as an excuse for boring lessons. The more active the student is in the learning process, the greater the retention and behavioral impact from the experience. This reflects the importance of providing various hands-on learning activities for elementary children.³⁷ If the emphasis is on the student and their learning, the students of today may turn into the scientists of tomorrow.³⁸

With a large number of students choosing science as their least liked subject, serious action is needed.³⁹ Reasons given for students' lack of interest in science include the dominance of teacher lectures, and the lack of interesting fun things in the curriculum.⁴⁰ It is often difficult for teachers to clearly introduce new vocabulary when the curriculum is not fully understood by the teacher. Also, science is often more difficult for students to learn than any other subject. Reasons for this are that science courses introduce new concepts very quickly and the life experiences of students leads

them to naïve theories and beliefs.⁴¹ In addition, the science curriculum often does not confront learners' current level of understanding.⁴²

Over the past decade, there has been a shift to experiential learning activities in science that are based on clearly specified and measurable objectives as guides to successful teaching and learning.⁴³ The classroom should not be a scene typified by rows of passive students listening or filling out worksheets. Instead, the classroom should be a place filled with active participation in the investigation of real problems and interests, with regular opportunities for discussion and collaboration.⁴⁴

The goal of conceptual teaching is the discovery of answers to questions that lead to meaningful conclusions. Conceptual learning goes on all the time, in and out of school. In the conceptual approach the teacher provides an accepting environment, arranges experiences facilitative of that kind of learning, and then simply allows it to happen.⁴⁵ There have been examples of a conceptual framework defining the body of knowledge in health education.⁴⁶ Based on the results of many carefully designed and implemented research projects, many of these concepts have had a lasting impact on health education.^{47,48}

In addition, the conceptual approach provides a rationale for study at every grade level. Although specific enabling objectives must be designed for every level of teaching, the concepts keep them on target.⁴⁹

One way to incorporate conceptual learning in the classroom is through demonstrations, experiments, and games, which offer many opportunities for students to learn both the knowledge of science and its associated vocabulary in an interesting way. Collected recommendations from the literature in learning theory, behavioral psychology,

and education have been summarized into a list of simple conceptual statements about the nature of student learning. Students have been shown to learn best when:

- (1) Information or skills seem relevant to them,
- (2) Students are actively involved in the learning process,
- (3) Learning experiences are organized,
- (4) Learning experiences enable students to derive their own conclusions,
- (5) Students become emotionally involved with or committed to the topic,
- (6) Students can interact with others,
- (7) Information can be put to immediate use or skills can be practiced rather than simply discussed,
- (8) Students recognize the reason for or value of the information or tasks to be mastered,
- (9) Positive teacher-learner relationships are cultivated, and
- (10) A variety of teaching methods and learning strategies are used.⁵⁰

In addition to learning and teaching techniques, it is important to examine the characteristics of learning with understanding. When outcomes are ideas, they can be used in daily life because they make sense to the learner (as opposed to information which can be recalled but which does not relate to problems which have to be solved). When true understanding takes place, links can be created between existing ideas and new experience (these give both the ideas and the experience new meaning). New knowledge can start from and build on existing ideas, so that new ideas emerge from previous ones. In this way, the learner takes an active part in the creation of understanding.⁵¹ So a child may now come to understand how a desk or a doorknob may have become contaminated when someone else who was sick touched it. It is important to consider this conceptual framework when developing curriculum for elementary school students.

METHODS

Unit Goals and Objectives

The goal of the infectious disease unit was that the student would have a basic understanding of what infectious diseases are, how they are spread, and what students can do to prevent them. Within this goal, there were several main student objectives: (1) the student will be able to explain/define what an infectious disease is, (2) the student will be able to label and identify the main types of infectious disease causing agents, describe their properties, and give examples of them, (3) the students will be able to identify one or more infectious disease and their causes, and the student will be able to list at least 3 ways that transmission of infectious diseases can be prevented. The criteria for reaching these objectives was a 70% or better accuracy on the unit post-test.

Classroom Sample

All 94 students in each of five classrooms, including special needs students: LD (learning disabled), (8.5%), EBD (emotional/behavioral disorder), (2.1%), ESL (English as a Second Language), (6.4%), and ADHD (attention deficient and hyperactivity disorder), (3.2%), as well as students receiving special accommodations, were part of the sample. The distribution of race/ethnicity was 85% Caucasian, 9% Asian, 2% Hispanic, 3% African-American and 1% Native American.

Ten fourth grade teachers from a rural Minnesota school district were given a survey and asked to rate both their basic science knowledge of and their confidence in teaching infectious diseases, bacteria, fungi, viruses, and infectious disease prevention. From that group, several teachers often involved in writing fourth grade science/health curriculum volunteered to administer the infectious disease unit in their classes. Those

five fourth grade teachers who taught the infectious disease unit filled out an evaluation after completing the unit in their classrooms. Sample teacher surveys, evaluations, and student pre- and post-tests can be found in Appendix A. The student copy of the infectious disease unit and the teacher copy of the infectious disease unit can be found in Appendix B and C, respectively.

Curriculum Development and Content

An infectious disease and prevention teaching unit has been developed, following content suggestions by the Centers for Disease Control and Prevention⁵² and a format consistent with proven pedagogical methods. Since AIDS education is often ineffective if disconnected from the conceptual level of the students' current knowledge and understanding,⁵³ the conceptual learning methods⁵⁴ were used as guidelines for development of this infectious disease unit curriculum. Piaget's conclusions regarding the distinct stages of learning were also considered in designing this health education curriculum, to allow for the varied cognitive abilities of each child.^{55,56,57}

Sigelman et al found the health education for children can be effective if it rests on the assumptions that even relatively young children already have coherent ideas about what causes a disease and that they can learn more correct ideas if given appropriate instruction.⁵⁸ In addition, it was also determined that greater emphasis should be placed on teaching children about behaviors that do not cause particular diseases, removing misconceptions and faulty inferences to which they are most susceptible, and helping them distinguish between diseases and their causes.⁵⁹ The student learning packets for the units contain information pages, with pictures of numerous diseases, as well as a glossary. In addition, as a brief introduction to public health careers, teachers gave

examples of careers where people worked to help make the population healthier (for details, see Appendix E).

The infectious disease unit also contained many activities, including the Glitter Experiment, HIV Experiment, and Life Saver Experiment, which addressed common misconceptions regarding disease transmission (for details, see Appendix D). For example, while using six different colors of glitter, students demonstrated how easily pathogens were transferred by shaking each others' hands. In order to illustrate how HIV is passed from person to person through blood or certain body fluids, the HIV experiment used jars of oil and green food coloring. An eyedropper went from jar to jar, symbolizing sharing IV drug needles. This experiment targeted a common misconception among children and illustrated that when you spread HIV/AIDS to another person, you still have the disease yourself.

In the Life Saver Experiment, Life Savers were passed around in sealed envelopes among the students. Three students signed their name under the "owner" of the envelope's name. The owner of the envelope opened the envelope and looked at the color of their Life Saver. Each color indicated a different outcome, including various diseases and vaccines against these diseases. Each person who had signed their envelope had been secretly exposed or vaccinated against their disease (as indicated by the Life Saver's color). The students were surprised to discover that they could have a disease and spread it to others without realizing it. Sigelman et al found these types of activities to be extremely effective in helping children to distinguish between faulty and accurate inferences.^{60,61}

Evaluation of Students

Evaluation of student progress included student pre- and post-tests to assess changes in knowledge. Since children's responses to open-ended questions are often inconsistent with their responses to limited-choice format questions,⁶² both formats were used in the pre and post-tests (for details, see Appendix B). This assessment instrument was developed by drawing upon the literature and used to assess changes in knowledge of the fourth grade students. The total possible score on each test was 20 points, with half of the test consisting of multiple-choice questions and the other half consisting of short answer questions.

In a study involving 141 middle school students, fewer than 60% of the students knew that AIDS was not transmitted by kissing.⁶³ Fassler et al surveyed 147 children in grades one through six and found frequent misconceptions (69% of fourth graders thought donating blood might give them AIDS).⁶⁴ In another study using resident physicians as AIDS educators, cataloging questions of 694 middle school students found that questions on AIDS transmission were more numerous than any other category.⁶⁵ Therefore, short answer questions on both the pre- and post-test focused on preventing the transmission of infectious diseases.

Thirty-six of the 94 students also completed pre- and post-tests in the required unit of dental health and these results were used for the purpose of comparison. One hypothesis is that the mean of improvement should be the same for both units. Like the infectious disease pre- and post-tests, the dental health pre- and post-tests had a total of 20 possible points, as well as both short answer and multiple-choice questions. Students were given the same amount of time to take both the infectious disease and the dental

health tests, although, according to the teacher, the dental health test was much easier than the infectious disease test.

Teacher Assessment

Prior to implementation, an assessment of ten fourth grade teachers in the district examined their knowledge of infectious diseases and their perceived self-efficacy in teaching such content. The assessment instrument was developed by drawing upon the literature, using a 1-5 scale to assess baseline confidence and knowledge of the fourth grade teachers in the district. The scale ranged from “very comfortable/extremely competent and knowledgeable” to “uncomfortable/needing more training/knowledge in this area” (for details, see Appendix A). The issues of teacher confidence and basic knowledge of a subject area are often directly related to the desire to teach new or unfamiliar subjects.⁶⁶

A study involving HPV (Human Papillomavirus Virus) education in Vermont found that although teachers indicated that HPV was an important health issue, few (16%) indicated that they possessed the resources necessary to teach it. “Not enough class time” was the main barrier in almost half of the participants surveyed, followed by lack of good curriculum materials, and need for more knowledge.⁶⁷ Therefore, numerous additional materials and information from the Center for Disease Control and Prevention⁶⁸ were included in the teacher copy of the unit to aid teachers in answering student questions and increasing their own knowledge and confidence in the material.

Upon completion of the unit, teachers evaluated the unit to determine its relevance, effectiveness, and ease of implementation. The assessment instrument was developed by drawing upon the literature, using a 1-5 scale to evaluate and comment on

the infectious disease unit. The scale ranged from “very clear and very usable” to “very confusing and not usable” (for details, see Appendix B).

RESULTS

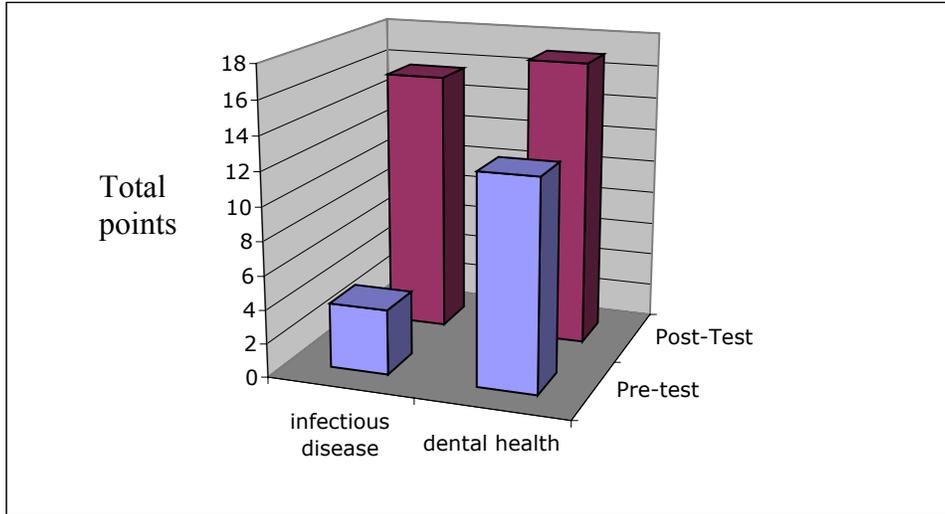
Results indicated that the Infectious Disease Unit was extremely effective in increasing student comprehension and interest in infectious disease prevention. Overall, the 94 students' mean raw scores on the infectious disease pre-test were (out of 20 possible points), 2.9 ± 2.4 and the post-test scores were 15.6 ± 3.3 .

Although the students seem to score, on average, slightly better on the multiple choice questions, which focused on vocabulary and basic microbiology, (20.3% on the pre-test and 79.2% on the post-test) the score averages were very similar for the short answer questions, which focused more on disease specifics (18.3% on the pre-test and 77.2% on the post-test). The average score of 75% on the post-test exceeded the overall goal of the unit of 70% and average scores of 79.2% and 77.2% met both objectives one and two.

When 36 of those students scores' were compared with their pre- and post-test of a dental health unit (each unit had a total of 20 possible points), it was found that the students infectious disease pre-test raw scores were 3.9 ± 2.7 with post-test scores improving to 15.6 ± 3.6 . This yielded a total improvement of 11.8 ± 3.7 or 12% for the infectious disease material (see Table 1).

However, the students taking the dental health pre-test scored 12.4 ± 3.2 , with a post-test performance of 17.0 ± 1.9 , for an improvement of 4.6 ± 2.9 or 5% overall (see Table 1). This illustrates that the students' knowledge of infectious disease going into the unit was significantly lower than their knowledge of dental health, further supporting the need for such a unit in the fourth grade classroom.

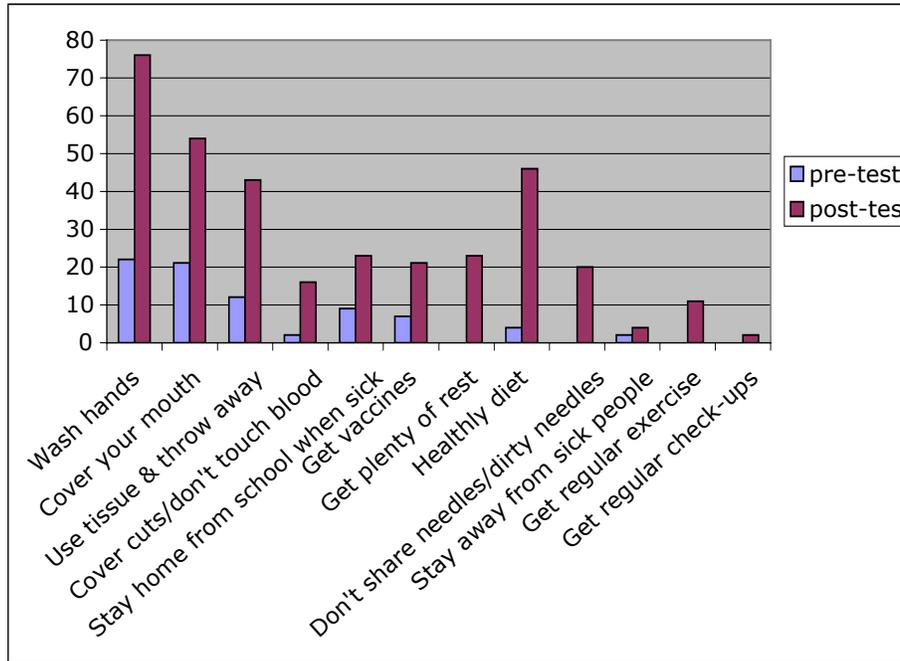
Table 1: Mean Improvement Score On Health Curricula



Hypothesis testing was used to test for significance in the differences in the mean pre- and post-test scores for both the infectious disease and dental health units for the two classes of students that completed both units (n=36). The mean number of correct responses on the dental health pre-test ($\mu=12.39$) was found to be significantly higher than the mean number of correct responses on the infectious disease pre-test ($\mu=3.86$), $t = 12.10$, $p < 0.01$. The mean improvement between the infectious disease post- and pre-tests ($\mu=11.78$) was found to be significantly higher than the mean improvement between the dental health post- and pre-tests ($\mu=4.64$), $t = 10.61$ $p < 0.01$.

Although there were varied scores on the multiple choice section of the post-test, illustrating varied knowledge levels of scientific vocabulary, 100% of the students correctly indicated at least three ways that they could help prevent the spread of infectious diseases, meeting the third objective of the unit (see Table 2).

Table 2: Student Infectious Disease Prevention Strategies

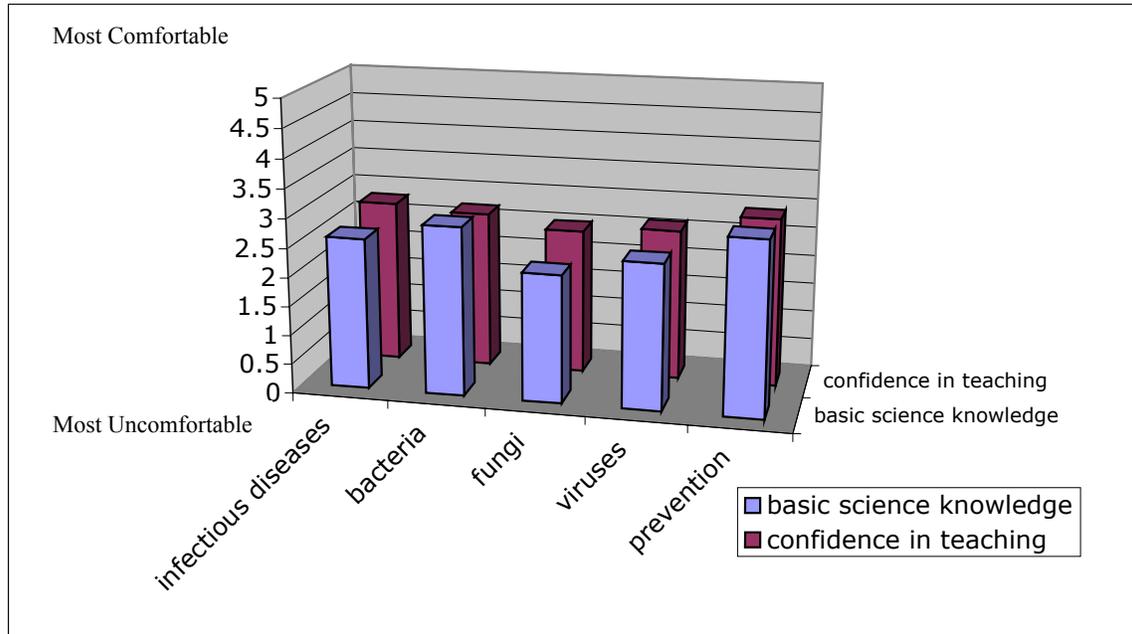


Results also indicated that the infectious disease unit was extremely effective in increasing teacher efficacy in delivery of the material. After surveying all (n=10) of the fourth grade teachers in the district, it was found that the majority of fourth grade teachers rated both their basic science knowledge and their confidence in teaching in infectious diseases, bacteria, fungi, viruses, and infectious disease prevention at a “somewhat uncomfortable/needing more information in this area” level ($\mu=2.6$ and $\mu=2.7$, respectively) (see Table 3).

In the comments section of the survey, many teachers responded that, “with an improved knowledge of base, I would be more comfortable teaching it [infectious disease].” Several teachers also remarked that if they had “materials to teach with” and/or “some training in this area” they would be comfortable teaching these topics.

One teacher commented, “The information that we have is from a 1984 text book--we need updated curriculum that is easy to teach from.”

Table 3: Teacher Comfort and Knowledge in Teaching Infectious Disease



The fourth grade teachers who completed the infectious disease unit in their classrooms (n=5), found the unit to be “extremely clear and very usable,” ($\mu=5$). Several teachers mentioned that the format and organization of the unit information was “easy to access and cross-reference.” Teachers also found the pre-test to be “helpful in recognizing students’ pre-existing knowledge or lack thereof.” According to the teachers, the demonstrations and activities “were a big hit with the students!” “They loved the disease detective series” and “really got into the glitter experiment!”

DISCUSSION

The primary objectives of the Infectious Disease Unit were that: (1) the student will be able to explain/define what an infectious disease is, (2) the student will be able to label and identify the main types of infectious disease causing agents, describe their properties, and give examples of them, (3) the students will be able to identify one or more infectious disease and their causes, and the student will be able to list at least three ways that transmission of infectious diseases can be prevented. The criteria for reaching these objectives was a 70% or better accuracy on the unit post-test. Upon analysis of the data it was found that the student's mastery level on the post-test was 78%, exceeding the 70% standard. This was surprising, considering the challenging nature of the mostly novel material.

Students scored an average of 19% on the Infectious Disease pre-test, indicating their limited knowledge base. The pre-test scores of the same group of students, on the Dental Health Unit was 62%, which indicated a much broader knowledge of the dental health topic. After completing the Infectious Disease unit, the students' average score was 78%, reflecting a gain of 59%. However, after studying the unit of Dental Health, the students' average score was 85% on the post-test, which indicates a gain of 23%. Although the post-test scores only differ by 7%, the gain, or improvement scores differ by 36%. This may indicate that while the students' potential to score well at the conclusion of both units appears to be similar, the students' potential to learn more new information was realized. It is also important to note that in the unit of Infectious Disease, although 22% of the students scored below 70% on the unit post-test, all of these

students doubled or, in most cases, tripled their number of correct answers on the post-test, when compared to the pre-test. The student's average score was 78%.

This unit has several strengths and limitations. The strengths include the unit's focus on prevention, the innovative and interactive activities, the amount of information learned and applied by the students, and the positive reviews of elementary school teachers and students. Many activities and demonstrations (see Appendix D for details) focused on ways that the students could prevent the transmission of infectious diseases as well as the consequences of ignoring prevention. In the Life Saver Experiment, the students were surprised to discover that they could have a disease and spread it to others without realizing it. The Glitter experiment was one of several experiments that targeted a common misconception among children; when you spread a disease to another person, you still have the disease yourself.

One major strength of the unit was its' focus on applied knowledge in preventing transmission of infectious diseases. Although there were varied scores on the multiple choice section of the post-test, illustrating varied basic science knowledge levels, 100% of the students correctly indicated at least three ways that they could help prevent the spread of infectious diseases, thereby meeting the third objective. This illustrated that the students could apply what they learned in a meaningful way in their lives. In a global society, it is more important to understand and use prevention methods, than it is to know the exact name of each microbe that causes disease. By using the innovative activities, demonstrations, games, and experiments, students were participating in active learning, which has been shown to increase retention and behavioral impact.⁶⁹ Prior to the unit on

infectious disease, many children disregarded the ease of disease transmission and may not have realized that they play positive or negative roles in disease transmission.

As was discussed in the results section, the amount learned by the students was found to be statistically significant. A surprising strength of this infectious disease curriculum was that fourth grade students' scores improved more than their scores on the state-mandated unit of dental health. Dental health is a topic that is taught yearly throughout elementary school and builds on itself year after year, including actual visits to the dentist by the student. It is difficult to imagine an elementary school health curriculum without a unit in dental health, however infectious diseases continue to be completely overlooked, despite their potential to create pandemics.

An additional strength of this curriculum was its immediate applicability in the classroom and the ease of use by teachers, as indicated by the teacher evaluations of the unit. When being introduced to the unit, all of the needed materials for both the teacher and the students were in a three-ringed tabbed notebook that was given to each teacher. The tabbed sections allowed the teacher to locate information in an efficient and quick manner. Each section was organized into the necessary parts: introduction to the unit and the unit outline, a list of the needed consumable materials for each section of the packet, student packets, teacher-annotated packets, pretests and post-tests with annotations and test administration directions, teacher background knowledge information, and additional teacher resource materials. All written materials that were needed by the students were in the notebook in an organized fashion and were easily copied for student use.

The teacher-friendly format saved preparation time for the teacher. Extensions for the teacher and student were written into the unit itself allowing creativity and

flexibility. Since there are not currently updated fourth grade curriculum units on infectious disease, prevention of infectious disease, and an introduction to public health careers, this unit helped to supply that need.

There were some limitations of this project, including limited sample size, length of time allotted to teach the unit, and the current obstacles of implementation. The unit was used with only five classrooms of ninety-four fourth grade students in the Southeast part of Minnesota in one school district. The population was mostly lower middle class to upper middle class with the inclusion of LD (learning disabled), EBD (emotional/behavioral disordered), and ESL (English as a Second Language) students. The time allotment for the Infectious Disease Unit was five to eight days, although, if more time were available in the curricular time schedule, the teachers mentioned that they would have benefited from having several more days to teach the unit.

Perhaps new national and state science standards for the upper elementary school student may soon require more education and curricular development in infectious diseases, which would then necessitate the implementation of this new curriculum. As with any new curriculum development, writing, and implementation, the proper procedure must be followed according to the state school district guidelines. Acceptance of the unit by teachers, parents, the curriculum committee, and finally the school board would ultimately lead to community acceptance of the curriculum.

CONCLUSIONS

This model curriculum can serve as a foundation to increase school health education in critical public health areas such as infectious diseases and preparedness. By using suggested content by the Centers for Disease Control and Prevention⁷⁰ and a format consistent with proven pedagogical methods, this model curriculum may be easily integrated, as a foundation or a supplement, into current fourth grade health and/or science curriculum. Additionally, sections of this unit, such as the innovative learning activities, may be easily adapted for upper elementary and middle school students.

The teachers involved in this project found the curriculum to be straightforward, easy to use, and very informative. Their confidence and knowledge of the material increased significantly and they were appreciative of the overall effectiveness and completeness of the unit. The fourth grade students involved in this project were very excited in learning about infectious diseases and how they could prevent their spread. The experiments, demonstrations, and activities were found to be the most memorable and enjoyable parts of the unit. The unit was extremely effective and significant in increasing student comprehension, both on its own and when compared to other text-based health units.

Teaching this infectious disease curriculum provides an opportunity for both students and teachers to learn about infectious diseases and prevention, thereby reducing fear and misconceptions, while empowering them to make informed decisions about their health. This unit serves as an early introduction to public health careers and has the potential to increase student interest in science, health, public health, and medical careers.

APPENDIX A: Unit Overview

(see attached document)

APPENDIX B: Unit Materials

(see attached document)

APPENDIX C: Student Packets

(see attached document)

APPENDIX D: Teacher Packets

(see attached document)

APPENDIX E: Background Information and Additional Resources

(see attached document)

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