



A STEAM Integrated Curriculum Activity: How to Make the SAD Alien Happy?

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Abstract: In recent years, there has been an emphasis on the knowledge and skills needed in today's competitive marketplace and job markets. Many scholars believe that among the necessary skills required for success in the current economy are Science, Technology, Engineering, and Mathematics (STEM) (Kennedy & Odell, 2014). Years later many scholars added Art as another important skill needed by students to improve their communication skills and overall performance, and here the concept of (STEAM) Education started. On the other hand, 21st century school learning emphasizes the acquisition of higher skills, such as critical thinking and problem solving that requires different teaching styles and strategies, such as jigsaw activities and storytelling that can help in creating a collaborative, effective and creative learning environment. In this paper, we will demonstrate a (STEAM) activity that can be used in primary school curricula as an example.

Keywords: (STEM) Education, (STEAM) Education, Jigsaw Method, Storytelling, Role-play, Cooperative Learning.

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We live in an era where many subjects, such as Science, Technology, Engineering and Mathematics are integrated and connected in several ways. The (STEM) abbreviation refers to these four multidisciplinary approaches that incorporate aspects from all these four significant areas in education and professional carriers. However, (STEM) is not a new concept, but it has been around for decades in different forms and fields, until policy makers and educational leaders captured its significant importance and vital scarcity (White, 2014). All these four areas are necessary for today's educational systems, world economy and creative enterprises.

(STEM) focuses on four areas of knowledge: Science, Technology, Engineering and Mathematics, by showing an interesting interaction and logical connection among these subjects (Allen, Chang, Gorrall, Waggenpack, Fukuda, Little & Noam, 2019). Authentic (STEM) education is expected to build students' conceptual knowledge of the interrelated nature of Science and Mathematics, to enable students to develop their understanding of Engineering and Technology (McDonald, C. V., 2016).

(Kennedy & Odell, 2014)'s definition of "STEM literacy" refers to an individual's ability to identify questions and problems in life situations, explain the natural and designed world, and draw evidence-based conclusions about STEM-related issues; Understanding the characteristic features of (STEM) disciplines as forms of human knowledge, inquiry and design; Awareness of how (STEM) disciplines shape our material, intellectual, and cultural environments. Also, inquiry-based teaching strategies are effective in maximizing the academic performance of (STEM) undergraduates (Lai, C., 2018).

Recent technological advances have affected many areas of our lives, and the need for a skilled workforce that can take part in the endeavor is increasing. Therefore, 21st century schools not only focus on academic success, but also provide students with a collaborative learning environment, where they can communicate with each other, think creatively and solve problems. As acquiring Science and Mathematics disciplines has gained significance recently, 21st century citizens need content knowledge of Science and Mathematics to apply them in technology and innovation. While considering all these, (STEM) education provides practice for 21st century learning (Akaygun, S. & Aslan-Tutak, F., 2016).

Both parents and teachers seem eager and willing to promote early (STEM) learning but need additional training and resources to do so effectively. Teachers in early childhood settings need more effective preparation and professional development to engage young children successfully in developmentally appropriate (STEM) learning (McClure, et al., 2017).

Considering the experience of students from Romanian universities in (STEM) fields during high school studies, the engineer's profession and skills, the factors that influenced their option to study one of the (STEM) fields as experienced by (Popa, R. A., & Ciascai, L., 2017), the findings indicate that the respondents have been involved in (STEM) fields since middle school and secondary school; this curiosity has decided whether they will choose to pursue their (STEM) field studies or not. Moreover, most respondents agreed that the teachers who taught them the subjects they studied at the university during their school years influenced their decision to choose their university specializations. The data also show that the students are convinced of the importance of the engineering profession, knowledge and skills.

The STEM education in our era, with all the technology advancement became a must knowledge for the future learner and a must skill for the future worker and this need will keep increasing with technological evolvement and innovation. Based on this, our school curriculum should move to more digital literacy and coding skills. School teachers also must move towards active students center learning that could challenge and engage students. One of the problems that easily could make the STEM education really challenging would be the traditional teaching methods deliver by the teachers who prefer lecturing and assessment based teaching. A good start to overcome this problem is to build a productive collaboration environment where the teachers can learn from each other's teaching style (Rozhenkova, et al., 2023).

In this study we will discuss a few active strategies and explore different ways of teaching STEAM subjects. The aim of this paper is to identify the benefits of integrating (STEM) education in the primary school curriculum; by defining (STEM) education and the role it plays to improve the school outcomes within the framework and style of education that can fit the needs of the Ministry of Education in the Kingdom of Bahrain. Research will also provide a (STEM) activity that integrates the outcomes of each single (STEM) subject in a well-defined course of work for one primary level grade as an example.

Active Teaching Strategies

Although the traditional lecture-based format is still pervasive in many disciplines, many studies have proven that active teaching strategies are beneficial for deeper learning, better

performance, longer-term retention, as well as improving collaboration and communication skills and social engagement (Calkins, 2021).

Cooperative learning is an active teaching and learning strategy, through which small groups of four to six students collaborate and work together in a given task that will help them to accomplish an intended learning outcome. Students will be equally accountable, share rewards, recognize success or failures, which will be contingent upon each individual effort. Jigsaw is one of the well-recognized cooperative learning methods which allows the students to work in teams and maintain the personal responsibility (Garcia, et al., 2017)

Active teaching strategies can involve the use of audio and visual aids (e.g., YouTube clips), individual and group work, hands-on (e.g., designing, making and testing the Medical Mission kit) and so forth, to engage students in learning. In this study, we will use two main teaching strategies, which are jigsaw and storytelling activities with the use of visual aids and some role-play. For instance, role-play around the three states of matter appeared to instill positive attitudes into students about their learning, as they said this was “fun learning” and “helped me understand how the different molecules and particles worked”. The usefulness of role-play as a teaching strategy has been recognized in academic works (McSharry & Jones S., 2000). According to (Archana Chauhan, et al., 2022), methods like jigsaw and role-play help to train medical students across cognitive, psychomotor, and affective domains. As many trainings on problem-based learning and case vignettes were possible through role-play and simulated patients, which also created supportive and motivating learning environment and increased students’ self-esteem and attention spans. In a qualitative case study done by (Halimah, L., & Sukmayadi, V., 2019), the researchers found that the Jigsaw method can enhance the prospective teachers’ pedagogical knowledge and their instructional communication skills towards their students, since it represents a form of cooperative learning.

Role-play also considered as an active experiential student centered scientific learning strategy. It helps students to be physically, emotionally, and intellectually involved in their science learning. It gives them the chance to express themselves in a scientific context and comprehend new concepts. It can also help in making science relevant, and as (McSharry, G. & Jones, S., 2000) mentioned, “Role play is a fundamental part of human psychology and is a potentially powerful resource residing in the children themselves since it gives children a feeling of ‘ownership’ of their education.

Jigsaw Strategy

The jigsaw strategy is a collaborative learning strategy that can be used in teaching to boost students’ engagement. The idea of it came from the jigsaw puzzle, where the player needs each single peace to reach the final picture. Putting it into the classroom setting makes each student represent a piece of the puzzle and each student individually will be needed to complete the educational collaborative activity. To implement the activity, a cycle of four steps should take place: Planning and Preparation, Implementation, Observation and Reflection (Dhull, et al., 2019).

The Jigsaw strategy represents an excellent model of the shift from teacher-centered to student-centered learning. It is a type cooperative learning, in which students are actively involved in the teaching-learning process that improves their listening and communication skills (Bhandari, et al., 2017). The jigsaw strategy guides students through formulating a

position by synthesizing key ideas from readings with diverse perspectives on a common topic (Button et al., 2021). It enhances the motivation and performance of students by enabling them to cover several topics in a short time (Bafadal, F. & Rafika, 2015). In a Jigsaw learning model, students often get trained in exchanging ideas, arguing, exchanging information, and solving problems in discussion groups which leads to develop high level skills, such as critical thinking and being able to solve complex problems and building social relationships. (Subiyantari, R. & Muslim, S., 2019).

Jigsaw method follows a specific procedure out of few steps (Hoerunnisa, N. & Suherd, D., 2017), as the following:

1. Dividing the class into groups of 4 to 6 students, each of these groups called “home group”. Each student in the home group will be assigned to learn a part of the lesson topic. Students will take time to read over their part at least twice and become familiar with it.
2. Forming temporary “expert group” that consist of one student from each home group which shares the same assigned part. Students will get time in these “expert groups” to discuss the main points of their lesson part and to summarise what they will explain to their home group.
3. Students will go back into their home group. Each student will be explaining the part he/she was responsible of to the group.
4. At this stage, it will be up to the instructor to evaluate the students’ learning through group presentations, competition, quiz, discussion, etc.

Alternatively, the teacher’s role in the class will be the following (Sabbah, S., 2016):

- Organize the resources needed for the readings and divide it across the number of groups and students.
- Set clear classroom procedures and guidance for the activity.
- Facilitate the communication and discussion process among the students in the groups.
- Encourage, monitor, and bridge gaps in students’ lexis, and provide alternatives when needed.
- Help students in self-correction discussion and support their learning.

Storytelling

Storytelling can be used as a teaching tool to present class material in an interesting and entertaining way. Research shows that storytelling can help improving students’ comprehension of difficult theories, having a better understanding of the world, visualizing themselves in similar situations which can enable them to comprehend concepts easily by seeing the relevance of concepts, allow students to see similarities in different setting experiences (Powell, R. M. & Murray, O., 2012).

Virtual video clips that tell stories also has been widely spread, a video of “baby Charlie precociously biting the finger of his brother” had hundreds of million views (Dreon, et al., 2011). So, this type of these quick or even quirky videos also can help teachers to capitalize student interest and integrate in the curriculum to help engage students and make learning fun. Some researchers mentioned that there is a hidden conception of critical thinking in the Storytelling method that is created by experiences (Gallagher, 2011). Digital storytelling is also a multipurpose methodology which promotes creativity and narrative skills and has also been recognised in recent research as a powerful tool for research in

social and educational settings (Rodríguez, C. L., et al., 2021). In research for (Rong, L. P. & Noor, N. M. 2019), they found that digital storytelling can also improve students writing skills.

A study for (Geraldizo, et al., 2022) revealed that there is a positive correlation between Storytelling and Math performance. The study was done with Grade 7 students and aimed at determining the effectiveness of Storytelling in improving Mathematics performance and self - efficacy level. Moreover, another study for (Khodabandeh, 2014) found a positive impact and English-speaking performance improvement on a group of students after using virtual storytelling techniques. Likewise, a study on Chinese students' learning of the English language as a second language done by (Nguyen, et al., 2014) showed increased development of language skills and comprehension. The study also revealed that storytelling allows students to become more engaged and creative and foster their self-image. Furthermore, in a study for (Satriani, I., 2019) on Indonesian students, the researcher found that storytelling can help in memorizing words, mastering vocabulary, increasing moral and encouraging students to read. Research also showed that it can help in improving students speaking abilities (Swari, U. R., 2022).

In this paper, we will use jigsaw and storytelling approach, where the students experience an implementation of an innovative approach of learning different subjects in an upper-thinking level context and creative design model.

Context

Students will be exposed to different:

Teaching Strategies

Full class lecture, video, small groups demonstration, storytelling, role-play, jigsaw activity, peer review, competitions.

Learning Domains

Cognitive, Effective and Psychomotor.

Learning Subjects

Science, Technology, Engineering, Art, Mathematics.

Intended Learning Outcomes:

Light the RGB, Improve the RGB intensity, Change the RGB colours by the ICT coding.

Topics

Electrical circuit, Intensity, lightening, ICT coding, Mathematical Operations, Artwork design.

Materials

4 RGB LEDs, 12 Resistors 220-ohm, 4 Potentiometer, 4 9V battery, Jumper wires, small breadboard, 4 Arduino Uno R3, 4 iPads, colours, handicrafts.

Day 1: Initiating the Home Groups

The teacher will explain the main topic and the subtopics, and all the instructions students should be following with how their work will be evaluated and give the students the chance to think and clarify all their concerns. This will include the following steps:

Teacher will divide the class into non-homogeneous groups (home groups) of 4 students.

- Each group will have: RGB LED, Arduino Uno R3, Resistors 220-ohm, Potentiometer, 9V battery, wires, small Breadboard and iPad.
- Teacher will identify the name of each object and explain to the students what each part is responsible for.
- Teacher will demonstrate in front of the student how to code, light, intense and blind an LED light.

Figure 1: Breadboard with 1 RGB LED and Potentiometer

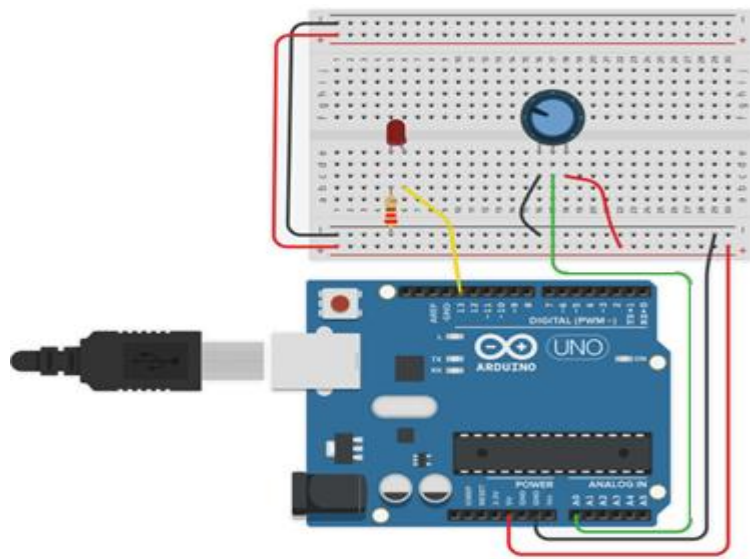
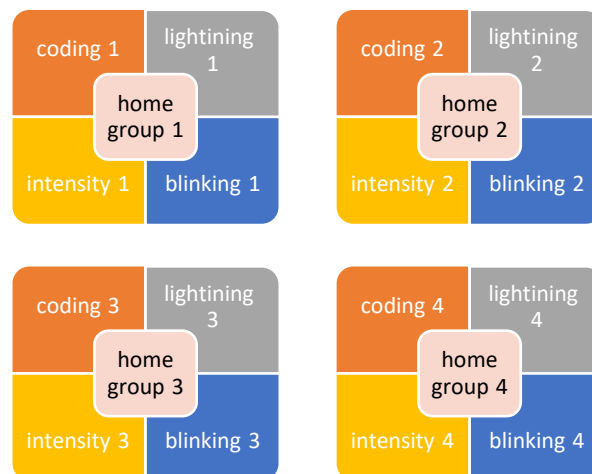


Figure 2: Jigsaw Strategy Home Groups



- Students should watch and hear carefully to decide which part each one of them in the home group would like to be expert in. Each group should have one expert from the four working domains.

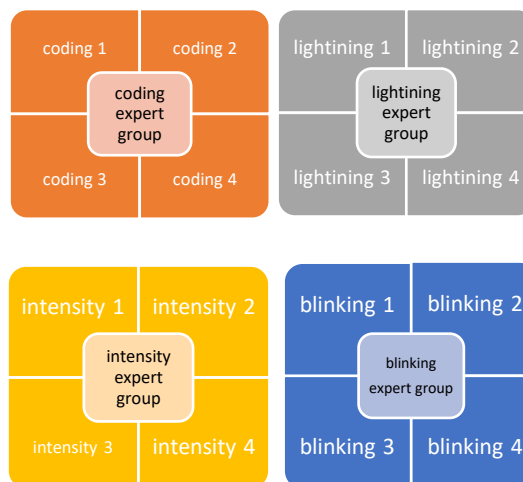
- Teacher will help students to choose the right domain according to their academic level. For example, ICT coding can be for the high-achievers, while lighting the LED through the electrical circuit can be for the low-achievers. And the intensity lightening and blinking would be appropriate for the average students.

Day 2: Practicing in the Expert Groups

The teacher will divide the class into expert groups that consist of students with the identical subtopics, where each student will be responsible in mastering a subtopic, through abiding by the following steps:

- Teacher will provide each expert group with a video showing them how to do what is required from them, so they can demonstrate the steps within their group.
- Lightning expert group will demonstrate just how to light an RGB LED.
- Intensity expert group will demonstrate how to light an LED, then try to intense the LED light, through using the Potentiometer.
- Blinding expert group will demonstrate how to light an LED, then try to blind it.
- Students will have the chance to watch the video more than once and demonstrate the steps and ask for help.
- ICT coding expert group will practice how to code to light, intense and blink a light, and might go further by trying how changing the codes will affect the lights.
- Each expert group should master their subtopic.

Figure 3: Jigsaw Strategy Expert Groups



Day 3: Return to the Home Group

At this stage students should be ready to go back to their home groups, and do the following steps:

- Each student will teach their home group members the subtopic he/she is expert in.
- Coding expert will start to show the student the basic codes needed to light an LED.
- Lightning expert will show them how to light an LED.
- Intensity and blinking experts will show the group how to intense and blink the lights.
- Coding expert can show them also how changing the codes change the effect on the lights.
- Teacher will work as facilitator and will support the students in their role.

Day 4: Storytelling

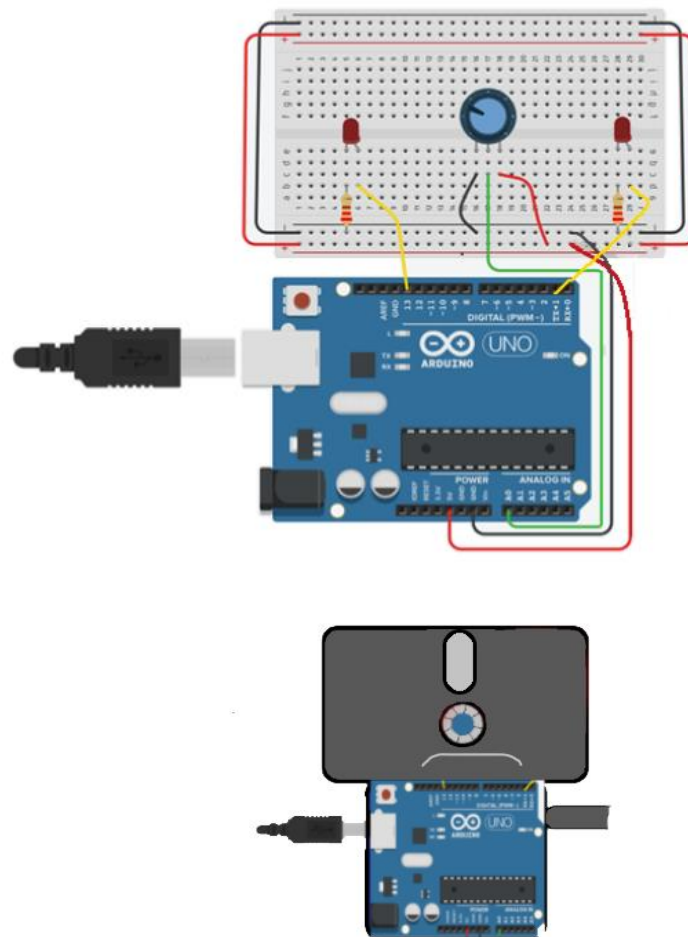
The teacher will be using the storytelling strategy to boost students' creative thinking and problem-solving skills.

- Teacher will present a fictional Alien character story to the student asking them to help in solving the problem of the Alien:

A lost baby Alien from the space landed in the kingdom of Bahrain. He was surprised that all humans have two eyes while he only had one. He had hard time having friends and adjusting to living on Earth. He felt lonely and sad, so he chose to go far from humans and live under the Tree of Life in Sakheer, surrounded with the darkness of the desert. The Sad Alien was thinking that his one eye and one nose are of no value on Earth. Can you help the sad Alien to be happy? Maybe by giving him another eye? Showing him how to intense his eye light or even to change his eye colour? So that he can finally feel home and be able to light his nights with nice colours?

- After hearing the story, the student needs to imagine that the Alien is the breadboard, the LED light is his eye, the Potentiometer is his nose and all the other wires and parts are his origins. The students need to continue the story in a way that the Alien will end up being happy and at the same time will present how he will look like after the changes they made to him to make him happy.
- Students will have more LED lights and electronic tools to help them assemble their story. They will also be provided with some crafting materials and colours to make their final design of the Alien.

Figure 4: Breadboard with 2 RGB LED and Potentiometer

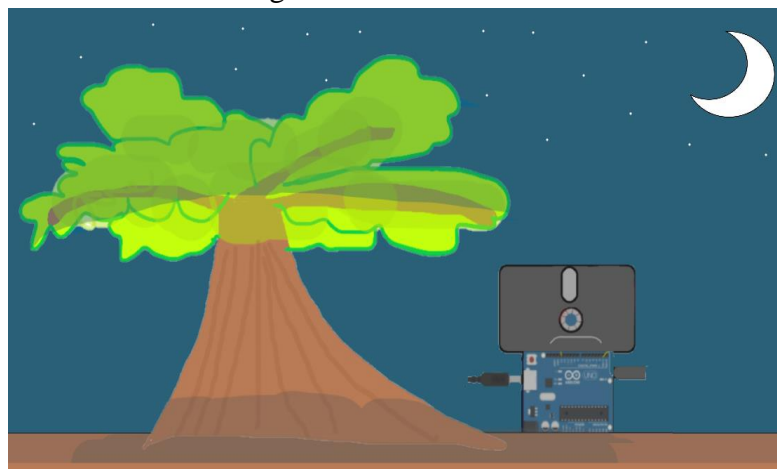


Day 5: Role-play

At this stage students should be done with their story writing and stimulating how their Alien looks like after solving his problem in their own way. Then, they should role-play the story they created to the whole class. For example, the following can represent one group role-play:

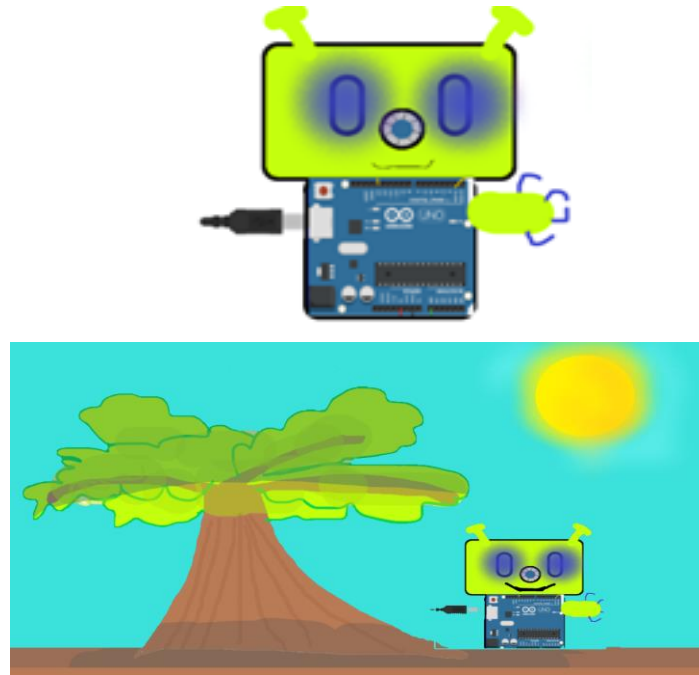
- Student1 (narrator): A lost baby Alien from the space landed in the kingdom of Bahrain. He was surprised that all humans have two eyes while he only had one. He had hard time having friends and adjusting to living on Earth. He felt lonely and sad, so he chose to go far from humans and live under the Tree of Life in Sakheer, surrounded with the darkness of the desert. The Sad Alien was thinking that his one eye and one nose are of no value on Earth.

Figure 5: The Sad Alien



- Student1 (narrator): In the morning, a father and his son were visiting the Tree of Life and saw the Alien sitting in deep sadness. The boy came to him and asked:
- Student2 (boy): Why are you sitting here sadly and alone?
- Student3 (Alien): I don't have friends. Nobody is interested in being a friend with someone like me with only one useless nose and one dull eye.
- Student4 (Father): Come on son. I think we need to help our friend Alien to know how he can use his nose and maybe give him another eye, so that he feels more like a human.
- Student1 (narrator): The baby Alien was so excited that finally he will get the help he needs. He was wondering how he will look like with two eyes and was thinking what his nose can be of use on Earth. On the other hand, the father and the boy were working so hard to make the Alien look as close as a human, so that he would not look scary and will be able to make friends. After hours of work, this is how the Alien looked like.

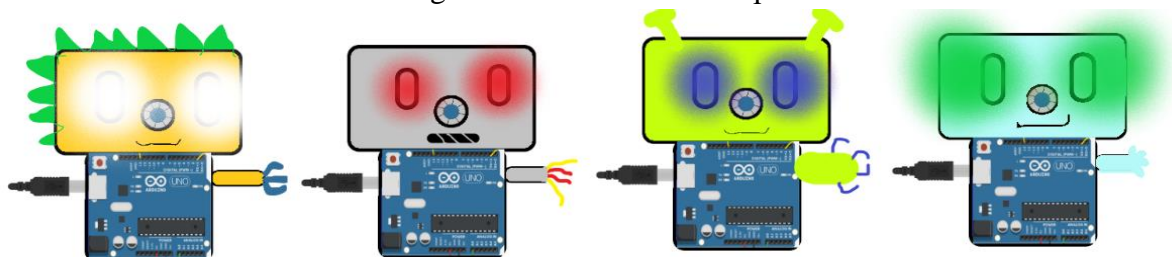
Figure 6: The Alien after Getting the Second Eye



- Student2 (boy): Wow!! Look at you!! You look so nice; your eyes are glowing!
- Student3 (Alien): I know!! Isn't it so fun?? I can't believe that this is me!! What did you do to me? How did this happen?
- Student4 (Father): You have interesting body parts my dear Alien. Your body carry an electrical circuit that can light your eyes. And your nose is not useless; you can use it to intense your eyes lightning. You can even blink and change your eye colours with some changes in your coding! I don't think any human can do that, but I am sure you will have many friends from now on.
- Student1 (narrator): After that day, the Alien was able to make many friends; all children in Bahrain were so excited to visit him under the Tree of Life to see and learn about his interesting eyes and nose, especially at night, during which he was able to shine the darkness with his glow under the stars.

By the end of the lesson, all groups will be presenting their stories and their Aliens.

Figure 7: The Aliens' Group



Conclusion

Based on the (STEAM) activity example we illustrated in this paper, we wanted to explore how we can merge a specific engaging collaborative activity in (STEAM) education. We attempted to use an interesting handiwork with some (STEAM) topics while adding the Art

component to flourish students learning and interest. We illustrated the characteristic features of (STEAM) disciplines and presented it in more human life base to engage the students with their own intellectual and cultural experiences while studying different sciences.

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