



# HEARTS OPEN TO THE WORLD

STEM EDUCATION AND  
CATHOLIC FAITH CASE STUDY



## EXECUTIVE SUMMARY

The Innovation Lab at Mary, Mother of the Redeemer Catholic School (MMR) is a year-long, multidisciplinary STREAM learning experience that engages students in designing novel solutions to real-world problems with both creativity and empathy. Students from pre-K to Grade 8 participate in the Innovation Lab to tackle a global challenge aligned to one of the United Nations' Sustainable Development Goals, realizing in the process that they are young members of a global community called by faith to uphold the human dignity of others.

The Innovation Lab has an established curriculum trajectory by grade level, but is better understood as an approach and a mindset. The lab provides regularly structured time and space for students to engage in an extended engineering design project that is largely student-directed, open, and creative. A dedicated STREAM director guides classes of students in exploring and understanding a particular problem and—ultimately—developing potential solutions. These integrated projects also call on classroom teachers to serve as co-facilitators when their classes are in the Innovation Lab and to incorporate learning opportunities that engage students in subject-specific content. This approach is paired with a mindset that constantly fosters empathy for others—the hallmark disposition that makes an explicit connection between faith and STEM learning experiences.

# HISTORY & VISION

The Innovation Lab originated with an idea, an airplane napkin, and a conviction for the creative potential of every student. On a return flight from a Catholic education convention, an MMR teacher presented the principal with a proposal for how their school might develop a STEM-based program based on the UN's 17 Sustainable Development Goals (SDGs). Within a few weeks, the teacher had drafted an initial set of materials to guide the process; over the course of time, these would evolve and become further refined.

From its inception, there were clear directives for the vision of the Innovation Lab. First, there was an uncompromising commitment to align the initiative with the religious dimension of the school's Catholic mission. Empathy, specifically, was envisioned as the focal disposition for the effort, reflecting both a Catholic-Christian ethos and widely applicable disposition for the global contexts relevant to the SDGs. Students would become problem solvers for questions that addressed the dignity of individuals around the world by joining STEM principles with Christ's great command to love your neighbor as yourself. They would develop solutions that put their faith into action to help others access clean water, alleviate hunger, maintain a living wage, and access equitable educational experiences. Empathy was envisioned as the "common thread that holds everything together," weaving in a religious dimension that—along with art— extended the initiative's multidisciplinary lens from STEM to 'STREAM.'

There was another key touchstone that directed the vision: students would not be graded as they developed their projects. At the start, the initiative's architects were convinced that students needed to be able to enter into these projects authentically—to feel that their contributions mattered to their faith and to their character, and that they needed to be free to innovate, fail, and try again to accomplish their goals. Removing the spectre of a grade, they hoped, would enable the projects to feel less like just another subject and more like an extension of the classroom, which could become an integral part of the educational experience at MMR.

The principal trusted the teacher and her initial plan, and both held credibility among the faculty to garner enough buy-in to implement this new initiative. By their own self-report, the first year contained ups and downs and its share of uncertainty, at times. The first iteration of self-developed handbooks, resources, and tools were an essential stabilizing force that shaped what the instruction looked like in practice and how other faculty members could adopt it early on. It was a culminating public showcase, called "Innovation Night," that ultimately served as a proof-of-concept and surpassed every expectation as an astounding nine hundred people attended. In addition to parents, other community members came to learn about MMR's new initiative.

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*"Empathy is the common thread that holds everything together."*

The work has subsequently thrived. The principal and the parish's pastor champion and cultivate the school-wide culture—paired with increasing resources over time—that has sustained the program's value into the future. The resources include a dedicated STREAM director role, shared responsibility with teachers being part of the instructional team, and a beautiful new space. The lab is well-outfitted with both technology and household supplies that can be used to construct models and prototypes while attending explicitly to issues of sustainable material use.

## **CRITICAL MINDS, COMPASSIONATE HEARTS, CREATIVE SOLUTIONS: THE INNOVATION LAB**

### **DESIGNING MULTIDISCIPLINARY SOLUTIONS**

The Innovation Lab aims to engage students in multidisciplinary problem solving across the STEM subject areas, religion, and art. This STREAM program is, therefore, better characterized as an instructional approach than a curricular one, in which students are guided throughout the year in using various disciplinary perspectives to understand and address a wide-ranging global issue. This extended project spans the academic year and empowers students to direct their own learning, thinking deeply about a particular challenge and creatively exploring possible solutions. “The key to the STREAM Lab,” explained one teacher, “is to never give an idea. It’s always to ask a question.” As students consider who may be impacted by the problem and their proposed solution, they cultivate a sense of empathy for others, including those who live far away and whose culture may be quite different from their own. This sense of global solidarity is tied to the local and particular through students’ group collaborations, where they grow in compassion as they work with their classmates.

Such an approach requires a great amount of responsiveness from teachers. Far from dispensing with preparation, though, this approach demands purposeful structures that are directive yet flexible. As one teacher explained, “You have to have a plan.” And the program has a clear, high-level pacing guide that sets out monthly markers for how teachers shape learning experiences related to the program. The process begins early in the year with religion lessons that forefront the role of empathy and kindness for becoming global citizens. The focus then turns to conducting research related to the problem and/or country of focus, then on to writing about the issue, using and representing mathematical data of the issue, and—in the spring months—using the engineering design cycle to develop a solution using scientific or technological ideas. Within this structured guidance, the specific details of students’ research and solutions are largely student-driven. Students’ autonomous decision-making is supported by an environment in which the solution pathways are open-ended and in which the designed products are not graded.



## TOPICAL FOCUS: UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

The program utilizes several of the United Nations' Sustainable Development Goals (SDGs) for 2030 to specify a global challenge that students address by engineering possible solutions. To do so, students develop the skills needed to tackle some aspect of the global issue, break it into smaller components, and work creatively and collaboratively to present a potential solution. Each grade level receives the topical focus of one of the 17 SDGs. For Grades 3 through 8, students develop a specific innovation over the course of the year to address some aspect of the goal. For example, in 2021 7th grade focused on *Goal 4: Ensure inclusive and equitable quality education and promote lifelong opportunities for all*, with three groups of students developing innovations to support learners with hearing impairments. The younger grades (PreK through Grade 2) examine their focal SDG with a greater emphasis on social studies—growing in understanding and respect for the culture of a particular country in the world—and art projects, which often tie in a religious dimension.

The topical focus is a prime example of a directive-yet-flexible structure of the Innovation Lab. The school-wide program maintains coherence by its focus on addressing global issues and cultivating empathy. Since each grade learns about a different topic, the projects are novel and non-duplicative as students progress through their K-8 educational journey. At the same time, there is a great deal of flexibility within the structure. For students, each SDG is wide-ranging enough to ensure that their subtopics are unique and solutions cannot be duplicated from previous years or found online. Teachers are able to select the country-of-focus each year without requiring wholesale revision to the program's structure. And even at the program-level, the essential elements are not tethered to the content of a single SDG, leaving open future possibilities if they wish to rotate in other SDGs that are not currently in use.

## INNOVATION NIGHT

The thoughtful, creative year-long projects are directed towards and culminate in a public-facing display of students' work with the Innovation Night in April of each year. Students in Grades 3-8 create three-dimensional models of their solution to present, preparing a tri-part poster board and a 6-8 minute 'TED'-style presentation. The preK-2 students also contribute to the event, producing murals and art that reflect their cultural sensitivity and knowledge. The hour-long event itself, now hosted across the school's outdoor grounds, is a bona fide community event that draws together parents, neighbors, and other interested members in the local area.

In addition to effectively engaging the broader community, the showcase serves as a soft accountability measure for both teachers and students, motivating the need to be prepared without the extrinsic control of the project being graded. The results are impressive: students are quite knowledgeable about their researched issue and their developed solutions are considerably creative.

The influence of the Innovation Night should not be understated, as it is a visible indicator of the school's commitment to both empathy and the UN Sustainability goals. School leadership reported receiving many affirmations from parents, prospective parents, and other community members; for example, an industry professional was impressed by students' perseverance and learning through failure, and a prospective parent was moved by the compassion communicated through an innovation designed with and for children with bilateral hearing loss.

## PHYSICAL SPACE

The renovation of the school's former library marks out the physical space of the Innovation Lab. The lab is a large, open classroom set in a modern style. The almost octagonal room is graced by beautiful bay windows that look out over the front of the school, a space that is central to the school building itself. The room is set with several pods of rectangular tables, as well as a



collection of hexagonal tables that serve to visually cue collaboration. A moveable Smartboard toward the front of the classroom complements the contemporary feel, with whiteboards hung along one wall and another wall lined with organized shelves of supplies, containing just about every imaginable craft material, from glue guns and paper towels to buttons and string. A series of three doors flank an interior wall—two lead into small breakout rooms, and the third to a brand-new green screen studio room.

This new, creative space embodies a program vision that was already being actualized and confirms an institutional commitment to the program. And while the ‘Innovation Lab’ can refer to the room itself, the name also reflects the program’s substance as a learning experience in which “students are designers, builders, scientists, artists, engineers, actors, and above all, empathetic human beings.” There is remarkable clarity and consensus among leadership and teachers that the ultimate goal is to form young people to be empathetic global citizens, and that their cross-curricular experiences in the physical Lab are a central mechanism to achieve it.

## PERSONNEL

MMR’s Innovation Lab program was molded—practically from scratch—by a teacher whose expertise extended across faith formation and STEM learning and who had sought to tie these together in her own classroom. After the first year of implementing the initiative, a new, formalized position of the STREAM coordinator was fitted into the budget, with this boundary-crosser serving the role initially. This role has been maintained since then, with a number of different personnel in the position. The role serves as the designated person for coordinating the projects across the school, serving as the lead instructor in the Innovation Lab, and creating the curricular materials related to the SDGs. Notably, the school has not used a formal STEM or STREAM curriculum to

guide this work, although they do have textbooks to serve as a supplement or as a fill-in in the event the coordinator has an extended absence. In addition to this role, a larger 'implementation team' of approximately 10 school personnel shepherd specific responsibilities of the program, like overseeing the Lab scheduling or serving as the PreK-2 creative designer.

Importantly, the Innovation Lab does not function as a 'drop-off' special and planning period for the classroom teachers. While it is scheduled in a rotating way across grade levels and is led by the STREAM coordinator, grade-level teachers assist as facilitators in the Innovation Lab, circulating among tables and supporting students during the period. Consequently, teachers are knowledgeable and 'plugged in' to the content of the Innovation projects, and can integrate these ideas seamlessly into disciplinary subjects that occur in their own classrooms—for example, a written essay about the STEM design challenge might occur within an English class. Collaborating with the STREAM coordinator is primarily focused on pacing and specifying each teacher's responsibilities; the coordinator herself is the primary planner of the learning experiences within the Innovation Lab.

Certain dispositions are crucial for MMR teachers, including being adaptable, trusting of the process, and being open to growth themselves. "You know not who that child will become," explained the principal, "so you *cannot* be judgmental and *cannot* have a preset notion of what a child's limitations are, or should be, or will always be." This openness to growth extends not only to teachers' expectations of students, but also to their own learning. "When we first started, we were all learning," described one teacher. "I was not a STREAM teacher and wasn't familiar with what we were doing. As a whole school, we had to come up with an outline for what we were doing, to specify 'why' and 'to what end.'"

The role and content expertise of the STREAM coordinator has, subsequently, been beneficial for lowering the implementation knowledge and energy for teachers. The coordinator takes the lead in conceptualizing and shaping the STREAM offerings around the SDGs, while the other teachers can gain enough content familiarity to offer support to students. This is aided by the fact that the grade-specific SDG narrows the necessary content knowledge considerably. The program's emphasis on living out the Catholic-Christian call for empathy also enables teachers to draw upon their faith convictions in authentic ways without requiring extensive expertise in Catholic moral philosophy or the social traditions of the Church. Still, teachers themselves continue to learn, particularly at the interface between STEM content and the Catholic faith; one teacher, sharing with honesty, reflected, "I'm not always sure myself how they are intertwined."

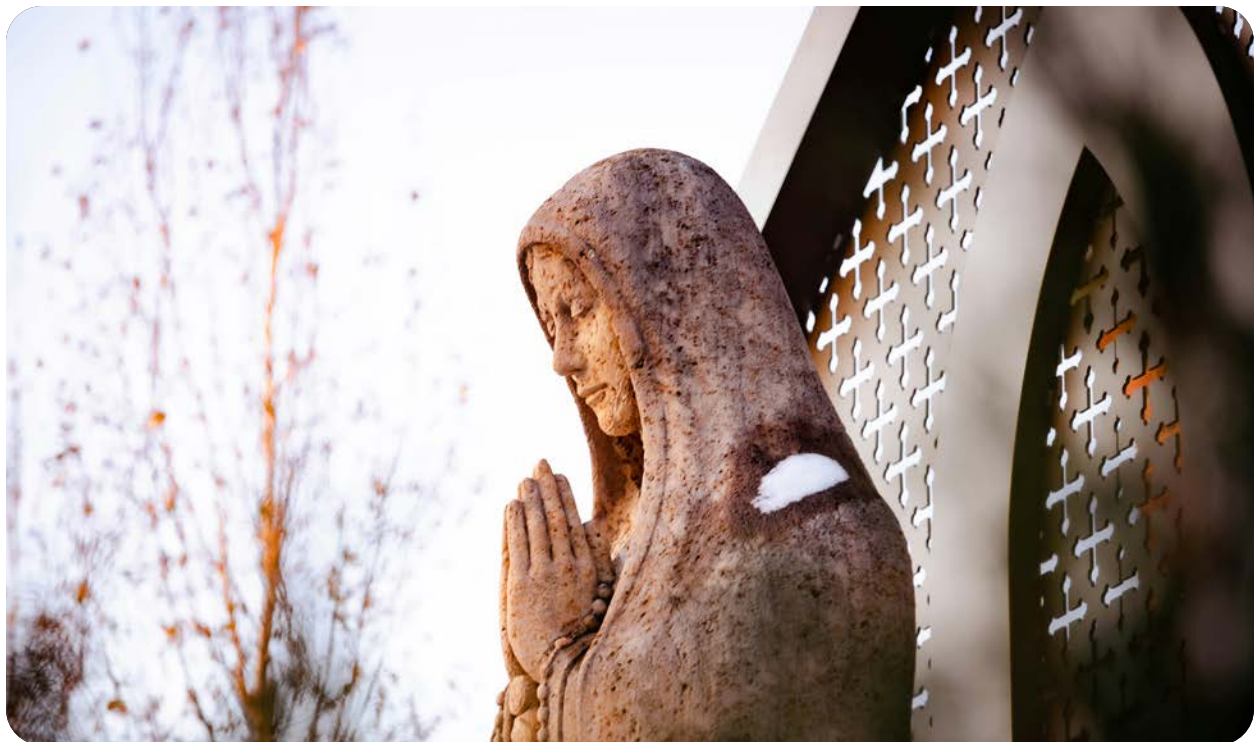
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*"You know not who that child will become..."*

## FAITH INTEGRATION

Empathy is the primary way that the Innovation Lab intentionally connects STREAM learning to the Catholic faith, a theme that was repeatedly attested to by various stakeholders. Empathy has a clear, multifaceted meaning for the MMR school community. Foundationally, it means respecting and preserving the dignity of each and every person, including those who might live in a different part of the world, who may have different cultural practices, or who might hold different beliefs than our own. By learning about different countries and their people, students begin to cultivate a sense of solidarity with others; by considering how other people may be impacted by particular global issues, students start to see how they can put their faith into action by developing solutions to help them. Empathy takes on a more direct and proximate application in the Innovation Lab, however, as students learn to collaborate with other students, to respect others' ideas and perspectives, and to work together toward a common goal.

This robust understanding of empathy is theologically rooted in Catholic Social Teaching (CST) and its central tenet of the inherent dignity of every human person, who is made in the image and likeness of God and loved by God. The Innovation Lab seeks to put this principle into action and become operative in the lives of students. In interviews, MMR's teachers and administrators expressed a remarkably consonant understanding of this foundation, one that echoed the language and ideas of a published resource they have shared: *Applying the Themes of Catholic Social Teaching*, by Sr. Joan Hart, SSND.



Beyond the intentional connection to empathy, teachers identified idiosyncratic ways in which STEM disciplines might connect to the Catholic faith; one teacher mentioned social justice broadly, and another described how care for God's creation linked the two. Nevertheless, most teachers spoke about how religion pervades everything that they do at the school. "Our morals, our faith should guide everything," explained one teacher, while another responded that there were no explicit expectations to integrate faith into teaching, because it is simply understood. Several teachers highlighted the value of the prayer at the start of Innovation Lab—including the thoughtfully crafted prayers specifically related to the projects, as well as one teacher's meaningful way of incorporating students' individual intentions.

Students' perspectives reveal a strong consonance with these intentions. Without directly mentioning 'empathy,' students spoke to a school atmosphere of kindness and affirmation and to their own respect for the religious and cultural differences of others around the world. They also described how teachers incorporated religious practice in their classes, like offering opportunities for prayer intentions, and how some teachers had deepened their awareness of specific ways that subject topics might implicate a religious belief – for example, how a student's proposed solution to overfishing might need to be aware of the geographical location of holy sites. Students also shared a clear consensus that science and religion, while different, can tie together and coexist. One student shared about St. Eleanor of Aquitaine, the patron saint of archeologists, explaining, "She had to believe in science and religion and how they coexist, so it is a beautiful thing when the two come together."



# IMPLICATIONS

This case study offers a high-quality model for the thoughtful and intentional development of extended STREAM projects for a coherent and flexible school-wide program. From this case, we offer five implications that we consider widely applicable to K-12 Catholic schools seeking to implement a program aimed at integrating the Catholic faith with STEM education.

- **Clear vision and thoughtful planning structures support teachers in connecting faith and STEM learning.** The clear emphasis on empathy as the program's anchoring element in the Catholic faith focuses teachers' attention on one aspect of the Catholic faith, which can then authentically be incorporated into their instruction. The directive, yet flexible, structures of the program provide teachers with guidance and expectations for students that enable them to be authentic in how they make connections between empathy and students' learning.
- **Autonomy granted to students empowers them to think critically and creatively.** The real-world contexts of the SDGs open up meaningful opportunities for students to direct their learning, to come up with innovative ideas, and to iterate to make their solutions better. This cycle leads students to develop a significant depth of understanding and skill.
- **Sustainability requires a balance between expertise and apprenticeship.** The foundations for the Innovation Lab would not exist without the founding teacher's expertise in both STEM learning and faith formation, which shaped its vision and its content. Yet the program continues because of thoughtful structures that have distributed responsibilities and effectively apprenticed teachers to be co-facilitators.
- **Faith-in-action can be a theologically-sound and age-appropriate way to link STEM learning with the Catholic faith, especially for K-8 contexts.** Empathy is a socio-emotional skill that is pertinent for children to learn; at MMR, it is also a concept that is deeply rooted in the Catholic social principle of the God-given dignity of each human person. This link enables this theme to be applicable across contexts and to be scaled in specificity so that it is developmentally appropriate.
- **Engagement with the broader public leads to greater stability.** The public showcase of Innovation Night has reaped many benefits, many of which were unanticipated. In addition to its merits for student learning, the showcase has galvanized interest in the community and confirmed for students that they can indeed make a difference in the world by using their creativity and knowledge for the good of others. It also offers a unique opportunity to engage adults on the compatibility of faith and reason.

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