

# THE INFLUENCE OF A STEM/STEAM EDUCATION BASED HIGH SCHOOL ON STUDENTS OF THE IVOTI INSTITUTE

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## **Abstract:**

*The aim of this paper is to determine the difference between the STEM/STEAM education High School model and the Traditional Basic General Education High School Model. Another important objective is to explain the benefits of the STEM/STEAM High School format being implemented in the Ivoti Institute, in Rio Grande do Sul, Brazil. I start by giving the definition of STEM/STEAM education, and then discuss the New High School format that is being used in the Ivoti Institute. I explain all the benefits and opportunities that this educational setting brings to the students, and how it has affected my life, personally. STEM/STEAM education is the future of education and will be extremely effective in the development of critical and autonomous individuals.*

*Keywords:* STEM/STEAM Education, Basic General Education, High School Model.

## **Introduction**

The goal of this paper is to emphasize the importance of STEM/STEAM education, and the role it plays in influencing the Traditional Basic General High School model. I will first define and explain the STEM/STEAM education format. I will also present the way it helps students grow in independent learning and to be better prepared for future educational opportunities and careers. Finally, I will share my personal experience in the New High School format, implemented in the Ivoti Institute.

## **STEM/STEAM Education**

According to Marrero, Gunning and Williams (2014), STEM/STEAM education is:

The term “STEM”, an acronym for science, technology, engineering, and mathematics, has come to the forefront of international discourse in education, industry, innovation, and competition. The term is used with students from preschool to postgraduate levels, and to describe careers in the respective fields.

Moreover, according to Xie, Fang and Sbaumann (2015), STEM/STEAM Education is different in each educational level:

At the foundational K-6 level, STEM education is synonymous with the math and science curriculum that is required for all students, so research on STEM education at the elementary school level focuses on participation and performance in science and math in general. STEM education is defined more specifically as the curriculum becomes increasingly specialized at progressive levels of education. For example, in grades 8–12 multiple tracks through the required math and science curriculum become available to students, as do elective courses in the social sciences (e.g., psychology), computer science, and applied topics in engineering and technology (NGSS 2015).

Some of the benefits of STEM/STEAM education are the development of more independent individuals. The students are more accustomed to technology, making them very capable in the Job Market. STEM/STEAM education brings many benefits to students (Stohlmann,2012), such as:

Several benefits of STEM education include making students better problem solvers, innovators, inventors, self-reliant, logical thinkers, and technologically literate (Morrison, 2006). Studies have shown that integrating math and science has a positive impact on student attitudes and interest in school (Bragow, Gragow & Smith, 1995), their motivation to learn (Gutherie, Wigfield & VonSecker, 2000), and achievement (Hurley, 2001).

With the implementation of the New High School format, STEM/STEAM education has become a big part of the Ivoti Institute.

### **New Highschool Format of the Ivoti Institute**

In the year of 2022, the Ivoti Institute implemented a New High School format, which has STEM/STEAM education as a main feature. The New High School format enables the development of critical and autonomous individuals, provides them with experiences and processes that ensure the necessary learning, and promotes situations in which students learn to respect one another and live in a society. The New Highschool format is a breakthrough for the students due to the fact that it prepares them for their future career. At present, the students have a choice in which formative course they want to specialize in, helping them choose which area they want to continue in after high school. Each formative course focuses on a different area of knowledge. There are two different kinds of formative courses: one that at the end of High School the student does not receive a Technical Degree, and one that the student does. The two formative courses that give out Technical Degrees are IT and Graphic Design. This differs from the past High School format which only included basic general education classes.

The basic general education consists of the essential classes established by the BNCC (Base Nacional Comum Curricular), which are common to all schools in the country. These essential classes are:

- Languages and their Technologies: Arts, Physical Education, English Language, Portuguese Language, Mathematics.
- Natural Sciences: Biology, Physics, Chemistry.
- Human and Applied Social Sciences: History, Geography, Sociology, Philosophy.

All the classes make up the basic general education offered in Brazil. The basic general education used to be 100% of the High School education, meaning that students did not have formative courses included in their basic general education. The New High School format has basic general education; however, the students are required to take a formative course. The formative courses in the New High School format have been added to the basic general education classes. I noted the difference by talking with my older siblings, who studied at the Ivoti Institute.

My older siblings studied at the Ivoti Institute when the basic general education was 100% of the High School format. They learned general knowledge but did not have the choice to specialize in a specific area. As a result, the school schedule was also different for them. They studied every weekday morning from 7:20 to 11:50 AM, and on Monday afternoons they had class from 1:30 to 4:00 PM. In the New High School format, if a student takes a formative class that is not IT or Graphic Design, he/she has class every weekday from 7:20 AM to 12:50 PM. People who take the IT or Graphic Design course have classes in the afternoon every Monday, Wednesday, and Friday from 1:50 PM to 5:25 PM, and classes in the morning every Tuesday, Wednesday, and Thursday from 7:20 AM to 12:50 PM. The formative classes are very different from one another and specialize in a variety of subjects.

The formative courses constitute the diversified part of the curriculum, where the student can choose what to study according to the proposal offered by the school. Those who begin the 1st year of High School at the Ivoti Institute must choose one or more of the five formative courses: Communication and Humanities, Human Reasoning and Sustainability, Teaching Formation, Technical in IT, and Technical in Graphic Design. The formative courses offer a degree when completed that certifies the students allowing them to work professionally in the area they specialized in. The main idea behind the new format is to prepare students for their future career or help them decide which areas they have most interest in and give them an opportunity to look into those areas. As the years progress, students will get more and more involved in their formative course, having more hours each year.

The formative courses take up a different number of hours each year. In the first year of High School, basic general education takes up 80% of the workload hours, while the formative courses take up 20%. In the second year, basic general education takes up 60% of the workload hours and the formative courses take up 40%. Finally, in the third year of High School, basic general education takes up 40% of the workload hours and the formative courses take up 60%. For the students to keep up with their basic general education, they have to do a lot of work out of school. The New High School format values time and provides students with a large percentage of experiences that contribute to their future.

An important aspect emphasized in the new High School format is the growth of independent learning, which is an aspect that every individual is required to have, if studying in an educational setting. Independence is needed to be able to achieve this kind of learning. As an individual matures, he grows more independent, learning how to do stuff on his own, without the need of supervision. Personally, independence has become a big part of my life, especially in the new format. Doing homework and studying specific knowledge is a decision that I have to make to be able to achieve my goals. The main differences between the new and the old High School format are the number of options available for students to choose from, the importance emphasized in their future, the creative thinking and development of the students, the growth in autonomy and independence of the students, and much more. For the purpose of those conditions to be met, the school has invested in implementing the STEM/STEAM education style, bringing to the school a large percentage of formative courses.

### **Personal experience with new Highschool format**

The implementation of the variety of formative classes brought great change to the Ivoti Institute. Before the new High School, there were limited options. If a student wanted to take a formative course, to graduate with a degree, he/she would have to take extra classes outside of normal school hours. The formative courses were not included in the school program. With the New High School format, students, at the present time, have the choice to take formative courses instead of not having any options to specialize in.

Out of the options I had, at the start of my sophomore year, I chose the Human Sciences and Communication course. I made that choice due to my interest in history. After a period of two weeks, I realized that the other components taught in the class did not interest me, so I looked into the other options. Out of all the other courses, two caught my attention: the IT course and the Graphic Design course. I was trying to decide between the two, so I investigated what each course taught specifically. My number one choice was IT since all my friends were taking it. I ended up choosing the formative course Graphic design as there was no spot for me in IT. At first, I was excited to see what we were going to learn, and it turned out to be a perfectly suitable course for me. At the present time, I realize it is suitable for me due to some aspects from my childhood.

Ever since I was young, I have been interested in creating and building designs out of LEGO. Graphic Design has some areas that are very similar to building things with LEGO. For example, the course teaches developing projects, using creativity to make new and different designs, or even the importance of colors to your design. Another area that intrigued me in Graphic Design was the creation of Logos. I am very interested in the area of architecture as a profession, and when I heard we were going to be creating logos in my technical class, I was very enthusiastic. As I look back at my decision to pursue graphic design, I am very glad the circumstances worked towards this end, and it offered me the experiences I have had in this class.

Nowadays, I compare both the formative course I had chosen first and the one I am in currently and see a large percentage of pros, for example, the use of creativity in my projects. A graphic designer is required to have creativity to make things that have not been made before. To be able to do that, I have learned to implement colors and different techniques to make my work unique. In the course, we train using creativity by doing a plethora of assignments that involve manual work (Drawing, coloring, etc.) and digital work (Designing Logos, making presentations, etc.). These assignments help us prepare to work with an actual client.

While taking this course, even though there are mostly pros, there are a few cons. My family travels a lot back and forth to different countries. The graphic design formative course does not allow students to leave the course during a semester. If a student were to leave for more than a semester, he/she would not receive the certificate at the end of the course. The certificate is essential for the student to be professionally qualified. In my case, my family was going to move out for 6 months and come back after that period of time. My mother and I were not able to travel and had to stay due to the course. Consequently, my father traveled by himself. To take the Graphic Design formative course, the student has to be dedicated, staying with it until the end. In the Graphic Design course, we are taught many things, and are evaluated differently than all the other formative courses.

A big aspect that changed when I switched classes was the evaluation process. A normal evaluation process is done either by a test, in which the student is evaluated by how much he/she knows of the content, or how well he/she did in the assignment. In the Graphic Design formative course, we are evaluated by what we produce in class and our dedication to the projects we receive. Consequently, we end up doing most of our work in class, and not out of it. The teacher asks us to do most of our work in class so they can evaluate our thought process and see us work. Being in the Graphic Design formative course has pushed me to grow in productivity and has helped me create better projects. These experiences have helped me develop my idea of a future, both professionally and personally, and to reflect on how my Graphic Design formative course has impacted my knowledge in the areas of STEM/STEAM.

### **Graphic Design and STEAM**

With the addition of the formative classes, the use of STEM/STEAM Education has become essential in teaching. The teachers have started teaching in a way that stimulates independent thinking, and that helps students learn more from the areas of STEM/STEAM. Personally, I have seen most growth in the areas of Technology, Engineering, Arts, and Mathematics. More specifically, in technology, I have learned to use apps and software in my projects. In Engineering, I have learned to develop and design 3d models and sites. In arts, I have learned multiple drawing techniques, and have learned how to use colors properly. Lastly, in mathematics, I have learned to make all my drawings, logos, and projects very precise. The Graphic Design course has helped me grow in a large percentage of STEM/STEAM areas, in various ways.

### **Technology**

The Graphic Design course I take has really helped me to learn how to use technology in various useful ways. A Graphic Designer has to know how to do all kinds of things. The profession of Graphic Designer in itself requires knowledge in the areas of creating logos. Graphic Designers are known for the purpose of making logos, so I have practiced making logos in the formative course. Graphic Designers also have to know how to make appealing presentations that are aesthetically pleasing and functional. Digital identities are essential in the current world and graphic designers help produce them. Other than that, graphic designers also use digital marketing. Whether it is a post on social media or an ad on the internet, digital marketing is present. With those tasks and requirements in mind, technology is essential in a graphic designer's everyday work.

Up until the present time, in my junior year of high school, I have learned how to use a large percentage of software and apps, such as editing software. I have learned to use Adobe Photoshop that gives me the ability to manipulate any image I want. I can do as much as swap two peoples' heads in a photo to make an entire digital world of my own. Photoshop can be used to make specific adjustments to photo projects, such as adding texture, or manipulating an image to change its color or shape. In my projects, I can use photos that have been taken in real time or

I can use AI generated photos. This causes my possibilities to be infinite in things I can create. I have learned how to use Adobe Illustrator, which is essential in the creation of logos. Illustrator gives me the possibility to make precise lines and shapes of all kinds. It also helps me make physical items (such as a shoe) into a digital item. Recently, I made a digital shoe based on a real shoe. Another software/app I have learned to use is Canva. In Canva, one can create almost anything they want. With the vast number of images, items, shapes, stickers, and colors I can design presentations, posters, flyers, logos, banners, cards, invitations, menus, eBooks, booklets, infographics, resumes, presentations, t-shirts, and much more. Canva is the app that I use the most, due to its functionality. I can access my projects on a computer, or even on my phone, to continue working on it. I learned how to use Cap Cut to edit videos and photos. It has a lot of features that make photo and video editing a piece of cake. I can add all kinds of effects to my photos and apply different kinds of transitions in my videos. Finally, Tinkercad is a website where I can create 3d designs. The site has a large variety of shapes and objects (such as gears) that can be manipulated to create a 3d visualization of a project. I can select from a variety of models, of things such as products and objects, to provide a visual result for a client to see. All of these features contribute to my projects and make my work much easier and enjoyable to do. Without technology, a Graphic Designers job would not be possible.

### **Engineering**

Another area my Graphic design class has helped me grow in is the area of Engineering. During the first year of the formative course, I learned basic coding, such as Python and HTML, and I designed sites using the codes. The project focused on designing a site that was attractive aesthetically, could grab the attention of its users, and focused on how to bring more and more users into our site. I saw that technology, in general, can be more attractive to users if it is simple to use. People are more attracted to a site that does not take a lot of work to handle, and will get them to their destination in a short period of time. Another aspect that attracts people to a site is its reputation. If a site is well known for the purpose of giving the clients what they ask for, it is more popular. A large percentage of other aspects are involved in making a website that attracts users. To make my website I used my basic coding knowledge and Google Sites. Engineering can be useful in a large percentage of areas.

Another area I have applied engineering to is model development and designing. To develop a model and design it, I have used tools along the lines of Tinkercad and photoshop. This software has brought infinite possibilities to the things I can create, helped me engineer 3d models and make productions with photo engineering, and contributed to the growth of my knowledge in the area of Engineering. In the future, I plan to pursue a career in architecture. I believe the knowledge I have gained in Engineering will contribute to my future career. Tinkercad can be used to create 3d models of houses, rooms, and all kinds of things. After drawing a blueprint of a house manually, I can make a 3d model of it on Tinkercad. I can also use Photoshop to make AI generated photos, or concepts of a house for the purpose of a client.

Engineering is an important part of my role as a graphic designer, but an even more relevant part is Arts.

### **Arts**

The third area that the Graphic Design formative course I participate in has helped me grow in is Arts. Arts is the fundamental characteristic of Graphic Design. The Psychology of colors and typography are essential in the process of creating graphical productions. The Psychology of colors is the message and the feeling each color induces in a human being. Color can induce feelings, for example, sadness, happiness, and fear. They can also change the way you think and act. Colors play a huge part in the world, and so in our Graphic Design course we learn to use them properly. Typography is also a fundamental aspect of a project. Different fonts send different messages and help build a different idea. For example, if I want to make a title for a movie about aliens, I am surely going to use a futuristic looking font. Both the typography and the psychology of colors contribute to the aesthetic part of a project, which is one of the most relevant parts. I have learned how to use drawing and painting in class. I design a plethora of models by hand and that requires basic skills in the area of drawing. More specifically, I have drawn houses, scenes, objects, and people using techniques such as perspective, shading, stippling, pointillism, contour drawing, etc. I learned all of these techniques in class and have used them to create drawings to this day.

The area of arts also involves marketing. Each company has a color that represents it. For example, some of the most famous companies can be identified by the color they use in their logo. That shows the influence color has on people, and how it can be used in marketing. The influence of colors and typography on a client is fundamental in marketing, and each color makes the client feel in a specific way. The color blue is more attractive than the color brown, so if I make an advertisement with a certain color, it may affect the client's choice. The area of arts is also very interconnected with the area of mathematics.

### **Mathematics**

The fourth and final area that the Graphic Design formative course has helped me grow in, is mathematics. One of the main characteristics of a good project is its preciseness and cleanliness. When a drawing or a logo is made with perfectly round edges and perfect symmetry, it is much more appealing than a poorly made one. Math is extremely important in the execution of a project.

Math is used mostly in drawings. To draw a specific perspective and execute it, I have to use Math. Angles are involved in perspective and are fundamental in drawing. A large percentage of times I have to use a ruler to be able to make a drawing that is symmetric and correct. Geometry as well is used in drawings to form shapes and lines. In the Graphic Design formative course, I have learned how to make drawings using math, and have learned in regard to how math is used in a digital setting. The Golden ratio is used in a large percentage of the



most famous logos. The Golden Ratio appears in some patterns in nature and is used to analyze the proportions of natural objects and artificial systems such as financial markets. In general, math is used in the construction of logos, drawings, and all other projects I work on in the Graphic Design formative course.

### **Final Considerations**

As I have put forth in this paper, the transition the Ivoti Institute has made from the Traditional Basic General Education model into the New High School format, having STEM/STEAM Education as a highlight has greatly benefited my growth and learning process. I have experienced growth in the areas of Technology, Engineering, Arts, and Mathematics, and have learned to be a more independent learner. In general, the STEM/STEAM Education format is superior to the Traditional format and will be more effective in the development of critical and autonomous individuals.

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