Assignment 1: Evaluating Integration of Technology in the Curriculum

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Introduction

Interpreting and applying mathematical concepts is one of the most common challenges students face in math courses. As a mathematics teacher, I am constantly seeking new strategies that incorporate technology to help students see learning as meaningful and stay engaged in the process. According to Vilarinho-Pereira et al. (2024), technology integration is not an easy task, as teachers interpret it in various ways—such as using technology effectively, adding technological resources to the learning environment, increasing engagement through technology, integrating it across all subjects, and supporting both instruction and learning. As a mathematics educator, I firmly believe that effective technology integration includes all of these elements. However, incorporating them all can be challenging, especially when trying to stay aligned with curriculum requirements.

To evaluate the level of technology integration in my classroom, I will use the Technology Integration Matrix (TIM), developed by the Florida Center for Instructional Technology at the University of South Florida's College of Education (2019). This tool will help me assess my current use of technology and identify the higher levels I aim to reach in my teaching practices at GP Upper School. As part of this process, I will examine how technology is currently used in teaching quadratic equations in my IB Applications and Interpretations class. My goal is to promote greater student autonomy in the learning process and increase student motivation.

Technology Integration Matrix

The TIM offers a structured framework for recognizing and promoting the effective use of technology to enhance student learning (Florida Center for Instructional Technology, 2019a). It is built around five interconnected characteristics of meaningful learning environments: active, collaborative, constructive, authentic, and goal-directed. These characteristics align with the five levels of technology integration: entry, adoption, adaptation, infusion, and transformation (see Appendix A). Together, these dimensions form a 5x5 matrix comprising 25 unique cells. Each cell is linked to four classroom video examples, one from each of the following subjects: math, science, language arts, and social studies—recorded in real classrooms across Florida. These videos provide concrete illustrations of technology integration in practice and highlight various instructional approaches (Welsch et al., 2011). To assess their own level of integration, educators can explore the videos, presentations, and supporting texts associated with each cell.

The Technology Integration Matrix (TIM) can seem overwhelming at first, leading many teachers to overlook it in favor of simpler models (Keller, 2016). However, once understood, it becomes a powerful tool for evaluating current classroom practices and identifying areas for growth.

It is worth noting that TIM aligns with the ISTE Standards for Students and Educators. Using TIM as an implementation framework helps teachers design lessons that better support the goals outlined in the ISTE Standards for Students (Winckelman, n.d.). At the same time, the ISTE Standards enhance and deepen a teacher's understanding of the TIM descriptors. This reciprocal relationship ultimately benefits students. According to Smaldino (2019), teachers play a crucial role in helping students use technology to support critical thinking, collaboration, communication, and creativity.

Current Learning Environment

The learning environment consists of 11th-grade students enrolled in the IB Mathematics Applications and Interpretations course at GP Upper School. These students engage with a mathematics curriculum that emphasizes conceptual understanding and real-world application, which can sometimes present challenges. However, as noted by Zenging et al. (2012), such challenges can be addressed through the thoughtful implementation of specific technologies in the classroom.

In mathematics, technology supports collaborative learning experiences that promote problem-solving and flexible thinking. In today's classrooms, it plays a critical role in both teaching and learning by shaping content delivery and deepening students' understanding (Capuano et al., 2019). Teachers who integrate mathematical software and physical resources, such as textbooks and workbooks, can foster an engaging and active learning environment (Zenging et al., 2012).

At GP Upper School, our infrastructure is fully supported by Google Workspace for Education, which provides access to a range of tools, including Google Classroom, Docs, Sheets, Forms, and Slides. According to Abdullaziz (2024), students value these tools and associate them with increased motivation to learn. My lessons are typically delivered using Google Slides, which students access through Google Classroom. Depending on the lesson, I incorporate additional resources, such as Desmos for interactive exploration and the TI-84 calculator for computational support.

For example, when learning about the characteristics of quadratic functions, students use the TI-84 calculator to analyze features such as maxima, minima, intercepts, and the overall behavior of the function. Desmos enhances this experience by offering activities that connect these concepts to real-world applications. Although students often work in pairs or small groups, all activities are conducted under my guidance to ensure focus and clarity.

The International Society for Technology in Education (ISTE) student Standard that is most evident in my classroom is *Computational Thinker*. It is vital for students to not only grasp mathematical concepts but also to apply them in meaningful, real-world contexts using technology (International Society for Technology in Education, 2017). These experiences encourage students to break down complex problems and draw thoughtful conclusions, enhancing both their critical thinking and problem-solving skills.

Additionally, the *Empowered Learner* educator standard is reflected in my teaching. Students are given the freedom to select the technology that best suits their learning needs, whether it is the TI-84 calculator or Desmos. This autonomy promotes decision-making, builds confidence, and supports independence as students take greater ownership of their learning (International Society for Technology in Education, 2017).

Current Level of Technology Integration

Google Slides is a powerful presentation tool that is part of the Google Workspace suite. It allows users to create, edit, and share presentations online, making it a popular choice among both individuals and organizations (Khan, 2024). As a web-based platform, it is ideal for real-time collaboration. In my classroom, I use Google Slides daily to deliver lessons via the Smart Board. I share these presentations through Google Classroom, allowing students to access them directly from their devices. For those who prefer to take notes electronically, this setup makes the process seamless.

However, during these lessons, students often remain passive participants. I lead the instructions while they follow along and ask questions as needed. Real-world connections are typically made through teacher-provided examples. Although students are given opportunities to choose the type of technology they use, such as Desmos or the TI-84 calculator, the experience still leans heavily on teacher direction rather than student exploration.

Below is a description of the current level of technology integration in my IB Mathematics Applications and Interpretations course at GP Upper School, as assessed using the Technology Integration Matrix (TIM). For each characteristic, I selected the level of technology integration present in my class when teaching quadratic functions.

Active Learning – Adoption Level

The Active characteristic highlights the difference between lessons where students passively receive information and those where they are actively involved in discovering, processing, and applying what they learn (Florida Center for Instructional Technology, 2019b). Student engagement is a crucial component of active learning. In this area, my classroom is currently at the Adoption level. Students use technology in typical, structured ways and are closely guided by me throughout the lesson. I monitor how they use the tools (Google Slides, calculators, Desmos) and provide clear instructions for completing each task, ensuring all students follow the same steps. Although I lead the process, my goal is to keep students engaged and involved in their learning along the way.

Collaborative Learning – Entry Level

The Collaborative characteristic describes the extent to which technology is used to facilitate, enable, or enhance students' opportunities to work with peers and outside experts (Florida Center for Instructional Technology, 2019c). In this area, my classroom is currently located at the Entry level, where students are generally instructed to work independently when using technology. While they are permitted to seek help from peers, most of this collaboration occurs through verbal communication, as the classroom is a face-to-face setting rather than an online environment.

Constructive Learning – Adoption Level

The Constructive characteristic describes learner-centered instruction that encourages students to use technology tools to connect new information with what they already know. It focuses on the flexible use of technology to help students build knowledge in ways that work best for them (Florida Center for Instructional Technology, 2019d). In this area, my instruction is currently at the Adoption level. I select activities from Desmos that allow students to make connections between their prior knowledge of quadratic equations and the x-intercepts of quadratic functions. For example, they can see that the number of solutions to a quadratic equation corresponds to the number of intercepts when graphing the function. These activities help students explore new concepts by linking them to what they already understand.

Authentic Learning – Adoption Level

The Authentic characteristic refers to the use of technology to connect learning activities to real-world contexts beyond the classroom. It emphasizes how technology can help make learning more meaningful, relevant to students, and engaging by tapping into their intrinsic motivation (Florida Center for Instructional Technology, 2019e). In the IB Math Applications and Interpretations curriculum, students are regularly expected to apply mathematical concepts to real-life situations. In my classroom, they are presented with scenarios that require them to use these concepts in practical ways. The use of the TI-84 calculator and Desmos are consistently required to solve these problems and support their understanding. For this characteristic, instruction in my classroom is currently at the Adoption level.

Goal-Directed Learning – Adoption Level

The Goal-Directed characteristic describes how technology is used to help students set goals, plan tasks, track their progress, and reflect on their results. It examines how technology facilitates thinking about learning and encourages students to take ownership of their progress (Florida Center for Instructional Technology, 2019f). In this area, my instruction is at the Adoption level. I use Desmos activities that allow students to plan their work, monitor their learning, and reflect on what they have accomplished. Some activities even ask students to share their thoughts and feelings about their learning. However, these activities are still guided mainly by me, although I occasionally allow students to work independently or in pairs.

Plan for Higher Technology Instruction

The Technology Integration Matrix was not created to promote technology use, but to encourage the meaningful use of available technology to support effective, research-based teaching practices (Florida Center for Instructional Technology, 2019b). It provides educators with a tool to assess not only what has already been implemented but also to guide future improvements in technology integration within the classroom.

After reviewing the current level of technology integration in my classroom while teaching quadratic functions, I identified specific characteristics that need to be strengthened to enhance student motivation and promote greater autonomy in the learning process. To address this, I plan to incorporate a partner activity that will allow students to explore quadratic functions through a topic of their own interest. Working in pairs, students will create a Google Slides presentation in which they will collect data, determine the quadratic model that best fits the data, identify all key characteristics of the model, and interpret their meaning within the context of the chosen topic. For this lesson, students are encouraged to select the form of technology of their choice.

Below is a description of the characteristics and the corresponding levels I aim to reach by incorporating this new activity into the lesson.

Active Learning – Adaptation Learner

At this level, students work independently with technology tools in conventional ways; the teacher acts as a facilitator toward learning and does not need to guide students step-by-step through activities (Florida Center for Instructional Technology, 2019b). At this stage, my plan is for students to work with a partner and apply quadratic functions to a topic of interest. They will use the technology of their choice to determine the features of the quadratic functions and explain what they represent in the context. It is essential to note that I will guide them through this process. However, they will have complete autonomy in deciding both the topic and the technology used to develop exploration.

Collaborative Learning – Adoption Level

This level provides students with opportunities to collaborate with others through the use of technology (Florida Center for Instructional Technology, 2019c). In the activity, students will work with a partner and take responsibility for communicating effectively with one another. They may choose any form of communication, such as email, text message, phone call, FaceTime, or Google Chat. Since the final presentation must be created using Google Slides, students will also have the opportunity to collaborate remotely in real-time.

This flexibility allows them to manage their schedules and work outside of regular class time, promoting responsibility and time management skills. By deciding how and when to communicate, students take a more active role in their collaborative process. Additionally, sharing ideas and dividing tasks through digital tools helps them strengthen essential skills such as teamwork, digital literacy, and peer feedback. These interactions contribute to a more dynamic and engaging learning experience.

Authentic Learning – Adaptation Level

At this level, students choose and explore a topic of personal interest, allowing them to take ownership of their learning. They begin to use technology independently in meaningful ways, and teachers design instruction that intentionally integrates technology tools to support learning beyond the classroom setting (Florida Center for Instructional Technology, 2019e). As mentioned earlier, in this lesson, students will select a real-world situation of their choice that can be modeled using a quadratic function. This not only promotes relevance and engagement but also helps students see the practical applications of mathematics in everyday life.

Through this activity, students will have the opportunity to connect a mathematical concept to a topic they are passionate about and share their findings with their peers through a Google Slides presentation. In addition, students will reflect on the entire process, what they discovered, how they applied quadratic functions to real-world data, and how technology supported their exploration.

Limitations

No doubt, incorporating this activity has the potential to significantly increase student engagement and foster greater autonomy in the learning process. When students have the opportunity to explore topics that interest them and apply mathematical concepts in meaningful ways, their motivation tends to increase, and they take more ownership of their learning. However, one possible limitation is time constraints. The IB math curriculum is extensive and rigorous, covering a wide range of topics to ensure students are fully prepared for the IB exam at the end of the school year. As a result, we sometimes find ourselves pressed for time. Lessons that involve exploration, collaboration, and presentation, like the one described, can take longer than traditional instruction and may disrupt the planned pacing of the curriculum.

Another challenge is that not all educators feel comfortable implementing this type of student-centered, technology-integrated activity. I am not the only teacher responsible for teaching this course, and some of my colleagues prefer more traditional methods of instruction, where the teacher guides students step-by-step through the content. Implementing a more flexible and open-ended approach requires a shift in mindset, additional planning, and a level of confidence with technology that not all teachers may possess. For these reasons, consistency in the application of this type of activity across all sections of the course could be challenging to achieve.

Summary

Incorporating a partner-based activity into the quadratic function lesson could enhance classroom engagement and foster student autonomy by allowing students to not only choose their topics of interest but also collect data, analyze the quadratic model, and interpret the results within context. This activity aligns with a higher cell in the Technology Integration Matrix compared to the one I currently use, particularly in terms of active, authentic, and collaborative learning. Although it supports the ISTE Standards for both teachers and students, it presents specific challenges for implementation, including limited instructional time due to the demands of the IB Math curriculum and potential resistance from colleagues who prefer more traditional teaching methods. Even with these challenges, this activity is an important step toward a more student-centered learning approach that uses technology effectively.

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Appendix A

The Technology Integration Matrix
Table of Summary Descriptors

The Technology Integration Matrix (TIM) provides a framework for describing and targeting the use of technology to enhance learning. The TIM incorporates five interdependent characteristics of meaningful learning environments: active, collaborative, constructive, authentic, and goal-directed. These characteristics are associated with five levels of technology integration: entry, adoption, adaptation, infusion, and transformation. Together, the five characteristics of meaningful learning environments and five levels of technology integration create a matrix of 25 cells, as illustrated below.

→ LEVELS OF TECHNOLOGY INTEGRATION ↓ CHARACTERISTICS OF THE LEARNING ENVIRONMENT	**ENTRY LEVEL** The teacher begins to use technology tools to deliver curriculum content to students.	**ADOPTION LEVEL** The teacher directs students in the conventional and procedural use of technology tools.	**ADAPTATION LEVEL** The teacher facilitates the students' exploration and independent use of technology tools.	**INFUSION LEVEL** The teacher provides the learning context and the students choose the technology tools.	**TRANSFORMATION LEVEL** The teacher encourages the innovative use of technology tools to facilitate higher-order learning activities that may not be possible without the use of technology.
ACTIVE LEARNING Students are actively engaged in using technology as a tool rather than passively receiving information from the technology.	**Active Entry** Information passively received	**Active Adoption** Conventional, procedural use of tools	**Active Adaptation** Conventional independent use of tools; some student choice and exploration	**Active Infusion** Choice of tools and regular, self-directed use	**Active Transformation** Extensive and unconventional use of tools
COLLABORATIVE LEARNING Students use technology tools to collaborate with others rather than working individually at all times.	**Collaborative Entry** Individual student use of technology tools	**Collaborative Adoption** Collaborative use of tools in conventional ways	**Collaborative Adaptation** Collaborative use of tools; some student choice and exploration	**Collaborative Infusion** Choice of tools and regular use for collaboration	**Collaborative Transformation** Collaboration with peers, outside experts, and others in ways that may not be possible without technology
CONSTRUCTIVE LEARNING Students use technology tools to connect new information to their prior knowledge rather than to passively receive information.	**Constructive Entry** Information delivered to students	**Constructive Adoption** Guided, conventional use for building knowledge	**Constructive Adaptation** Independent use for building knowledge; some student choice and exploration	**Constructive Infusion** Choice and regular use for building knowledge	**Constructive Transformation** Extensive and unconventional use of technology tools to build knowledge
AUTHENTIC LEARNING Students use technology tools to link learning activities to the world beyond the instructional setting rather than working on decontextualized assignments.	**Authentic Entry** Technology use unrelated to the world outside of the instructional setting	**Authentic Adoption** Guided use in activities with some meaningful context	**Authentic Adaptation** Independent use in activities connected to students' lives; some student choice and exploration	**Authentic Infusion** Choice of tools and regular use in meaningful activities	**Authentic Transformation** Innovative use for higher-order learning activities connected to the world beyond the instructional setting
GOAL-DIRECTED LEARNING Students use technology tools to set goals, plan activities, monitor progress, and evaluate results rather than simply completing assignments without reflection.	**Goal-Directed Entry** Directions given; step-by-step task monitoring	**Goal-Directed Adoption** Conventional and procedural use of tools to plan or monitor	**Goal-Directed Adaptation** Purposeful use of tools to plan and monitor; some student choice and exploration	**Goal-Directed Infusion** Flexible and seamless use of tools to plan and monitor	**Goal-Directed Transformation** Extensive and higher-order use of tools to plan and monitor