THE EFFECTS OF SCIENTIFIC PRACTICES

IN NINTH GRADE RELIGIOUS EDUCATION LESSONS

by

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Jacquelyn Charlotte Haas

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ABSTRACT

High school religious education lessons were not effectively capturing students' attention or enhancing their understanding of basic faith concepts. From September 2013 to April 2014, scientific practices were integrated into newly designed ninth grade religious education lessons, using inquiry-based learning strategies and fundamental Catholic teachings. Classroom environment and Catholic resources were overhauled to provide students with Catholic Study Bibles, YouCats, YouCat Study Guides, YouCat Prayer books, Scripture reference sheets, *Samsung* tablets, and a lab-like setting, with elevated tables, stools, journals, and mini-whiteboards. Over the course of 20 lessons, scientific practices, including: asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and simulation thinking, constructing explanations, engaging in argument from evidence, and obtaining, evaluating, and communicating information, were implemented with innovative demonstrations, case studies, peer-to-peer service projects, and mock court sessions to improve students' faith knowledge and engagement. With meaningful and relevant topics, mini-lectures with PowerPoint, Prezis, and video accompanied practices in lessons.

Incorporating scientific practices proved to be an effective way for students to learn and personally engage in the Catholic faith. The Religious Education & Scientific Practices Questionnaire indicated that 92% of ninth grade students believed that scientific practices had a positive impact on their faith learning (N=12). One student reported, "This year I have learned more than I ever had in religion." Another student said scientific practices "made class more interesting than in other years." Ninety-two percent of surveyed students reported that using scientific practices in religious education lessons improved faith knowledge and 75% stated that scientific practices are an *effective* way of improving faith knowledge. Before scientific practices, 0% of students felt knowledgeable about their faith. After scientific practices, 75% of students surveyed *strongly agreed* that they felt knowledgeable about their faith. Data further revealed heightened engagement in students' religious education experience. Before practices, 17% of respondents *strongly agreed* that religious education classes were interesting and engaging. After practices, 75% *strongly agreed* that lessons were more engaging. One student reported, "It made the classes more interesting. I didn't know what was going to happen next."

INTRODUCTION AND BACKGROUND

In the middle of picturesque farm fields at the edge of Hartford, Wisconsin, there is a small village parish called Saint Lawrence. Established in 1846 by European settlers, Saint Lawrence Catholic Church stands as the only consecrated church in Washington County today. Rooted in generations of faith, Saint Lawrence values their children's faith upbringing and religious education experience. Grandparents, parents, and grandchildren grow in faith together in a predominately white, middle class community comprised of hard-working, service-oriented families.

Currently, there are 156 students from kindergarten through Confirmation, or eleventh grade, enrolled in the Saint Lawrence religious education program. Each school year, there are 21 religious education classes offered outside public school hours. All students attend public school and come to religious education from four different public school districts. Class sizes range from 10 – 22 students, with 1 or 2 teachers per classroom. Two to three times per month, sixth through eleventh grade students meet for an hour and a half class on Sunday nights. Regular attendance is good but not ideal. Several absences are due to sports, sicknesses, broken home situations, reliance on transportation, or other conflicts.

Religious educators use modern teaching methodologies and have varying levels of faith background and knowledge. Since most teachers have children in the religious education program, they are genuinely devoted and highly vested in creating a positive religious education learning environment for students. Every classroom is furnished with tables and chairs, blackboards, radios, and a television with a DVD player. Wireless

technology was installed in the school last year, and we have one laptop computer, projector, and projector screen.

When I began serving as the Saint Lawrence Director of Religious Education four years ago, Saint Lawrence teachers and students were primed for meaningful religious education lessons, excited for engaging curriculum changes, and desired depth in spirituality. Working off an unfinished binder system for several years prior to my arrival, teachers were exhausted and students were disengaged. The work-in-progress binders provided minimal teacher direction, incorporated non-age-appropriate material, such as coloring sheets for eighth graders, and offered uninspiring student lessons, such as reading information copied from the Internet aloud. Further, student assessments showed a lack of proficiency in religious education core concepts. These circumstances, along with parental requests for religious education relevancy, solidified the need to improve our curriculum.

With positive encouragement from Father Joseph Dominic, our pastor, I began to integrate curriculum with high-quality Catholic content and engagement activities. Group prayer, service nights, and unique large group programs were incorporated as well for faith enrichment. In the midst of this change, students and teachers demonstrated spiritual progress, were open and eager to implement new curriculum, and showed interest in learning about the faith. One parent said, “My children are learning more now than they ever have before.”

Even after numerous lesson adjustments, there remained a significant curriculum concern with ninth and tenth graders. As students moved from middle school to high school, I noticed their attitudes and interest in religious education classes seemed to

diminish. Students were more influenced by peers who did not attend religious education classes, were more involved in school, sports, and work activities, and were generally less interested in learning about faith. Further, many religious education students lacked strong faith habits and were heavily immersed in secular culture with little reverence for God. Compounding the issue, available high school religious education curriculum did not successfully impact youth in long-lasting, personal ways, or allow students to experience their faith firsthand.

Knowing that it was a struggle to get high school students to attend religious education classes, and having Confirmation, a sacrament of initiation into the Church, being seen as a graduation from religious education, affirmed the unfinished binder system was no longer an option for ninth and tenth grade curriculum. Video and small group discussions were implemented in tenth grade as a stopgap to address student learning issues. These measures were a step forward in religious content. Conversely, no change in curriculum or teaching methods was made for ninth grade religious education students. Due to the inexistence of effective ninth grade resources, they continued to learn from the binder system. As a result, ninth grade students exhibited little growth spiritually and hardly illuminated zeal for the faith.

With this imminent need, the release of the scientific and engineering practices, and the publishing of a youth Catholic Catechism, I recognized an opportunity to positively change ninth grade religious education curriculum. Along with being an ardent Catholic, I have a strong science background and non-traditional methodology experience. These skills, the desire to strengthen students' faith experience, and the noted similarities between faith and science education skills and thinking, led to the formation

of my focus question: Does the implementation of scientific practices in ninth grade religious education lessons improve students' engagement and faith content knowledge? The following sub-questions were researched as well:

1. What ways do scientific practices affect students' confidence levels in learning about faith in ninth grade religious education lessons?
2. How does using scientific practices affect students' lifelong faith learning and their attitudes about faith and religious education?

CONCEPTUAL FRAMEWORK

From its inception, science education has aimed to develop students' scientific thinking with knowledge and practices. To fully grasp science's creative practices or appreciate how science knowledge develops, *A Framework for K-12 Science Education* (National Research Council, 2013) proposes students have the skills to think like scientists. The three curriculum dimensions of the framework are scientific and engineering practices, crosscutting concepts, and disciplinary core ideas. Each presents a new way of teaching and learning science in the classroom. Scientific and engineering practices describe how scientists think and engage in science investigations with knowledge and skill simultaneously. Disciplinary core ideas emphasize learning in depth and crosscutting concepts link fundamental ideas (National Research Council, 2013).

Fostering growth in scientific and engineering practices requires science education to "cultivate students' scientific habits of mind, develop their capability to engage in scientific inquiry, and teach them how to reason in a scientific context" (National Research Council, 2013, p. 41). By returning to the fundamental nature of scientific knowledge as a way of thinking, students can put "knowledge in use" with a set

of science practices that expand and improve that knowledge (National Research Council, 2007, p. 38). The framework recommends the following eight scientific and engineering practices for how scientists think and apply skills:

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating and communicating information (National Research Council, 2013, p. 3)

Similar to scientific and engineering practices, the Catholic Church embraces the advancement of scientific thinking and knowledge. Over half of the Pontifical Academy of Sciences (2013) goals relate specifically to the dimensions outlined in the framework:

- Support learning of scientific questions and issues
- Encourage an interdisciplinary approach to developing scientific knowledge
- Advance science understanding and education
- Communicate and work with other scientists

Outside the scope of the framework, the Pontifical Academy of Sciences encourages faith to work in partnership with reason. Pope Emeritus Benedict stressed the significance of interaction and open communication between science and religion.

Without collaboration, he asserted, modern day questions would be left to illogical, unreasonable, and unfounded thinking (Benedict, 2012). Over the course of history, many Catholic leaders and Saints have publicly voiced the important relationship between faith and reason. Launching the discourse of faith and reason was Saint Augustine, a Doctor of the Church. He emphasized seeking the truth, applying reason, and using intellect. Where theology contradicted scientific facts, he declared the theology to be wrong (Bourke, 1945). Saint Augustine's doctrine of faith authority and reason still stands today (Olson, 2014). More than 1,500 years later, the Church re-affirms Saint Augustine's position. Pope Paul VI proclaimed that the truths of science do not oppose the truths of faith. Rather, reason and faith are united through knowledge (Paul, 1970).

Renowned scientists have been successful at nurturing the relationship of knowledge between science and religion with scholarly arguments and scientific evidence. Monsignor Dr. Michal Heller, a Roman Catholic priest, Templeton Prize winner, and cosmologist, rationalizes that faith and science have common goals: understanding humankind and God's creation of the world (Macek, 2010). With a theological and scientific lens and methodological approach, Heller investigates the world scientifically. First, he uses physical science theories to analyze a basic question of our existence. Then, he applies the analytical results to creation interpretations. Using this approach, he explains such theories as quantum mechanics using evidence that leads to God. Recently, Monsignor Heller established a Theology in Science program to focus on the theological reflection of science, and its methodologies and findings (Heller, 2003). Throughout scientific studies, Heller has stressed faith cannot be separated from science, because science experiences further solidify our relationship with God (Macek,

2010). Reverend Dr. John Polkinghorne, an Anglican priest, physicist, and theologian who is associated with the Nobel Prize and discovery of the quark, approaches scientific and theological practices with a hypothesis and question. He starts with a statement, such as “I believe God acts in the world, but he is not a show-off conjurer who violates the same laws of nature that he made. Is there a way of describing God’s actions that is consistent with science?” (Merali, 2011, p. 2). Polkinghorne also participates in public meetings with other scientists to argue theories. He contends discussions on religion and science topics encourage creativity and heighten how theologians think (Heffern, 2009).

The extent of creative theological thinking with science practices in Catholic high schools and religious education programs is limited. A few of the top 50 Catholic schools in the United States selected by the Cardinal Newman Society (2012) intertwine theological thinking with scientific practices. St. Augustine Academy (2013), one of the top schools, has the guiding principle that experience is necessary for the development of knowledge. Their building curriculum includes logic as a foundation to provide tools of intellectual learning, natural science as a way to expand scientific practices, and ultimately, theology to contemplate God with knowledge and experience gained through all disciplines. Another top 50 Catholic school, St. Monica Academy (2013), deepens students’ understanding about God’s creation through scientific lab work. Xavier High School (2013) offers a freshmen course on critical thinking that develops scientific practices within science education but not in theological thinking. On the other hand, religious education focuses on faith and the teachings of the Church as a guiding principle, not science knowledge and practices (Congregation for the Clergy, 1998).

Studies suggest science and religion can help each other in the search for truth

(Espagnat, 1983). Habits of the mind, or thinking, are not solely related to science. They could be integrated into any scholarly activity. Like scientific thinking, religious thinking is open to argument, relies on scholarly evaluation of evidence, is rooted in communication and relationships, is full of questions, and is based on truth and reason (Gauld, 2005). As a whole, religious education is a scholastic discipline that necessitates an inter-disciplinary exchange of ideas (Congregation for the Clergy, 1998).

Although the collaborative, purposeful application of scientific and engineering practices to religious education lessons has not been done, the framework serves as a guide to employing practices in the classroom. In addition, there is a great deal of research on science inquiry learning strategies that could be used as a model for integrating scientific and engineering practices into religious education lessons.

One of the scientific practices important to scientific and religious thinking is argument based on evidence and reasoning (National Research Council, 2013). In an instructional model called the Argument-Driven Inquiry, researchers aimed to develop the knowledge and skills of students through participation in oral and written scientific arguments. In purposefully designed argument sessions, they wanted students to engage in logical discussions on how ideas relate to evidence. Based on an explained event, small groups would present their scientific arguments to other groups, critique each other's work, and decide which theory was the most valid. After an 18-week intervention, students contributed with a higher level of scientific thinking. Researchers also found participation among students was better balanced, with a more engaged student population. To compare pre- and post-intervention written arguments, students were evaluated on the following four criteria: adequacy of reasoning and explanation,

and quality of concepts and evidence. Students' written argument post-intervention scores increased by 158% (Sampson, Grooms, & Walker, 2011).

Another commonality between thinking like a scientist and learning faith is asking questions. Recognized as a best practice for teaching science, science inquiry was implemented to develop students' scientific thinking through investigations and writing. At the start of the experience, student groups explored science with a hands-on approach and created a list of questions. Groups expanded and refined their questions; ensuring questions could be scientifically tested. From there, students worked together to make predictions, collect data, and present results to the class. Teacher explanations followed the student presentations, along with a written lab report, where students linked data to science principles. Science inquiry improved students' ability to ask scientific questions, enhanced understanding of science concepts, increased engagement, and allowed students to bridge real-life science experiences to their own lives (Goldner, 2007).

Students' lives and real-world concerns are of interest to science and the future of the Catholic faith. The Dynamic Catholic Institute suggests the Catholic Church in America has failed to discuss everyday issues that affect young people, which has resulted in decreased student understanding of the faith and dramatically lowered levels of engagement. Presently, religious education in the Catholic Church does not grow faith in practical ways. Going forward, there needs to be a new way of thinking with best practices (Kelly, 2012). Albert Einstein keenly observed, "The significant problems we face cannot be solved with the same level of thinking we were at when we created them" (Kelly, 2012, p. 197).

Religious education teachers are well poised and familiar with implementing

education approaches to address needs (Buchanan, 2005). In order to achieve learning outcomes, they currently employ teaching and learning strategies from other curriculum subject areas (Dorman, 1997). In the Bishops' Curriculum Framework for religious education, the Bishops call for a diversity of methods developed by education specialists (Manning, 2012). Some recommended religious education methodologies that relate to science practices include service experiences, group work, technology, and social communication (Congregation for the Clergy, 1998; National Research Council, 2011).

Although most religious education students attend public schools, are accustomed to modern educational approaches, and have been exposed to science, a potential barrier is students' familiarity with using scientific and engineering practices, specifically in their ability to think, communicate, and write scientifically (Sampson et al., 2011; Walch, 2001). Another potential obstacle is some may think science hinders religion or vice versa despite evidence on the contrary attributing many great scientific advances to Catholic scholarship and education. According to Gauld, Christian scientists grew in faith and have contributed significantly to the progress of scientific developments, thinking, and practices (2005). Dr. Francis Collins, director of the Human Genome Project and Christian believer, became more faith-filled while being a scientist. He now links faith, reason, and revelation for full understanding. Through his work with DNA, he found what he calls the scientific language of God (Collins, 2007). For profound and long-lasting results, religious education must be co-created with science culture (Heller, 2000).

To achieve religious education goals, and improve student engagement and faith content knowledge, there is a "need for creativity in methodology" (Paul, 1987, p. 4).

Even though the effectiveness of applying scientific practices to religious education lessons is yet to be determined, spiritual and mindful thinking need to occur in harmony. Science or reason alone is not enough (Collins, 2007).

METHODOLOGY

From September 2013 to April 2014, scientific practices were built into newly created ninth grade religious education lessons. Designed with best practice science pedagogy and fundamental Catholic teachings, lessons integrated scientific practices through a variety of inquiry learning strategies. Discrepant events, the 5E learning cycle, case studies, personal experiences, the conceptual change model, and journaling were employed to intentionally construct innovative religious classes. During the 20-lesson treatment, there were opportunities for students to explore the Catholic faith by identifying sources of uncertainty, defining problems, analyzing and evaluating information, utilizing resources and technology, developing explanations with critical thinking, communicating with peers, investigating models, applying faith to the real world, and carrying out arguments with evidence. Mini lectures with PowerPoint slides on core faith concepts accompanied scientific practices in lessons. Additionally, interaction between students and notable faith figures occurred through in-person visits or videoconferencing. 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 throughout (Appendix A).

In order to design a learning atmosphere that resembled a scientist's laboratory, the classroom underwent a makeover before September. Youth Catechism books, religious resources, Catholic Study Bibles, prayer journals, and tablets were purchased

and incorporated into the learning space, providing necessary tools for the treatment. Classroom furniture was re-organized and group spaces were created for faith dialogue and message delivery.

Among 17 religious education students, artifact, inquiry, and observational data sources were collected with a mixed-methods strategy. For the primary question, My Response of Faith Writing Sample was used as a pre- and post-treatment to compare students' ability to effectively answer faith questions by employing scientific practices (Appendix B). All students crafted a written response to the same faith-based question at the beginning and end of the treatment. The My Response to Faith Writing Sample was evaluated on four criteria: adequacy of explanation, adequacy of using resources to connect faith with daily life, quality of faith content, and quality of reflection. Each criterion was scored using the My Response to Faith Writing Sample Rubric that was disclosed to students verbally for both writing samples (Appendix C). The difference, between writing samples' pre- and post-treatment average scores, was calculated for the entire class and each student and analyzed for trends of improvements.

The Religious Education & Scientific Practices Questionnaire was used as a pre- and post-treatment to measure students' perceptions on implementing scientific practices in religious education lessons (Appendix D). Incorporating both closed- and open-ended questions, the Religious Education & Scientific Practices Questionnaire was analyzed for class and individual patterns of improvement in engagement and faith content knowledge. In regards to classroom environment, questions were scored using a Likert scale of *strongly agree* (1), *agree* (2), *disagree* (3), *strongly disagree* (4).

The Scientific Practices Classroom Assessments were incorporated to determine

students' progress using scientific practices with religious education core concepts (Appendix E). Scientific Practices Classroom Assessments evaluated prior knowledge, recall, and understanding, and were given during various religious education lessons on topics including: creedal, sacraments and liturgy, morality, and prayer. For each student and the entire class, the results of the Scientific Practices Classroom Assessments were analyzed for patterns in faith content comprehension and general effectiveness of scientific practices in religious education lessons.

The Religious Education & Scientific Practices Interview was conducted after the treatment with eight students (Appendix F). Questions were closed- and open-ended, focusing on their value of the Catholic faith, whether they felt they had the tools to be lifelong faith learners in the Catholic faith, and their thinking processes about learning the Catholic faith. The Religious Education & Scientific Practices Interview was analyzed for reoccurring, positive behavior and impacts of scientific practices on learning and embracing the Catholic faith.

For secondary questions, the Religious Education & Scientific Practices Survey was used as a pre- and post-treatment to measure students' confidence using scientific practices, attitudes about faith and religious education, and feelings on engagement and faith content knowledge using scientific practices (Appendix G). The Religious Education & Scientific Practices Survey was scored using a Likert Scale of *strongly agree* (1), *agree* (2), *disagree* (3), *strongly disagree* (4). The results of the pre- and post-treatment were compared for the entire class and individual students. The mean changes for each question were analyzed for positive and negative tendencies.

The Teacher Observational Records were used as a data collection tool to detail

information about the implementation of scientific practices in religious education, student responses and progress, general observations, and surprising events (Appendix H). Supplementing these records were attendance records and a classroom assistant's passive observations on lesson events and issues. Together, the Teacher Observational Records results were analyzed for relevant contextual information, narratives on classroom research success, and areas for future improvement.

The 9th Grade Religious Education Classroom Map was used to provide data on classroom layout, resource use, and interactions of students in the classroom environment (Appendix I). Observations were made on the 9th Grade Religious Education Classroom Map to evaluate patterns of student engagement with varying table arrangements for lessons in the treatment. Additionally, Photographs of 9th Grade Religious Education Scientists showed what different treatments looked like and provided points of reference on the implementation of scientific practices in religious education lessons (Appendix J).

The 9th Grade Religious Education Student Journal was used to study the effects of implementing scientific practices in religious education lessons (Appendix K). Prompts focused on personal faith experiences, specific scientific practices, and areas of discipleship, such as worship, fellowship, service, ministry, or evangelization. Responses were evaluated to gather student perceptions, treatment strengths and weaknesses, student understanding of faith content and scientific practices, and engagement levels.

The abovementioned data sources, along with primary and secondary research questions, are listed in the Data Triangulation Matrix (Table 1). Cross-referenced and triangulated for validity, data sources corroborated study results.

Table 1
Data Triangulation Matrix

Focus Questions	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Primary Question: 1. Does the implementation of scientific practices in ninth grade religious education lessons improve engagement and faith content knowledge?	Pre- and post-treatment student writing samples	Pre- and post-treatment student questionnaire	Classroom assessments on scientific practices and faith lesson content	Post – treatment student interviews
Secondary Questions: 2. What ways do scientific practices affect students' confidence levels in learning about faith in religious education lessons?	Pre- and post-treatment student survey	Pre- and post-treatment student questionnaire	Teacher observational records	Classroom map, photographs of students and treatments
3. How does using scientific practices affect students' lifelong faith learning and their attitudes about faith and religious education?	Pre- and post-treatment student survey	Pre- and post-treatment student questionnaire	Post – treatment student interviews	Student journals and teacher observational records

DATA AND ANALYSIS

The Religious Education & Scientific Practices Questionnaire indicated that 92% of ninth grade students believed that incorporating scientific practices in religious education lessons had a positive impact on their faith learning (N=12). One student reported, "This year I have learned more than I ever had in religion." Another student said scientific practices "made class more interesting than in other years." Ninety-two percent of surveyed students reported that using scientific practices in religious education

lessons improved faith knowledge and 75% stated that scientific practices are an *effective* way of improving faith knowledge. Before scientific practices, 0% of students felt knowledgeable about their faith. “In previous years, I didn’t get that much out of it,” one student said. After scientific practices, 75% of students surveyed *strongly agreed* that they felt knowledgeable about their faith (Figure 1). One student reported, “This is the first year I’m learning – for lack of a better term – new stuff about the faith.” Additionally, 83% of surveyed students reported they *strongly agreed* that religious education classes taught them the skills to think and learn about faith on their own, compared to 8% before scientific practices. One student stated, “I feel more informed. We understand more of what’s out there because of our research.”

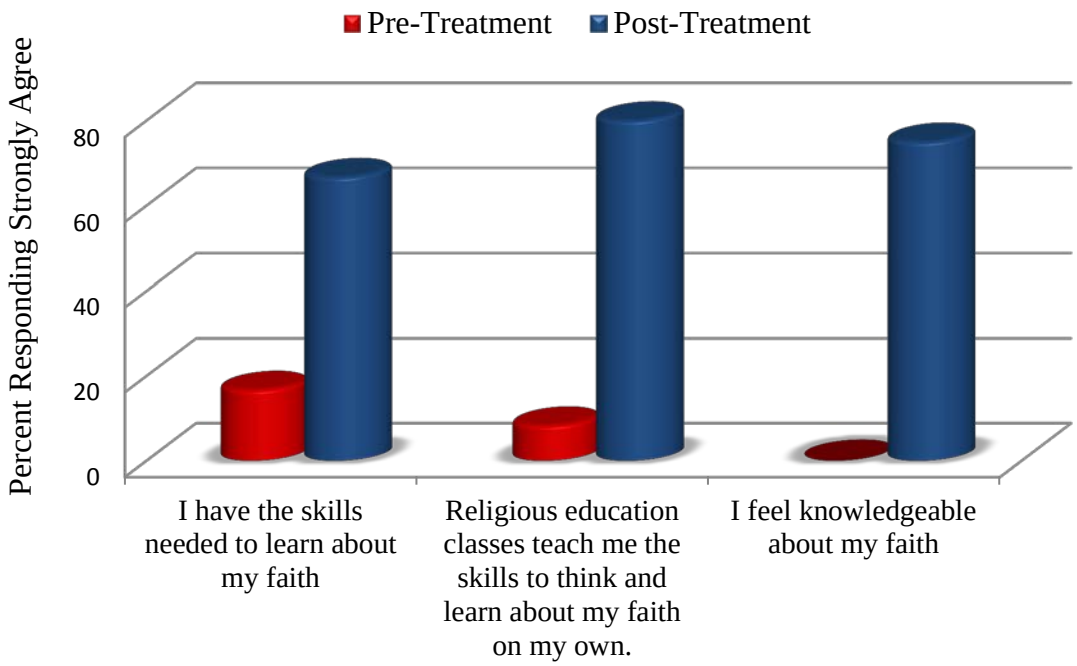

Figure 1. Students’ Results in Faith Skills and Knowledge, (*N*=12). 1 = *strongly agree*, 2 = *agree*, 3 = *disagree*, 4 = *strongly disagree.*

Data further revealed scientific practices strengthened students’ growth in using and understanding Catholic resources. Before scientific practices were introduced, 8% of

students knew how to use the Bible and Catechism of the Catholic Church. Not one student used a single Catholic web site to investigate their faith. After introducing the Bible, Catechism, and tablets in lessons with scientific practices, 100% of students were able to describe Catholic resources and knew how to use them. One student said, “I know how to exactly use the Bible. I understand better what we believe and why on everyday topics and issues. By taking the time to really analyze the Bible, I realized that I never really knew what the Bible was. I think that by knowing this it just makes everything seem more real.” Another student said they think about faith differently now because, “We looked at so many different resources that really helped my understanding.” Students also considered how technology resources impacted their faith learning. There was a 50% increase in the number of students that *strongly agreed* they used several Catholic web sites to investigate faith, after scientific practices (Figure 2). One student said that the tool they always wanted to keep in their toolbox for faith learning was, “Catholic web sites that are trustworthy.” Another student stated the one thing they would have changed about using scientific practices in religious education lessons was to, “Get more involved in the internet and the world around us.”

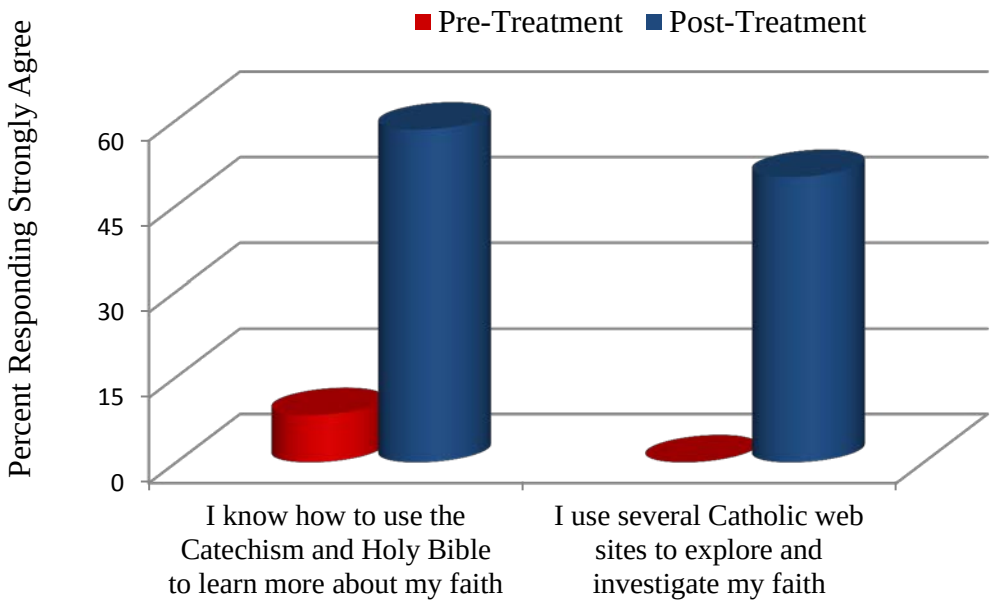

Figure 2. Students' Results using Scientific Practices to Learn Faith and Resources, (*N*=12). 1 = *strongly agree*, 2 = *agree*, 3 = *disagree*, 4 = *strongly disagree.*

Not only did students find value in Catholic resources, but they valued their classroom environment as well. Eighty-three percent of students *strongly agreed* that the environment and resources improved faith knowledge, a 66% increase that followed the classroom and resources transformation. Moreover, in the lesson immediately following data analysis using Catholic resources, 50% of students independently chose to use Catholic resources to conduct their planning investigations.

Another trend the data revealed was how scientific practices increased students' skills in becoming lifelong faith learners. As students completed the ninth grade, they were more confident in their ability to learn on their own and share their faith with others. Prior to scientific practices, 42% responded *agreed-strongly agreed* that they knew how to communicate with others about the faith. After scientific practices, 100% of students surveyed responded *agreed-strongly agreed*, a 58% increase (Figure 3). In addition, a 9th grade student willingly shared a personal witness in front of 75 student and adult peers.

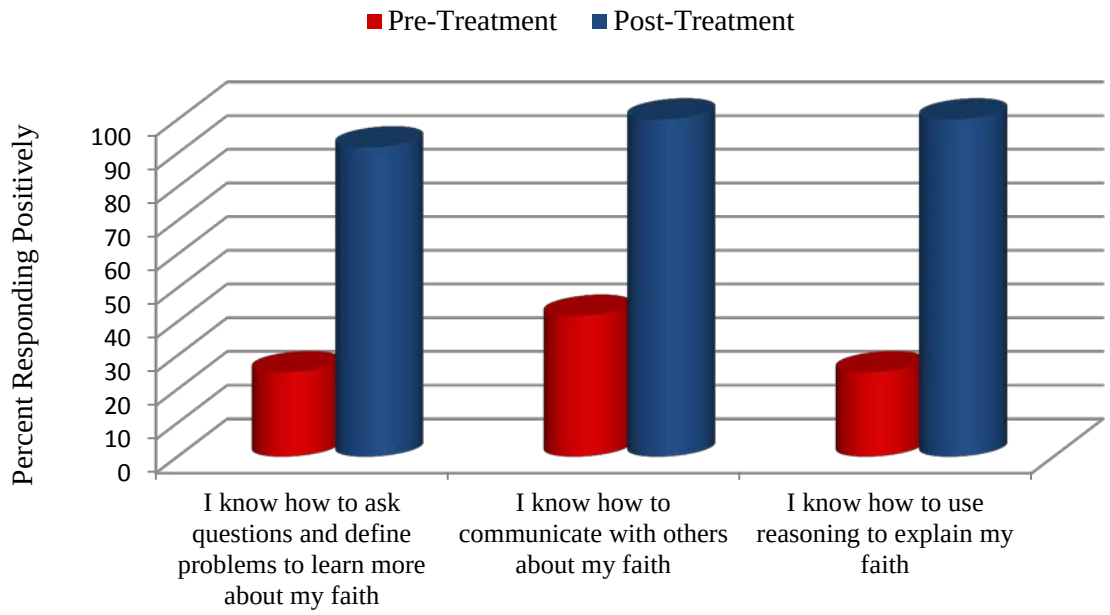

Figure 3. Students' Confidence using Scientific Practices in Religious Lessons, (*N*=12). 1 = *strongly agree*, 2 = *agree*, 3 = *disagree*, 4 = *strongly disagree.*

This confidence shift was seen in more advanced communication styles as well like argumentation and reasoning. While engaging in argument with evidence, one student asked, "Could I go first? Because I know exactly what questions to ask them." Although observational data showed reasoning with evidence was a challenge for students, when asked if finding evidence helped in learning the faith, one student responded, "Yes, because I get to find out for myself, not just someone telling me." Sixty-seven percent of surveyed *strongly agreed* they were confident in using reasoning to explain faith, compared to 8% before practices. Students also broadened their abilities to ask questions with scientific practices. Following the treatment, 92% of respondents *agreed-strongly agreed* that they knew how to ask questions and define problems to learn more about faith, a 67% increase. One student reported, because of this class, I "think of more questions to be answered and it encourages me to take part in faith." Another student said, I "know where to go if people asked me questions." Observational

data showed the level of questioning improved over the year from basic student to teacher questions, to clarifying and argumentative student to student questions. Countering for further evidence, one student asked, “If Catholic was not the first religion, then what was?” Another student used nail props to pose the question, “Would Jesus put these through his hands if he wasn’t the Son of God?”

Providing clarity to faith concepts was another factor in integrating scientific practices. Before implementing scientific practices, 8% of students *agreed* that they used models to think about their faith. After scientific practices, 58% *agreed*, more than doubling students’ average responses (Figure 4). One student stated about models, “It sticks to you. Water, balloons, and tug of war – I think about that and remember exactly what you were talking about.” Another student reported, “It really helped with better understanding of it. Puts it into perspective.” Students also reported they knew how to obtain and evaluate information to enhance faith learning. One student said, “I enjoyed it when we could gather information, then argue and discuss a point of view on a topic.” Prior to scientific practices, 0% *strongly agreed* that they knew gather and analyze information about the faith, compared to 83% of respondents who chose *strongly agreed* after practices, a 190% mean increase.

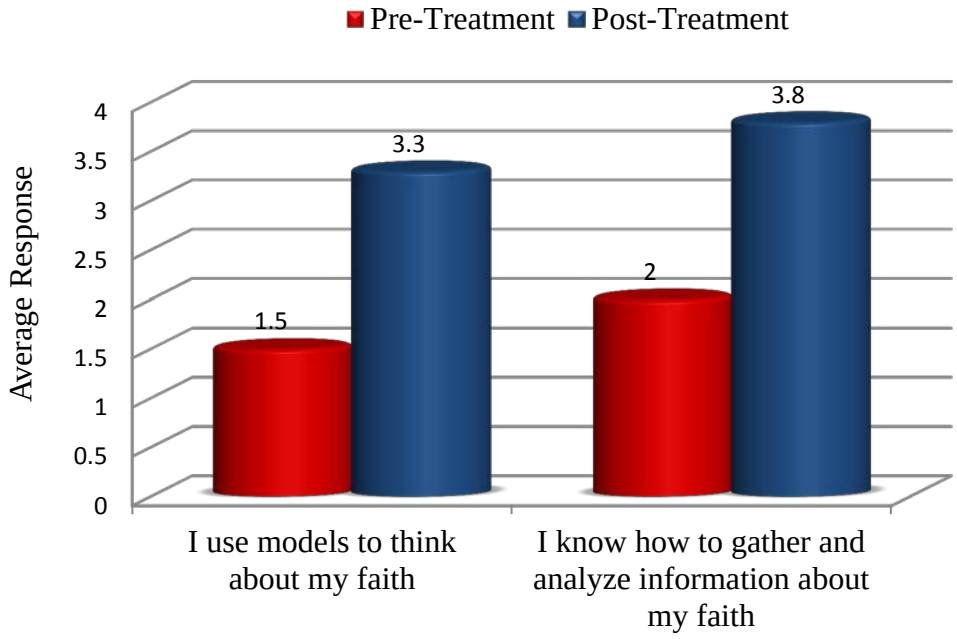

Figure 4. Students' Confidence using more Scientific Practices in Religious Lessons, (*N*=12). 1 = *strongly agree*, 2 = *agree*, 3 = *disagree*, 4 = *strongly disagree.*

With increased confidence, students valued the religious education classroom as a place to learn about their faith and felt encouraged to pursue faith on their own. One student said, "This motivated me to go to church more. There is so much more I can learn." Another student reported, "I found myself praying more if there's something I'm unsure of at night." Of those surveyed, 92% *strongly agreed* that religious education lessons brought them closer to God, a 67% increase after using scientific practices. Further students began to embrace their call for discipleship. One student said, "What you taught us is what we can do to become better Catholics." Another reported, "I like how we are learning how to be a better Catholic and follower of Jesus."

With scientific practices, data also showed heightened engagement in students' religious education experience. Student discussions centered on more productive topics, such as gathering, recording, and evaluating information on faith lessons, and were more

constructive, focusing on developing explanations and making claims. Seventeen percent of respondents *strongly agreed* that religious education classes were interesting and engaging before practices. After practices, 75% *strongly agreed* that lessons were engaging, a 58% increase (Figure 5). “It made the classes more interesting. I didn’t know what was going to happen next,” one student said about what they liked best about using scientific practices.

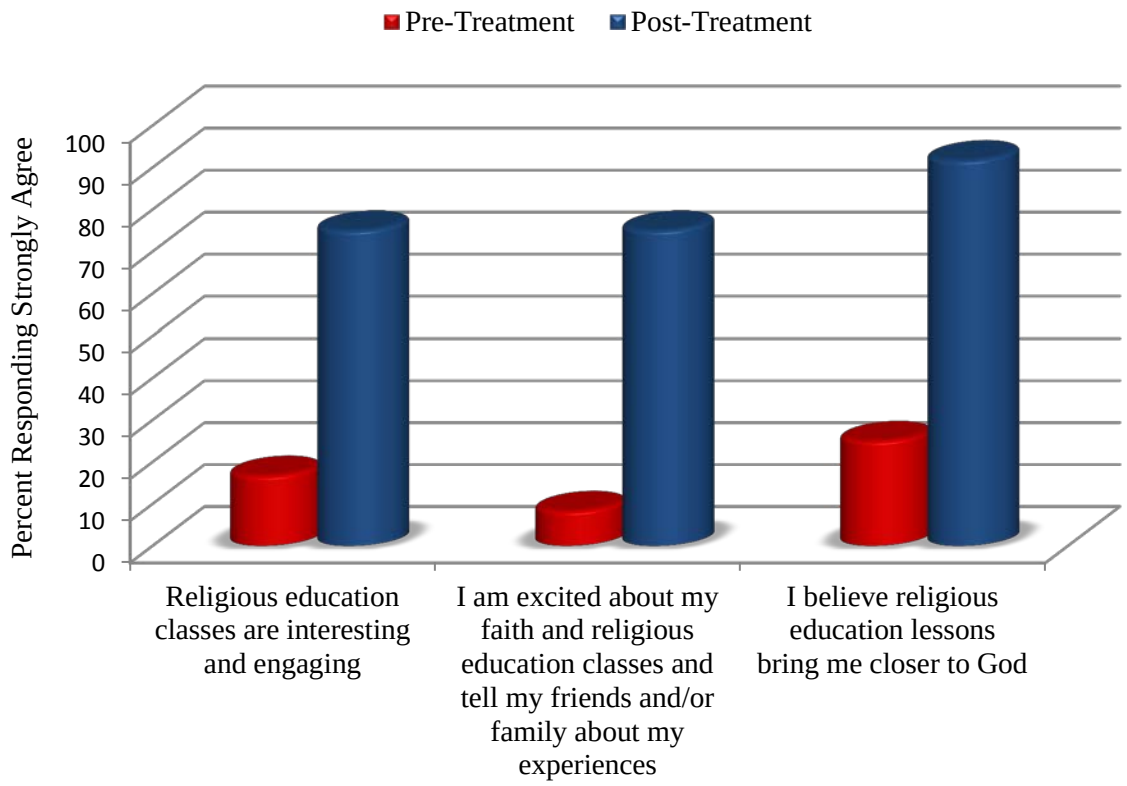

Figure 5. Students’ Attitudes and Engagement in Religious Education Lessons, (*N*=12). 1 = *strongly agree,* 2 = *agree*, 3 = *disagree*, 4 = *strongly disagree.*

Another student said, “I liked this a lot more than other years. It’s more interesting and captured my attention. I want to bring a friend.” After practices, 100% of students *agreed-strongly agreed* that they were excited about their faith and religious education classes and wanted to tell friends and family about their experiences. One 9th

grade student, on the way home from class, told his 10th grade friend and mother, “I learned something today.” Another ninth grade student went home and told his mother, “It was really cool.” Additionally, scientific practices generated excitement among classmates. One student reported the best part about using scientific practices was, “The engagement of all our classmates together.” Another student said, “You should for sure do this next year because I had a lot of fun and I know so did my classmates.”

INTERPRETATION AND CONCLUSION

According to the United States Conference of Catholic Bishops (April 2014), “Effective catechesis will assist young adults in examining their lives and engaging in dialogue about the great questions they face.” After the treatment, 75% of surveyed students reported that scientific practices are an *effective* way of improving engagement and faith knowledge. Combining scientific practices with religious education lessons proved to be a valuable way for students to not only learn about the Catholic faith, but also to engage in faith discourse and personal faith exploration. “It’s making a big difference, and they feel comfortable doing it. No one knows all the answers, but if they know what to do and where to go, that’s where it all starts,” noted the teaching assistant.

From the beginning, scientific practices, done in a particular sequence, reached out to students where they were in their faith journey. This approach fostered unexpected growth, as students not only began to think like saints, but act like ones. In the Roadmap to Sainthood lesson, students planned a path to heaven, received a personalized saint name, and created a diagram of their big picture faith journey. The students loved their saint names. One student said, “It’s not crazy to think that I could become a saint. I always used to think that wasn’t even a possibility, but now I realize it really is.” Another

student said in class, several classes after the original lesson, “I’m asking everyone to call me this [saint name] at school.” What is more, the students fostered a relationship with God and became aware of how their actions impacted others. One student said after the treatment, “I try not to judge others because that’s not what God wants us to do.” Another student reported, “I know my sins affect others.” Other students got more involved in the parish by becoming altar servers, lectors, or teaching assistants.

Although the creative approach to teaching is challenging, it is worthwhile. When interviewed, 100% of students said they valued their faith more because of this project. One student said their favorite part about lessons with scientific practices was, “They were fun and creative.” This unique inter-disciplinary approach with purposeful instruction improved students’ faith knowledge and ignited a renewed faith interest. One student reported, “It was a good year and I learned more than any other year. I like the more hands-on things and demonstrations better than last year when we just read packets all the time.” Another student stated, “This is more intriguing.”

Not only methodology, but also content and its relevancy are important when designing lessons with scientific practices. Observational data revealed that student discussions and involvement were vibrant after solid content was taught or opportunities for personal growth in faith were introduced. Students “looked forward to coming” and “the time went by really fast,” as one student commented. Additionally, it was important to students that faith learning experiences had content that was meaningful, related to their lives, and made worldly connections. One student said, “I feel I would be even more interested if we focused more on using the practices and relate topics to the real world.” When a lesson like this was taught, the same student stated, “I found the topic of

creation we discussed to be the most interesting."

As an added bonus, the classroom research process generated extra involvement. This study drew positive attention and support from high school seniors, parishioners, teachers, and parents. All wanted and did assist in the classroom and helped with student learning. One parent, whose child attended every class, commented, "You do such a good job of keeping it interesting. My child never complains about coming to class, and it wasn't always like that." Another 9th grade parent commented, "It's amazing what you have done in such a short time. It's like 100% better."

VALUE

This study was invaluable. I developed not only a brand new religious education curriculum for ninth grade students, but also a model for religious education lesson construction at St. Lawrence and other Catholic parishes. Going forward, I will apply this model of incorporating science inquiry pedagogy and practices into my 10th and 11th grade religious education lessons, and share my lessons and classroom videos on our web page for other religious education teachers to use in the classroom. Additionally, I created an overview of instructional strategies to employ when creating religious education high school lessons (Figure 6).

Figure 6: Retooled Religious Education Instructional Strategies.

Due to the success of these instructional strategies inside the classroom, I plan to expand their employment to the home setting utilizing the internet. Over the next two

years, I am going to create web-based misconception probes for each grade level that students would take with their parents before the start of the school year, habits of faith for the family, and a Road to Emmaus case study for high school students.

While reflecting on scientific and engineering practices exclusively, I recognized that some practices were building blocks to others and that students needed time to grow with select practices before endeavoring more advanced ones. For example, I noticed the inherent value of students' learning how to ask questions before engaging in argument or constructing an explanation. Therefore, I created an order to employing practices and teaching lessons. My scope and sequence for ninth grade lessons will serve as a starting point to map our entire high school religious education curriculum (Table 2).

Table 2
Religious Education Scope and Sequence for 9th Grade Lessons

Religious Study	Scientific and Engineering Practices
Mystery of Revelation	Asking Questions
My Questions of Faith; Faith Circle	Asking Questions, Communicating Information
Catholic Resources: The Catholic Bible	Asking Questions, Carrying out Investigation, Gathering and Communicating Information
The Catechism of the Catholic Church	Asking Questions, Carrying out Investigation, Gathering and Communicating Information
Catholicism Online	Asking Questions, Carrying out Investigation, Gathering and Communicating Information
New Testament	Communicating Information
Roadmap to Heaven	Planning and Carrying out Investigations, Gathering, Evaluating, and Communicating Information
Old Testament	Asking Questions, Carrying out Investigation, Analyzing and Interpreting Data, Gathering and Communicating Information
Sacraments and Liturgy	Communicating Information
Prayer and Adoration	Using Models, Communicating Information
The Church; The Mass	Asking Questions, Using Models, Communicating Information
Scripture and Worship	Obtaining, Evaluating, and Communicating Information
Service; Evangelization	Using Models, Analyzing Data, Communicating Information
Morality	Asking Questions and Defining Problems, Analyzing and Interpreting Data, Constructing Explanations, and Obtaining, Evaluating, and Communicating Information
The Last Four Things	Asking Questions and Defining Problems, Developing and Using Models, Carrying out Investigations, Analyzing and Interpreting Data, Using Mathematics, Constructing Explanations, and Obtaining, Evaluating, and Communicating Information
Sacraments and Prayer	Using Models, Obtaining and Communicating Information
Apologetics	Asking Questions and Defining Problems, Developing and Using Models, Carrying out Investigations, Analyzing and Interpreting Data, Constructing Explanations, Engaging in Argument with Evidence, and Obtaining, Evaluating, and Communicating Information
Apologetics	Asking Questions and Defining Problems, Developing and Using Models, Carrying out Investigations, Analyzing and Interpreting Data, Constructing Explanations, Engaging in Argument with Evidence, and Obtaining, Evaluating, and Communicating Information
Creation and Marriage	Asking Questions and Defining Problems, Developing and Using Models, Carrying out Investigations, Analyzing and Interpreting Data, Using Mathematics, Constructing Explanations, Engaging in Argument with Evidence, and Obtaining, Evaluating, and Communicating Information
Discipleship	Asking Questions and Defining Problems and Communicating Information

Observing scientific practices firsthand in the classroom, I saw the value in their complimentary, universal nature. I considered whether any practices were missing or not helpful for lessons of faith. From this, I created a specialized list of practices religious education students need for growing in faith knowledge and embracing their faith in an engaged, lifelong, and personal way (Figure 7).

Figure 7: 9 Faith Disciplines.

Watching students grow in their abilities to learn the faith, seeing their genuine desire to learn more, and needing to provide opportunities for high school students to be with their peers outside class on their faith journey, inspired me to start a high school prayer group called PG33, which stands for prayer gathering centered around Christ who died circa 33 A.D. We meet in a relaxed setting, build friendly relationships, and focus on prayer, sacraments, and study. We began meeting monthly in December 2013, and more and more students are expressing interest in joining. Their favorite activities are to ask wonder questions about the faith, hold prayer vigils for students in need, and explore Catholic resources. Much of what I was doing in the ninth grade lessons was extended to these prayer gatherings. The students involved expressed interest in wanting more of this type of gathering, suggesting meeting every other week and over the summer.

Inside the ninth grade religious education environment, I transformed the setting with new furniture and resources and re-cultured the classroom to foster a learner-centered environment where inquisitiveness was highly valued. While other classrooms struggled with student-teacher discourse, my students remained after class, wanting to ask more questions. After the last class, students expressed their interest in me being their 10th grade teacher because of their level of enjoyment and faith learning. “You should come with us,” one student remarked. Another student took it further and said, “I really enjoyed the class this year! I really look up to you as a role model in faith and how you live.” This was powerful feedback to me. It reminded me of the great value teachers can have in the classroom, the positive, influential role teachers can play in students’ lives, how much teachers can learn from students, and the significance of a teacher’s esteem of their students. As much as the students were inspired by me and the project, I

was inspired by them.

Thanks to this study, I have become more than an inquiry teacher. I have become an example of how to interact with religious education students in a meaningful way throughout the St. Lawrence school. This transformation is something I treasure deeply, for this project was challenging, daunting at times, and completely unfamiliar to me. It was also an opportunity to grow from every aspect. Even though I have taught with science inquiry methods prior to being a director of religious education, I had not integrated science inquiry into religious education lessons before this study. I had zero experience with implementing science practices in a religious education setting and little working knowledge of scientific practices or how to meld them with religious lessons.

With continued professional development through extra coursework, I learned how scientific practices are integrated into inquiry and lesson design. This ignited my abilities to teach with practices. My lessons and teaching strategies improved over the school year. I tried new things like discrepant events and models with success. With persistence, my aptitude for incorporating scientific practices into lessons blossomed, and my lessons became effective and engaging for students. Somewhere along the way, I discovered an incredibly powerful way to teach inquiry-based religious lessons with scientific practices and became an inter-disciplinary inquiry teacher.

Ultimately, this study has provided a platform for me to try new teaching strategies, build my comfort level in teaching inquiry with scientific practices, and make real-life student observations and evaluations that will have benefit for students for years to come. Now, I know what it means to be a purpose-driven inquiry teacher in a religious setting, what scientific and engineering practices are and how to implement them

effectively in a religious education setting, and how valuable the classroom research process is to bettering student learning outcomes. Looking ahead, I am refining lessons for next year, communicating results with others, and building a curriculum support system with parents interested in strengthening lessons and making a difference for students.

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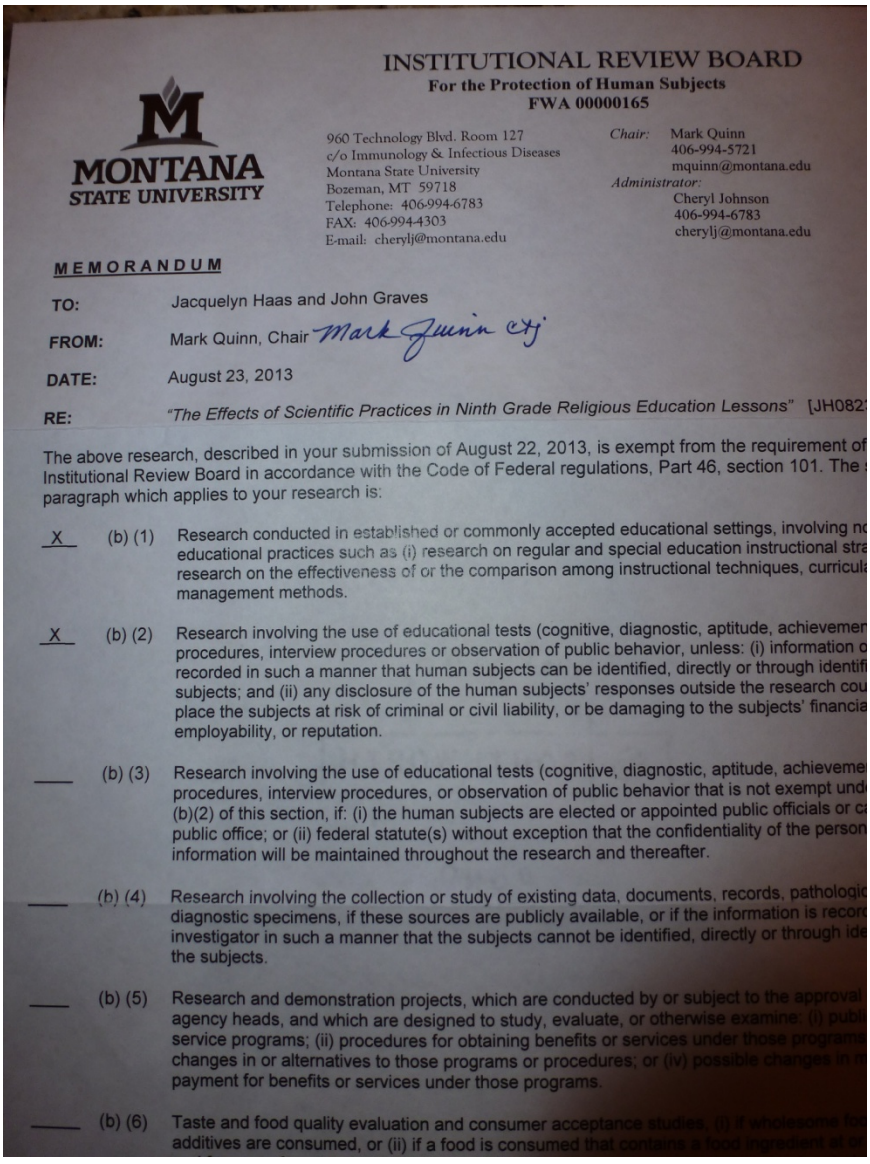
APPENDICES

APPENDIX A

MSU's INSTITUTIONAL REVIEW BOARD EXEMPTION



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MONTANA STATE UNIVERSITY

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MEMORANDUM

TO: Jacquelyn Haas and John Graves

FROM: Mark Quinn, Chair Mark Quinn CTJ

DATE: August 23, 2013

RE: *"The Effects of Scientific Practices in Ninth Grade Religious Education Lessons"* [JH082

The above research, described in your submission of August 22, 2013, is exempt from the requirement of Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The paragraph which applies to your research is:

_X_ (b) (1) Research conducted in established or commonly accepted educational settings, involving n educational practices such as (i) research on regular and special education instructional stra research on the effectiveness of or the comparison among instructional techniques, curricul management methods.

_X_ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievemen procedures, interview procedures or observation of public behavior, unless: (i) information recorded in such a manner that human subjects can be identified, directly or through identif subjects; and (ii) any disclosure of the human subjects' responses outside the research cou place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financia employability, or reputation.

____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achieveme procedures, interview procedures, or observation of public behavior that is not exempt und (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or c public office; or (ii) federal statute(s) without exception that the confidentiality of the person information will be maintained throughout the research and thereafter.

____ (b) (4) Research involving the collection or study of existing data, documents, records, patholog diagnostic specimens, if these sources are publicly available, or if the information is recor investigator in such a manner that the subjects cannot be identified, directly or through id the subjects.

____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approva agency heads, and which are designed to study, evaluate, or otherwise examine: (i) pub service programs; (ii) procedures for obtaining benefits or services under those program changes in or alternatives to those programs or procedures; or (iv) possible changes in payment for benefits or services under those programs.

____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome fo additives are consumed, or (ii) if a food is consumed that contains a food ingredient at

APPENDIX B

MY RESPONSE OF FAITH WRITING SAMPLE

Pre-Reflection: Faith

Name:

Directions: Answer the following question, using Biblical and Catechism references, examples, stories, and/or other relevant references. You may write on both sides of paper.

Why does faith matter?

- to you

- for the Church

- in society

APPENDIX C

MY RESPONSE OF FAITH WRITING SAMPLE RUBRIC

My Response of Faith Rubric

Criterion	Scoring			
	5	**3**	**1**	**0**
Adequacy of explanation	Constructed extremely well with reasoning	Provided reasoning that needed expansion	Did not provide reasoning	No explanation included
Adequacy of using resources	Used resources extremely well to connect faith to daily life	Used resources but needed to expand connection of faith and daily life	Used resources minimally, connected faith to daily life	No use of resources or connection of faith to daily life
Quality of faith content	High faith content knowledge	Fair amount of faith content knowledge	Little faith content knowledge	No display of faith content knowledge
Quality of reflection	Obtained, evaluated, and communicated faith information in an extremely effective way	Obtained, evaluated, and communicated faith information in a mostly effective way	Obtained, evaluated, and communicated faith information with little effectiveness	Obtained, evaluated, and communicated faith information in an ineffective way

APPENDIX D

RELIGIOUS EDUCATION & SCIENTIFIC PRACTICES QUESTIONNAIRE

The Religious Education & Scientific Practices Questionnaire

Your participation in this research is voluntary and participation or non-participation will not affect your religious education status in any way.

Name:

Directions: Read each question carefully and answer questions following instructions.

1. Would you like to have more religious education lessons that use scientific practices? *Circle one.*
    a. Yes
    b. No
    c. I don't know

2. Would you encourage a friend to take religious education classes with you if scientific practices were used? *Circle one.*
    a. Yes
    b. No
    c. I don't know

3. Using scientific practices in religious education lessons:
    *Circle **as many as** you agree with. Read carefully.*

    a. improves my faith knowledge
    b. does not improve my faith knowledge
    c. makes religious education lessons more interesting and engaging
    d. does not make religious education lessons more interesting and engaging
    e. are an effective way of improving my faith knowledge
    f. are not an effective way of improving my faith knowledge
    g. are an effective way of improving my interest and engagement
    h. are not an effective way of improving my interest and engagement
    i. is unfamiliar to me

4. Using the scale below, how would you rank the following statements? Write the number in the blank provided that best expresses your ***current*** opinions.

    1= strongly agree **2**=agree**3**=disagree **4**=strongly disagree

    ____ The classroom environment and resources make religious education lessons more interesting and engaging.

    ____ The classroom environment and resources improve my faith knowledge.

5. Out of these eight scientific practices, which ones are the most effective in helping you develop your faith knowledge? *Circle **as many as** you want.*

    a. Asking questions and defining problems
    b. Using models
    c. Exploring and investigating information
    d. Analyzing information
    e. Using resources and technology
    f. Constructing explanations with reasoning
    g. Developing and engaging in arguments; recognizing others' argument strengths and weaknesses
    h. Obtaining, evaluating, and communicating information with others
    i. None of them

6. Out of these eight scientific practices, which ones are your favorites to use to grow in your faith? *Circle **as many as** you want.*

    a. Asking questions and defining problems
    b. Using models
    c. Exploring and investigating information
    d. Analyzing information
    e. Using resources and technology
    f. Constructing explanations with reasoning
    g. Developing and engaging in arguments; recognizing others' argument strengths and weaknesses
    h. Obtaining, evaluating, and communicating information with others
    i. None of them

7. What did you like best about using scientific practices in religious education lessons?

8. If you could change one thing about how we use scientific practices in religious education lessons, what would it be?

9. Is there anything else that you would like me to know?

APPENDIX E

SCIENTIFIC PRACTICES CLASSROOM ASSESSMENTS

Resources of the Catholic Faith (Pre-Lesson)

Class Two

Name:

1. What is the Bible?

2. What is one reference tool in the Bible?

3. What is the Catechism of the Catholic Church?

4. What is one thing that you find in the Catechism?

5. What is one Catholic web site or online application that you either use of know of?

Resources of the Catholic Faith (Post-Lesson)

Class Two

Name:

1. What is the Bible?

2. What is one reference tool in the Bible?

3. What is the Catechism of the Catholic Church?

4. What is one thing that you find in the Catechism?

5. What is one Catholic web site or online application that you either use of know of?

Class Three

What's our process to reading scripture?

What Bible reference tools did we use?

Class Five

Online Catholic Resources

What is a Catholic Web site? Write the address here.

What does this Catholic Web site share? Describe how you would use this here.

How did you find this Web site? Write what words you used to search for this Web site.

What else would you like to find on the Web about our Catholic faith?

Class Ten

What is prayer?

What is adoration?

Class Fourteen

Agent Name:

What are the three things you must consider when making a moral decision?

1.

2.

3.

What is morality?

Last Four Things

Pre-Assessment

Name:

What are The Last Four Things? Name and define each of them.

1.

2.

3.

4.

STOP

Post-Assessment

What are The Last Four Things? Name and define each of them.

1.

2.

3.

4.

- Did the water splash simulation and dart board graphs help you better grasp the effects of sin and the last four things? **Yes or No**

- Do you know more about The Last Four Things and effects of sins than you did before? **Yes or No**

- Were you interested in learning about our faith from the balloon demonstration? **Yes or No**

- Did you like how we learned about our faith tonight? **Yes or No**

Class Seventeen

Concept Mapping. Did your drawings match up with your words? Okay, so, let's talk words. "Who is Jesus?" Invite students to share their written statements with the large group. Write correct responses on one mini white board and misconceptions on the other mini white board. (Misconceptions would be answers, such as, a man, a prophet, Father, or Holy Spirit.) After all responses have been recorded, hold up each mini whiteboard and ask students, "Which one do you think is correct about Jesus and which one is incorrect?" "Why? What are your reasons?" See if students can come up with the Apostle's Creed.

The Question: Who is Jesus?

Lawyer's Belief:

Evidence Present in Case	Resource

Opposing Counsel Views	Expert Testimony Rebuttal

Closing Argument (lawyer's claim with explanation and evidence)

Did finding evidence help you better understand what Catholics believe on this topic? Yes or No

Do you like learning about our faith with evidence and reasoning? Yes or No

Creation and Evolution

Three college students were discussing creation and evolution. One was a doctorate student in physics, the other had a PhD in philosophy, and the third was a roommate of an atheist trying to find the truth. As they chatted and watched the video blog of the atheist roommate, the topic of how the universe began came up. Based on scientific evidence, what response correctly depicts creation and evolution? Choose one response and write a reason for your choice below.

---

1. Creation and the theory of evolution are not based on science, but on religion; therefore, neither theory explains scientifically how the universe began.
2. Creation is explained in the Holy Bible; therefore, there is limited scientific evidence on how the universe began. However, there is extensive scientific evidence on the theory of evolution from numerous scientists, such as Charles Darwin.
3. Einstein created The Big Bang Theory to scientifically explain how the universe began with the explosion of a single particle at a definite point in time, which is accepted by scientists and Catholic Christians. The theory of evolution is also based on scientific evidence from scientists such as Charles Darwin, but this theory is not accepted by Catholic Christians.
4. Scientists thought The Big Bang Theory, or the idea of an expanding universe as proposed by a Catholic priest, was preposterous. The theory of evolution, based on scientific evidence and modern scientific discoveries, was recently accepted by Pope Benedict.

Reason for Choice: *I think choice # ____ because*_____

_____.

Final Assessment. After all concepts have been researched and discussed, do a final assessment of all concepts in an arm wrestling type review. Have concept/question in center and have possible answers on each side. The team with the right answer is to tug.

APPENDIX F

RELIGIOUS EDUCATION & SCIENTIFIC PRACTICES INTERVIEW

The Religious Education & Scientific Practices Interview

Your participation in this research is voluntary and participation or non-participation will not affect your religious education status in any way.

Name:

Directions: There are three questions that I would like to ask you about the ninth grade research project. As you answer, I will be taking notes and listening to everything you have to say. Thank you for accepting this interview. I look forward to learning from you.

1. Is the way you think about your faith now different? How so? Are there certain steps you go through now to think about the Catholic faith? What are they?

2. Do you think you have the tools now to learn about your faith on your own and with others? What tools, or books, resources, technology, and activities, do you want to always keep in your toolbox for faith learning?

3. Do you value your faith more or less because of this research project? Can you explain?

4. Is there anything else you would like me to know?

APPENDIX G

RELIGIOUS EDUCATION & SCIENTIFIC PRACTICES SURVEY

The Religious Education & Scientific Practices Survey

Your participation in this research is voluntary and participation or non-participation will not affect your religious education status in any way.

Name:

Directions: The statements in this survey have to do with your attitudes about religious education and confidence about using scientific practices.

Using the scale below, how would you rank the following statements? Write the number in the blank provided that best describes your ***current*** opinions.

1= strongly agree **2**=agree **3**=disagree **4**=strongly disagree

1. ____ I have the skills needed to learn about my faith.
2. ____ My classmates have the skills needed to learn about the Catholic faith.
3. ____ I feel knowledgeable about my faith.
4. ____ I know how to ask questions and define problems to learn more about my faith.
5. ____ I use several Catholic web sites to explore and investigate my faith.
6. ____ I know how to use the Catechism and Holy Bible to learn more about my faith.
7. ____ I know how to stand up for my faith on real world issues.
8. ____ I know how to gather and analyze information about my faith.
9. ____ I know how to communicate with others about my faith.
10. ____ I know how to use reasoning to explain my faith.
11. ____ I use models to think about my faith.
12. ____ Religious education classes teach me the skills to think and learn about my faith on my own.
13. ____ Religious education classes are interesting and engaging.
14. ____ I am excited about my faith and religious education classes and tell my friends and/or family about my experiences.
15. ____ I believe religious education classes bring me closer to God.

APPENDIX H

TEACHER OBSERVATIONAL RECORDS

Examples from Teacher's Journal

Class One – Sept. 8, 2013

- Students loved going outside on their mystery walk. Probing questions led to surface-level responses with no ties to our faith or religious study. The walk gave them a moment to reflect outside themselves, giving them a good point of reference for the rest of the class. Students liked talking to the 85-year-old neighbor.

Class Twelve – Jan. 19, 2014

- There were pages of questions from students today. I remember the first time we were discussing what questions we had about Catholicism, it was a struggle to come up with four. Now, they had no problem coming up with almost 50 about one topic. I did notice though that Church and Mass were synonymous to them, which isn't exactly right. The Church is much more than the Mass, and the Mass is an essential part of the Church. I will need to better explain this next year. Also, I would like to add more information about St. Lawrence and have a Prezi on The Great Catholic History, featuring people and inventions and works of Catholics in the past. I'd also like to put together some numbers on the future.
- Student X who I was hoping to see increased engagement from jumped in today with excitement, and said, "Tell them what you told me." I was answering questions earlier, and student X thought it was so interesting, they wanted everyone to know.

Class Thirteen – Feb. 9, 2014

- We began our lesson, outside the classroom, in the large group prayer area. I liked this; it was more homey with couches and chairs. The students liked it to, as we watched a music video and reflected on how to bring Christ into the world. For the classroom, I brought all the tables together into a large block; this worked really well for Student X. Student X was productively working and contributing to the discussion with great ideas. Students loved the model of candles and how we need to fill our lives with Christ to continue burning. When discussing the service project, some students were anxious, due to school rules, as we discussed putting up post-it notes at school. This was a good thing, as next class I want to emphasize that we must do the moral thing, and if the circumstance doesn't follow all the rules, then find a circumstance that does, so that it can be moral.

Class Fourteen – Feb. 16, 2014

- Students were highly engaged in today's case studies on The Case of Morality, with an FBI spin. One student asked, "Should we be taking notes?" Many students were flipping their assessment sheets over, and seriously, intently taking notes, as if something really important was being discussed. Students were asking clarifying questions as well to make sure they understood the nuances of the material. None of the students knew how to make a moral

decision or what three things constituted a moral decision at the beginning of the lesson. At the end, students were constructing explanations for their case and making a case for it in front of the class. They did this in pairs of two. I liked asking the students after each case whether they thought it was real and then sharing the real stories. Students were intrigued by this and several asked clarifying questions. I would like to add a case on pornography next year, as I just heard about an EPA worker who makes $120,000 a year, watching 6 hours of porn at work a day. With this, and other topics that are uncomfortable to talk about, I want to better prepare for this part of this discussion with fact sheets for the students, or maybe a prezi, that they can look through to learn the facts and evidence on some of these topics and what effects they have on people and the world. Or maybe, I can find real-world examples on the web they can explore. Or maybe, I can use pictures or have them draw pictures of certain things in their journals. Then, we can compare and contrast them to my journal. I connected back to last lesson to discuss circumstances and how we shouldn't give up if things aren't perfect. Instead, we need to persist creatively and morally. Having students consider this and come up with a new solution was good practice. Overall, this was a great lesson and I enjoyed it.

Class Fifteen – Feb. 23, 2014

- This was the best lesson of the year so far! The students were engaged the entire lesson, fully participating with outstanding interest and enthusiasm. Models are my new favorite part of teaching. I absolutely love them and what they can bring to student learning. At the beginning of integrating scientific and engineering practices, models were what I was afraid of incorporating into lessons. What were these? How do I bring them into a religious education lesson? With this lesson, a light turned on and I figured out how to use and develop models with students, and the results were fantastic. There is a video on The Last Four Things, I'd like to share that with students next year.

Class Sixteen – Mar. 9, 2014

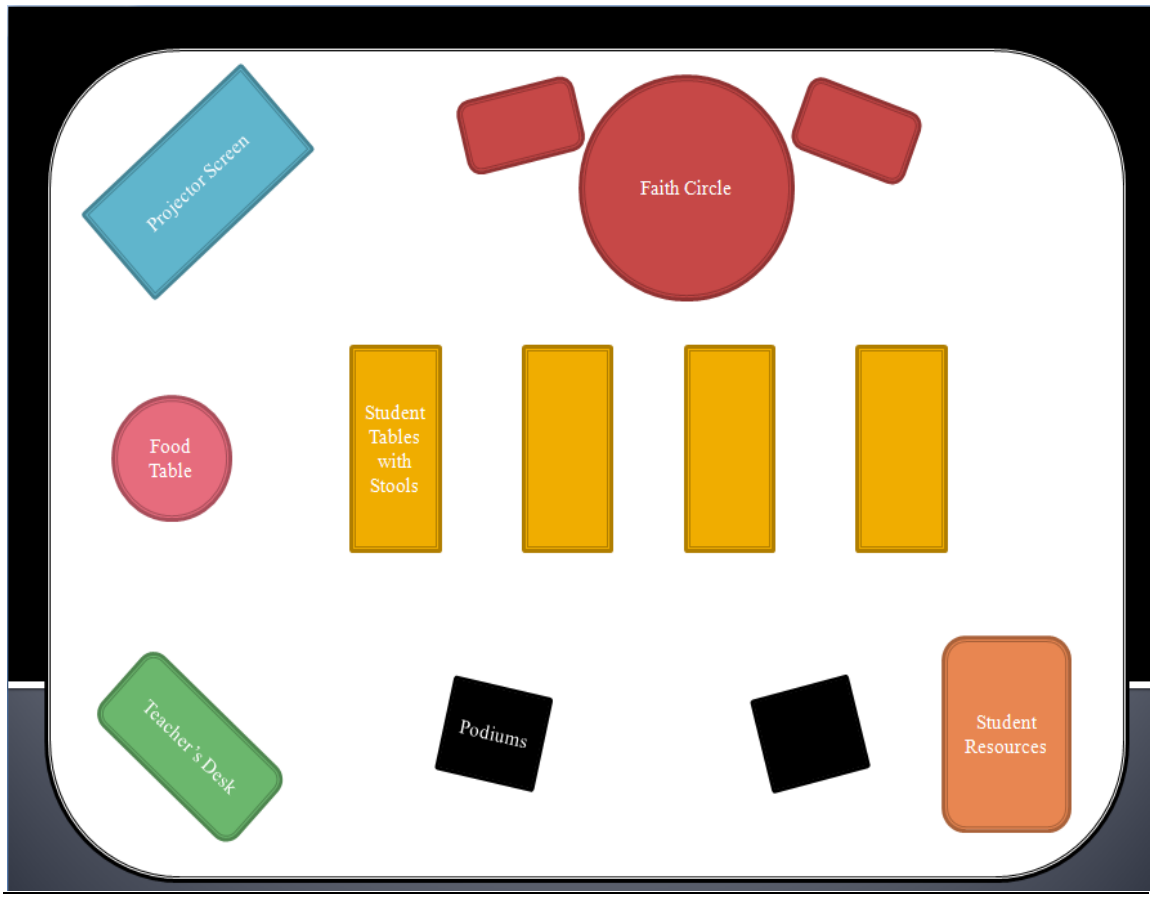
- For the first time, students were engaged in a friendly conversation at ease with their own formation. Student Y was participating, smiling, and adding to the conversation. Students formed a circle on their own and were laughing and showing fellowship.

Class Nineteen – Apr. 6, 2014

- Students did not want to leave; they were asking questions about the faith after class ended. Student X was so excited and said, "You should come with us to 10th grade. You should be our teacher next year. I've learned so much this year."

APPENDIX I

9TH GRADE RELIGIOUS EDUCATION CLASSROOM MAP



Pictured above is the treatment classroom design. Pictured below is the pre-treatment classroom environment.

At the start of the treatment, the classroom was re-designed with elevated lab-like tables, stools, podiums for debate, a faith circle area, new Catholic resources, and technology.

For certain treatment lessons, tables were brought together as one block. For others, they were separated into two blocks, one for female students and the other for males.

Near the end of the treatment, to increase discourse and engagement with arguments, tables were formed into a u-shape.

APPENDIX J

PHOTOGRAPHS OF 9TH GRADE RELIGIOUS EDUCATION STUDENTS

Examples of Scientific Practices: Using Mathematics

APPENDIX K

9TH GRADE RELIGIOUS EDUCATION STUDENT JOURNAL

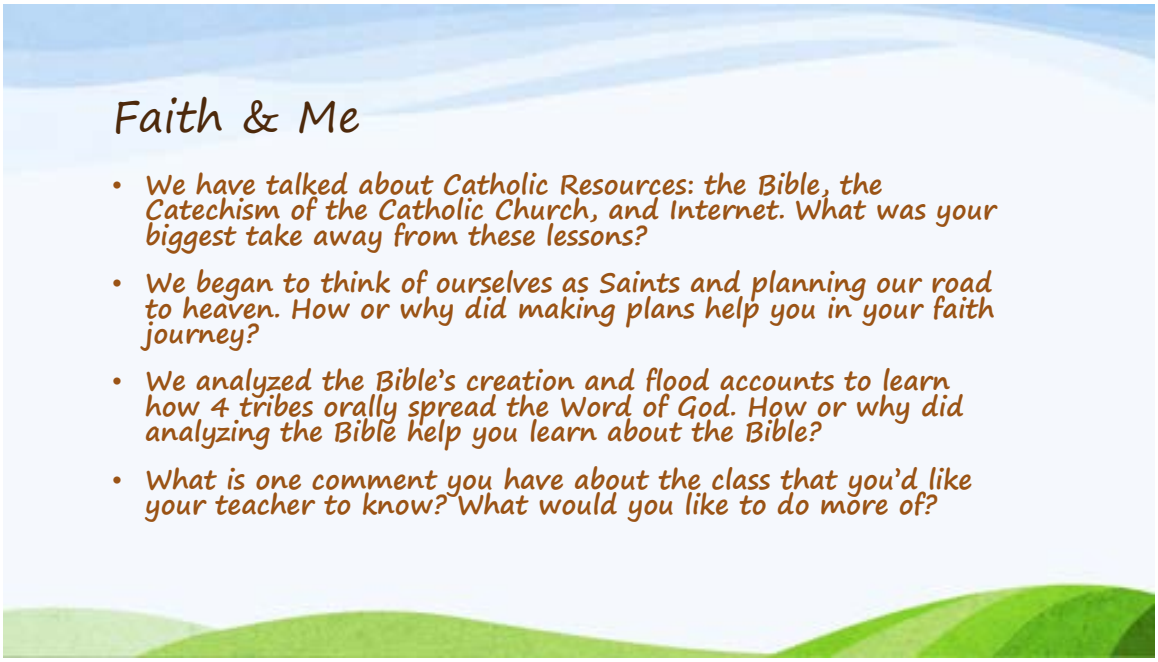
Week Four: Catholic Resources – Scripture reflection

- **PRAYER JOURNALS:** Another way to prepare for carrying the Gospel is spending quiet time with the Lord. So, we are going to just take some time now and listen to what God has to say to us by reflecting and journaling whatever comes to mind. Our reflection tonight is on faith, also based on the Gospel from today. READ GOSPEL. GIVE MUSTARD SEEDS and TAPE for their Journals. SHOW PLANT.

  Faith & Me Reflection: *Your time to spend with God growing in faith, hope, and love*

  - Faith is personal adherence of the whole person to God.
  - What are the challenges of living your Catholic faith in today's culture?
  - Faith is a gift from God that helps us believe in him. Take time to thank him for his gift of faith to you.

Week Ten: Prayer & Adoration



Week Fifteen: The Last Four Things

Determine Habits to Heaven. Have you been practicing what you planned to do on your Roadmap to Sainthood? If not, look at your habits. What is One Habit for Heaven that you can start to improve our relationship with God? Create a specific plan on how to do that one habit to keep your sights on heaven.

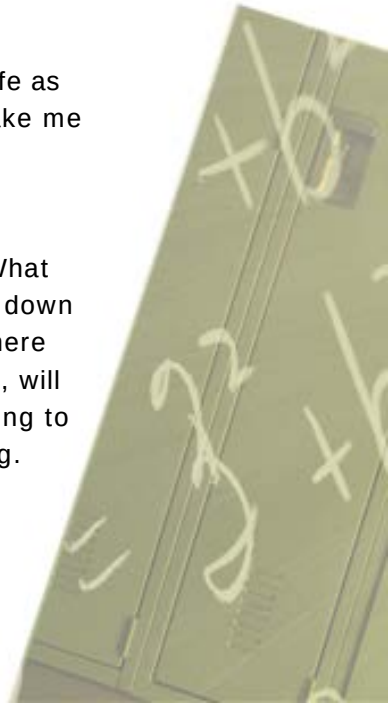
Week Seventeen: Apologetics – Who is Jesus?

Journal Prompts

Prayer:
Jesus, your words today challenge me to look at my life as your disciple. I am weak and sometimes cowardly. Make me strong in my defense of your “least ones.”

Prompt:
It is hard to take a stand, but imagine for a minute “What would Jesus be fighting for today in our world?” Write down two things Jesus would be fighting for, along with ”Where would Jesus stand on these injustices?” As his disciple, will you stand with him? Write down one thing you are going to do to stand with Jesus, the Son of God, Christ our King.

Prayer:
Thank you, God, for Jesus, and for this time with you. Help me to be willing to take a stand for you.



Week Eighteen: Apologetics – Catholicism and Religion Timing

From the YouCat Study Guide: What matters more, how one begins or how one finishes in life?