Women in Digital Transformation: Basic Programming

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Abstract

The field of engineering is one of the least explored fields by women today. Many times for fear of discrimination in the treatment of workers, as well as the salary they earn in the work in this field. Institutions such as SEMUJERES are trying to put an end to this problem and are seeking to increase the number of women applying to this field by creating projects like this, where the attention of women can be drawn to the different applications that they can exercise, improving their inclusion in the digital changes taking place, showing them the importance that they have in this field.

This project promotes the use of programming and the inclusion of new digital technologies, such as applications developed in python, as well as artificial intelligence that can also be developed with this programming language. The course consisted of teaching python, java and other languages to a group of women assigned by SEMUJERES, with the aim of capturing their attention towards the field of engineering. In addition, topics such as attention to the user, methodology for the development of applications based on the needs of the user, performances and ethical applications of AI were taught, as well as doing jobs and projects where they could apply their knowledge during the course and realize the importance of women in this field.

Index Terms

Women, programming, digital transformation, digital inclusion, self-learning.

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I. Introduction

IN principle this document was drafted with the purpose of demonstrating a way to improve the integration of women into the engineering branch, since currently this branch does not have their participation in large numbers.

According to "El Financiero" [1], nowadays only 2 of every 10 engineers are women, which means that in Mexico, in the engineering area 81% are men and only 19% are women. Taking that point into account and based on our location (Yucatán), different institutions like IBM and SEMUJERES were willing to carry out this project.

In the first part of the document the reader should note the objectives on which the project approach was based and the purpose of the project, which can also be considered as the problems that were to be solved, as is the main objective, increase women's interest in engineering careers.

In the second part the reader will be able to notice the different investigations or studies that were done before designing the project. In addition, we can demonstrate the importance of this project and give a more truthful reason in which we can demonstrate that this project is really focused on an important problem for both the engineer and society.

The third part presents a detailed description of the whole project, in which the reader can duplicate this same methodology, forming part of these projects that benefit society so much. An example of what you will see the plan for methodology that was applied for example when they used python and how the girls who participated in this project had an evolution in their knowledge and were able to make small projects by themselves, which were not only projects focused on their knowledge. It is also important to note that they are shown how to apply inclusion in their programs in order to have a better reach.

In the fourth part the reader will not only see the plan of the methodology, also will be shown how the facilitators and the girls interacted during the project, explaining more deeply the methodology used, so that it can be replicated by the reader. It also shows the part where the facilitators were instructed to teach the course, as well as the truthful advice and opinions of the girls and instructors from IBM and SEMUJERES.

The last part shows the changes that the girls noticed and also the graphics based on the opinions that the girls had about the course. It shows the changes and the objectives achieved by the project based on the opinions of the girls and the graphics, also shows the survey that was done to make this analysis.

It is important to mention that the replication of the project and the taking of the idea for the benefit of society and women are accepted, as long as the founders of the idea (IBM and SEMUJERES) are mentioned.

II. Objectives

1) Include women in programming: The main objective of this project is the inclusion of women in the world of programming [2], as mentioned above 2 out of 10 engineers are women. A complex plan was developed focused on improving the skills and interest of the participants, where in the end they were able to develop applications using different languages, implementing confidence in themselves and showing them the things that they could do. This program, in promoting the inclusion of women, was designed only for women participants.

2) Show the importance of women's work: As the reader can see, in the world women suffer from discrimination and inequality in the world of work, both in terms of pay and treatment; even if they have the same knowledge as men, But just because they don't belong to that sex, they're treated differently. This has created a fear among women, which limits them to show the potential they have, the important thing is that they never forget the great changes they have made and the contributions that women have given to the world in the technological sphere.

For that reason SEMUJERES developed a way to show that they could be able to develop great things, even if they did not have the previous knowledge. The themes and sequence of them were made to develop their skills from scratch. The facilitators were part of a counseling for the delivery of topics, in a way that we could show how capable they were and improve their self-learning, it was given by IBM. [3]

3) Focus on the user: Focus on the user [4]. Many times when you develop software you never think about the scope it can have. For this reason and since the project is focused on inclusion, the topics were taught always focused on the development of applications focused on users.

One of the topics, for example, was the development of tools that can read websites for people with visual disabilities. Topics like the previous one were shown to teach the participants the approach they should have when developing

programming projects, in order to improve the inclusion of people with disabilities.

4) Programming with digital inclusion in mind: The last objective was to teach women who already had knowledge in software development and those who did not, that all the applications or software they develop should be accessible to the whole community, unless they write the limitations in their presentation.

In order to achieve this, IBM developed one of the most complex topics, which was "the development of inclusion tools". This theme was designed for the understanding of inclusion tools, such as aloud readers, color modification on web pages, even explanation of the tools that IBM developed as the carbon desing. So they explained the topics and were taught how to identify those tools in different applications.

III. State of the Art

In April 1967, the American edition of the women's magazine Cosmopolitan published a report entitled "The Computer Girls" [5]. The photos were of a young IBM programmer surrounded by male engineers. In 1947 a girl could be a secretary, teacher, perhaps librarian, social worker or nurse, "the text said. " If she was really ambitious she could compete with men, often working longer hours for less money. But now the great, fascinating computers have arrived. So in 1967 the salary in this new job could reach 20,000 dollars a year, about 150,000 euros to the current change and after calculating the inflation.

Long before PC became the new technology, computers occupied entire rooms and women were almost half the people in charge of programming them. This lasted until 1980, according to writer Clive Thompson in his book "Programmers" [6].

Evelyn Berezin was another example of women's empowerment in the digital inclusion of that era. In 1968 [7], I created a program to manage and create texts that could help secretaries in the performance of their work. In addition to this, she is the creator of the first flight reservation system, made for an American airline.

Currently there are great examples of women engineers such as the mexican Gabriela León Biochemical Engineer, scientist who developed and patented the nanobiomolecule NBELYAX (antiseptic), Ali Guarneros, Master in aerospace engineering, works at the Ames Center in Sillicon Valley which belongs to the National Aeronautics and Space Administration (NASA) or Dorothy Ruiz Martinez, Space Engineer, works at the "Lyndon B. Johnson" Space Center NASA and is a space operations specialist for the International Space Station at the Houston Mission Control Center.

According to Thompson, in 1984. At the beginning of that year 37.1% of computer students in the United States were women. From there, the drop. In 2012, the percentage was around 17%. The data is more shocking because in other careers, female students have increased since the 1960s. In medicine or law they were around 50% from a start that did not reach 10% 8].

What happened to make women disappear from computing or for men to arrive to displace them? Three things, according to Thompson. One, software was becoming increasingly important and companies were beginning to appoint managers with that training. Two, the arrival of personal computers in homes. Teenagers could play from a very young age with their Commodore 64 and parents used to give the device to the child or at least put it in their room. According to a study on the gender difference by Jane Margolis of Carnegie Mellon University, in the 1990s, parents were twice as likely to give a computer to a son as to a daughter. And it was easier to get into the race with previous computer knowledge, although later research has dismantled the idea that teenage hackers are better graduates in computer science.

IV. Methods and Tools

A. Methodology

The pilot program will be implemented through a triple helix collaboration. DGPPP (Dirección General de Planeación, Programación y Presupuesto) coordinate activities for the implementation of the pilot. Universities will collaborate with the participation of social service providers with basic knowledge and who will serve as facilitators of the course.

The private sector, in this the IBM company, will be in charge of training the facilitators, in order to increase their capacities and provide them with the necessary material to teach the courses gratuitous.

Target population: Targeted at women at the technical or upper secondary level, with zero or basic programming skills. The capacity is 20 students per group.

Skills to develop: Introduction to algorithms and programming languages with higher demand (Python and Java), computational logic, basic concepts (use of bases of data, loops and conditionals) and knowledge generation.

Duration of pilot program: 100 hours.

Required software (for both facilitators and beneficiaries): Computer and internet.

The methodology used in this project was self-learning and persuasion techniques. By self-learning we mean that the girls who participated in the project were able to develop by themselves web applications, even without having previous knowledge. This was achieved thanks to the fact that IBM gave the facilitators a course on how we should teach and show autonomy and encourage self-learning in students [9].

By doing so, the facilitators were able to convey feelings for the themes and emotions that prompted them to achieve new things. As a result of excellent projects in HTML and other languages, they became more open to the option of going to a career related to programming. The facilitators during the process were in charge of following the distribution of knowledge and other advice to the girls, to generate environments of trust where the girls can try things by themselves, but if any doubt arose they could ask and realize it with company, thinking about "It was not difficult as my expectation".

Learning and building trust is one of the most widely used techniques nowadays, since studies confirm that many times the students do not learn, since they think that the subject is very difficult, or they do not have confidence in themselves to be able to do it, so showing you at partial levels the topics and increasing, together with a consultant, generates self-confidence and improves their learning.

B. Tools

1) Python3.8: Python is a platform-independent, object-oriented scripting language for any type of program, from Windows applications to network servers or even web pages. It is an interpreted language, which means that you don't need to compile the source code to run it, which offers advantages such as speed of development and drawbacks such as lower speed.

Python has a very visual syntax, thanks to a notation by indentation blocks (with margins) of obligatory fulfillment. In many languages, elements such as keys or begin and end keywords are used to separate lots of code. To separate portions of code in Python it must be tabulated inward, placing a margin on the code that would go into a function or loop.

2) Visual Studio: Microsoft Visual Studio is an integrated development environment, created by Microsoft and available for Windows, Linux and macOS operating systems, and at the same time supports multiple programming languages, such as C++, C, Visual Basic. NET, F, Java, Python, Ruby and PHP, as well as web development environments, such as ASP.NET, was released in 1997, has free and sale versions.

3) Java Script: Javascript is a language with many possibilities, used to create small programs that are then inserted in a web page and in larger programs, oriented to much more complex objects. With Javascript we can create different effects and interact with our users.

4) HTML: HTML is the language used to define the content of web pages. It consists of a set of labels that serve to define the text and other elements that will make up a website, such as images, lists, videos, etc.

5) Jupyter notebook: Jupyter Notebook is a client-server application that allows you to create and share web documents in JSON format that follow a versioned schema and an ordered list of input and output cells. These cells house, among other things, code, text (in Markdown format), mathematical formulas and equations, or also multimedia content (Rich Media). The prerequisite is to install and run the Jupyter Notebook server on the system.

Documents created in Jupyter can be exported, among other formats, to HTML, PDF, Markdown or Python and can also be shared with other users by email, using Dropbox or GitHub or using the built-in Jupyter Notebook viewer.

V. Development

Modality: Given the situation (COVID-19 pandemic), the DGPPP team and IBM have agreed implement this pilot program remotely in virtual or online mode.

Educaton (training of facilitators): The training was given by videos with teaching and preparation materials at home, as well as virtual question and replies on 5, 7, 12 and 14 May (approximately 2 hours per session, between 8 and 10 hours in total).

Request to SEMUJERES: Get 5 facilitators with basic programming notions of the above mentioned careers and 20 beneficiaries with a higher average or interested in taking basic programming courses.

A. Teaching by IBM

The first step of the process was the presentation and teaching of the topics by exhibitors belonging to IBM.

The process consisted of teaching by virtual means. First there was a video call with the exhibitors and course controllers, in which they were presented, followed by that for 4 weeks they showed the following topics. The tasks were developed between periods of time of a week.The course materials had already recorded videos of the exhibitors showing the subject, so after delivering the task, each Saturday had a session of questions and answers, where the exhibitor answered the doubts we had during the performance of the task, that helped so that we could generate a higher self-learning and measure our interest.

B. Question and answer sessions.

The question and answer sessions consisted in being able to speak with the instructors of each topic, who answered by video call the questions that we sent them in the week. The call had a duration of 1 to 2 hours approximately, depending on the number of questions they sent.

C. Replication of the course

This was the turn of the facilitators, so the first step was to create an agenda and plan of how the course would be handled. The aim was to replicate the course to the girls and to be able to take them or attract them more to the field of programming with what they had already learned in the IBM course that was taught, so they designed a syllabus with these topics:

- Frameworks for innovation
  1) Enterprise Design Thinking
  2) Elements of UX/UI
  3) Digital accessibility for people with disabilities
- Introduction to algorithms
  1) Data flow diagram
  2) Pseudocode
- Introduction to programming with Python
  1) Basic reading of the programming language
  2) Preparation of the environment
  3) Basic concepts of Python
  4) Data types
  5) Logical Operation - Mathematical
  6) Data structure
  7) Fundamentals of Python programming
  8) Working with data in Python
  9) Working with pt2 data PANDAS edition
- Programming languages
  1) Types of programming language
  2) Introduction and syntax of Java
  3) Introduction and syntax of JavaScript
- Data and knowledge generation
  1) What are data and data types?
  2) Data analysis for decision-making
  3) Introduction to data analytic
- Emerging technologies
  1) Introduction to artificial intelligence
  2) Use of artificial intelligence cases
  3) What is deep learning?
  4) Use of artificial intelligence tools
  5) How does a neural network work?

1) Frameworks for innovation: The first themes were based on a series of methodologies focused on the thought of software development for the user and the accessibility that the user comes to have, according to the tools they possess, either the change of colors, reading aloud, changing calligraphy, etc. Here the topic was taught by the facilitators through the ZOOM platform and I explain to them how to analyze websites or applications, to identify the accessibility tools they have, so that they could understand the importance of these tools and always think about the user. They also showed the methodology that IBM shared, which is based on a loop of constant change and analysis, to be able to always adapt to the needs of the user. Articles that was shared for us. [10][11]

2) Introduction to algorithms: In this topic through tasks, constant checks and virtual explanations through the ZOOM platform, beneficiaries are taught how to make flow diagrams, which are the most important basis in the world of programming, since it allows to plan all the code flow and identify possible logical errors in it.

The tasks were a series of basic problems where must design its code diagrams as they thought, after having had the explanatory session. It is important to mention that the facilitators were always aware of the girls through groups within whatsapp and there resolved doubts, when moving to the following explanation always wondered about the doubts they had about the previous topic.

3) Introduction to programming with python: In this session the girls were taught the basics about the programming language (Python), in which after explanations and tasks the accompaniment of the facilitators, they were able to solve complex problems. During the sessions, live codes were shown and all the syntax of python was explained, and the rules that govern the language and all the types of data that it has were also taught. After each session was left a small task related to the topic, reinforcing the domain of the subject and language.

At the end was left a project ”hanged program”, where the girls at the end of this session could show their skills and what learned in the sessions. The projects received were very impressive, as many even used python libraries that were not shown in depth, therefore a great improvement and progress of this project was demonstrated.

4) Programming languages: As mentioned earlier, it was not just about introducing girls to the world of programming with one thing. This theme consisted of getting deeper into the world of programming by showing the different types of programming that exist as object-oriented programming is, so they were taught some java script and HTML. At the end of this section the girls were able to develop a website using this type of programming. The tasks were omitted as the project made everything cheaper, from the viewed themes of programming with Java Script and styles with CSS.

5) Data and knowledge: What was seen in this topic was how learning methods for machines are created, in addition to the types of data and databases that exist. It explained the importance of databases and also the importance of learning in computers or virtual media. They explained and clarified hard about how they work, giving a brief introduction to the heaviest topic, but in turn of the most important.

6) Emerging technologies: This last chapter was one of the most important, as girls and new generations of youth are attracted to the issue of artificial intelligence. What was done in this very extensive topic was to solve the doubts that the girls presented about how virtual assistants work and some platforms with machine learning algorithms, so they are

asked to choose different platforms or applications that use this technology and to be clarified the functioning of the same.

The other sessions were to show the mathematical processes behind an AI, the differences between machine learning and deep learning, among other characteristics and differences. At the end a code with live execution was presented by means of ZOOM, where its application was explained. The code was an image sorter, based on the color of the images. With this last chapter the course was finished.

VI. Results

As a first point it is important to mention that these results were obtained from only 10 girls who participated, since for external reasons of the 20 girls who were selected by state, 10 could not stay in the course, either because they had problems with the schedule of the classes or another reason.

At the end of the course a call was made to ask about how they felt about the course, where most of the girls commented very excited that they were more interested in the program or that they would even study it, because they ignored many topics and had not explained them very clearly, which when entering the course was solved.

It could be seen in the graphics (Appendix A), the beneficiaries did not come with any previous knowledge and each of them gave their opinion based on their experience of the course. What you can see in the graphic of ”knowledge” is that more than 50% of the girls were able to improve their knowledge.

On the other hand if we look at the comments part, we can note that all the girls provided positive feedback, which means that the facilitators were able to meet the goal of transmitting trust and the knowledge previously received.

VII. Conclusion

In conclusion it was shown that people tend to learn for themselves, but if there is no means or tool of support we do not generate enough confidence to move forward. As we realized, the accompaniment of the facilitators in this project was fundamental, as the girls could feel confidence in themselves. Is important to say that we investigate and apply things of different articles .

On the other hand showing the topics in a partial and clear way allowed the girls to develop great programming skills. This showed that if we taught from a basic to a high level, learning outcomes will be better.

The third objective and one of the most important. An improvement in the attractiveness to the world of programming by women could be noted. That gives us a lot to talk about, since it is shown that women are currently uninformed of technology and also that if there is discrimination between men and women in this field, so the girls no longer decide to enter this field because they’re afraid they can’t do things that the boys can. This project showed that women are also able to do important things in a short time and how to attract them and show them what they are capable of, is to talk to them and make them experience how great they can become in this field of work that is growing every time.

History can be brought to the present, history where women were the ones who dominated technology, but as mentioned, stereotypes change people and also create fear. Fear is always there, you just have to learn that it is a weapon to move forward and believe in what we are able to do, always thinking about others and with the help of others.

Recommendation: From my point of view the course by IBM was very organized and covered the topics in a very appropriate way. On the other hand if you want to replicate this project, you should have a better schedule, since one of the reasons why the 10 girls left the project, was because the time was not compatible.

The organization is an important factor and should be taken into account during the planning of projects like this, if you want to cover all the objectives in the corresponding dates.

Appendix A

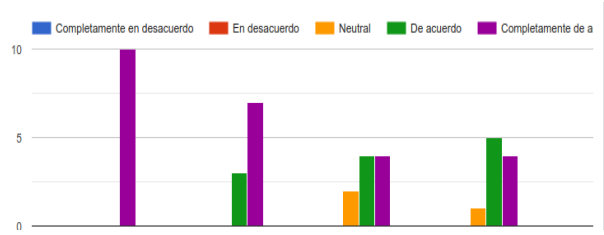

Fig. 1. Review of satisfaction

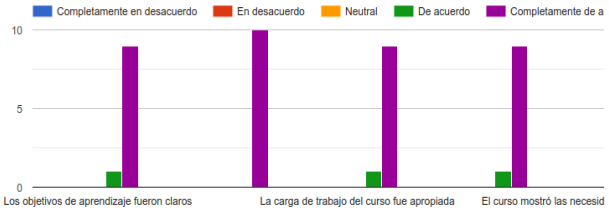

Fig. 2. Topics for the course

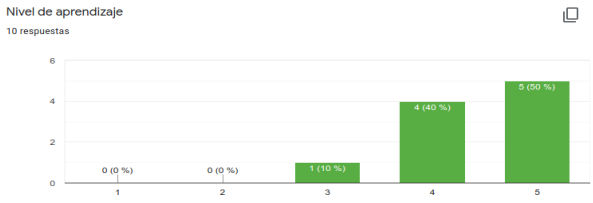

Fig. 3. Review knowledge

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