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► To cite this version:

Eleni Vordou, Margarida Romero. Supporting grammar language through a Micro:Bit activity. [Research Report] 0002, UCA - INSPE Académie de Nice. 2021. hal-03408009v2

HAL Id: hal-03408009

<https://hal.science/hal-03408009v2>

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Research supported by the Erasmus+ Let's Steam project and the data collection support of ANR CreaMaker.



Funded by the
Erasmus+ Programme
of the European Union



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Supporting grammar language through a Micro:Bit activity

Eleni Vordou¹, Margarida Romero²

MSc SmartEdtech Program

Research Report N°0002 — October 2021 — 19 pages.

Abstract: STEAM activities engage the learners in active learning activities supported by a diversity of technologies. In this study, we focus on the use of microcontroller boards such as Micro:Bit for analysing the learning process of grammar knowledge. We engage 21 primary pupils in a study aiming to evaluate the grammar learning activity through the use of Micro:Bit. The results confirmed our initial hypothesis about the benefits of using technology in conjunction with interactive activities to accelerate learning objectives.

Key-words: STEAM, Micro:Bit, Grammar, Block-Coding

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1. Interdisciplinary learning through STEAM activities

1.1 STEAM education

Technologies can support the learning activities in different ways as it allows for an unprecedented level of flexibility and differentiation for the different learning levels and styles of students (Boundless, 2016). While some technologies are only engaging the learners in a passive or barely interactive activity, other uses of technologies engage the learners as (co)creators of new knowledge and artefacts (Romero, Laferriere & Power, 2016). In STEAM education, learners are engaged in (co)creative activities supported by an important diversity of technologies. From tinkering to educational robotic kits, there has been an important expansion of technologies through the last years. Despite higher accessibility of technologies supporting STEAM education activities and the potential to develop an interdisciplinary approach to education, STEAM activities are still not generalized in France.

1.2 Microcontroller boards

Tangible technologies in STEAM education include not only pedagogical robots but also microcontroller boards. One of the most popular microcontroller boards is Micro:Bit. The BBC Micro:Bit is a tiny, pocket-sized computer with 25 LED lights and two programmable buttons. Apart from the device, the package includes one small battery which powers the circuit board and a USB cable to download the created code, to the Micro:Bit. Thanks to its batteries and Bluetooth technology, the Micro:Bit is controllable from anywhere. More specifically, it can be connected to other sensors, devices or everyday objects and users may create a step counter, a music instrument, a digital watch or even a games console with it. The low-cost nature of this device makes it accessible to a large percentage of public and private educational institutions, or even individuals.

1.3 Pedagogical uses of Micro:Bit board

Technology can be a creative tool used by teachers and students in different content areas and includes art programs such as animation and three-dimensional modeling (Olejarz, 1996). In this activity, we use the Micro:Bit both as a tool to teach/practice grammar and to introduce young children to the logic of block-coding in visual programming tools such as Scratch³ or MakeCode⁴.

The Micro:Bit board was created targeting a young audience and was given free to every child in year 7 or equivalent across the UK in 2016⁵. Independent research tracked the progress of the BBC Micro:Bit in the UK during the first year of its deployment and found, that 85% of teachers who used this device agreed, that it makes Computer Science more enjoyable for their students, and 90% of the children who used it said it helped to show them, that anyone can code (Funke, Geldreich & Hubwieser, , 2017).

³ <https://scratch.mit.edu/>

⁴ <https://makecode.microbit.org/>

⁵ <https://www.bbc.co.uk/programmes/articles/4hVG2Br1W1LKcmw8nSm9WnQ/the-bbc-micro-bit>

Coding is the process of developing commands in the computer in a language the computer understands so that the computer can carry out the said command, and perform the task⁶. Any computer program is similar to a long set of instructions. However, in block-based coding the “blocks” are lego-like pieces of instructions, a user is combining in order to tell their computer what to do. Block-based coding utilizes a drag-and-drop learning environment, where programmers use coding instruction “blocks” to construct animated stories and games. Moreover, it is an entry-level activity, where kids can gain a foundation in computational thinking through visuals as opposed to coding that is based in text⁷.

The BBC Micro:Bit is programmable through Microsoft MakeCode, a web-based environment for learning to code with physical computing devices such as the Micro:Bit⁸. This visually stimulating and colourful site is a place for users to build their code in blocks or in JavaScript, depending on their level. As learners are presented with a problem they need to solve, they become creative and explore the different possibilities and settings of the site. Thus, coding can be used as a tool to teach problem-solving, critical thinking, organization, storytelling, designing, math, creativity and more.

In the case of the Grammar:Bit activity, the students gain knowledge about the hardware features of the Micro:Bit and its abilities, as well as the software through which they can program the console. Although the activity focuses on 2 of the total 17 settings of MakeCode, the students are taught the basic logic to building a code, namely dragging the blocks into one another and using the Micro:Bit simulator to verify if the outcome is what they intended to create. In completing the tasks of the activity learners are required to use all of the language knowledge available to them at the time to express their ideas and overcome problems. Therefore, building a code becomes an opportunity for peers to communicate their intentions with each other and collaborate, having a common goal. Practising communication skills also includes receiving feedback from classmates and revising the code to create second or third versions. The BBC Micro:Bit and coding for it provide a perfect task for learners to tackle. The possibilities are numerous and “combining languages and computer skills empowers children with critical skills for their future” (British Council, 2019, para. 3)⁹

⁶ <https://hackr.io/blog/what-is-coding-used-for>

⁷ <https://www.idtech.com/blog/what-is-block-based-coding>

⁸ <https://makecode.com/blog/makecode-overview>

⁹ <https://www.britishcouncil.org/work/partner/coding-summer-school>

2. Method

2.1 Grammar:Bit activity

Grammar can often become monotonous for the students (Zarzycka-Piskorz, 2016), as it includes limited interaction. However, the implementation of technology can help the classrooms move away from a 'lecture style' and more adjust to a student-led style that can cater to different learning styles and paces. (Boundless, 2016). When developing this activity one important aspect was to familiarize teachers and students with technology. More specifically, the prevailing idea was to "take" the technology used by students outside of school and bring it into the classroom by making it part of the curriculum. Hence, it would become evident to the students that technology is not only a tool to pass time but can also be used for educational purposes.

Physical devices such as microcontrollers naturally support an exploratory 'bricolage' approach, as argued (Stiller 2009), where students learn using their existing knowledge by following a step-by-step pedagogical problem-solving. Thus, by introducing microcontrollers in language learning teachers can provide deep coverage of their content area and reinforce what is being taught in other content areas; which will lead to students developing functional literacy that will allow them to learn and adapt in diverse learning environments. (Long II & Davis, 2017).

Grammar:bit, which is a combination of the words Grammar and Micro:Bit aims to make grammar fun and interactive by applying grammar rules through an entertaining game with a Micro:bit. Task-based learning is a methodology that promotes the idea that "the most effective way to teach language is by engaging learners in real language use in the classroom. This is done by designing tasks – discussions, problems, games and so on – which require learners to use the language for themselves" (Willis & Willis, 2007, p. 1). Based on that, in this activity grammar rules of the French language are practiced with a Micro:Bit, while at the same time children have the chance to experience the basics of block-coding. In this way, a learning experience is provided where grammar escapes theory and is being transformed to a tangible.

Until now the Grammar:Bit activity has been tested with students of the Bischoffsheim primary school in Nice, France, where primary learner practised their knowledge on the grammar rule of "Les prépositions devant les noms de ville et de pays" assisted by a Micro:Bit. Yet, since there are a variety of grammar rules in different languages, the main focus for the future of this research would be to expand the testing not only by engaging different schools but also by using grammar rules to teach foreign languages.

2.2 Research Questions

We organise this study around two research questions :

RQ1. How did the students perceive the combination of grammar and technology during the activity? More precisely, did they enjoy practising grammar in that form?

RQ2. What do the students feel like they have learned after completing the activity?

2.3 Research Instruments

For the assessment of Grammar:Bit, 6 criteria were defined which were completed by the team of researchers. A 6 point Likert scale is used for the assessment based on the higher reliability of this type of Likert scale compared to 4 and 5 points Likert scales¹⁰.

1. Were the students engaged? 1-6
-Through this question, we evaluated if the main objective of this activity was met.
2. Did the majority of the students participate? yes / no
-Through this question, we evaluated the group dynamic, how many group members interacted the most.
3. Were the groups collaborating in a positive atmosphere? 1-6
-Through this question we evaluated the climate within the group, if the students were competitive with each other, fighting or interacting positively.
4. Has the group reached the desired result? 1-6
-Through this question, we evaluated if the students managed to build the code and understand the game.
5. What kind of difficulties did the students face?
-Through this open question we received some insights regarding the struggles the students faced. Based on this feedback we have the opportunity to alter some parts of the activity, to help the students.
6. Was the group-oriented on the task? 1-6
- This question was added in our second visit to the school when we examined groups 6 and 7. The objective of the question is to understand if the students were only engaged to play and explore or if they also focused on solving the task.

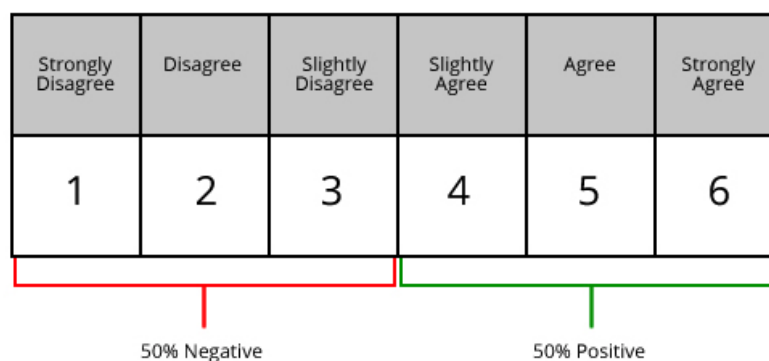


FIGURE 1: Likert Scale used for the assessment of Grammar:Bit

¹⁰ <https://www.tandfonline.com/doi/abs/10.1080/01488376.2011.580697>

2.4 Participants

The activity was developed in November 2020 and the data collection took place during March 2021. For the assessment of grammar learning through the Micro:Bit activity, we engaged a class of 8-9 years old pupils in Nice, France. A total of 21 pupils (11 females, 10 males) participated in the activity. The participants were paired up by their teacher in groups of 3 with boys and girls involved in each group. At this point, it is important to mention the high level of multiculturalism the vast majority of the schools maintain in terms of their students. Before their participation, the students had to show a paper of consent signed by their parents, stating that their children are allowed to take part in Grammar:Bit.



2.5 The session

The activity lasted around 20 minutes for each group and took place in a separate classroom next to the students' official classroom. For the last two groups 6 and 7, the activity was applied within the original classroom, in a special corner, since the classroom next door was occupied.

As mentioned above, each group consisted of 3 students that we escorted to the classroom next door. First, the names, ages, and gender of each participant were collected. For the sake of anonymity, each participant received a participation number. At the beginning of the activity, the group was given a Micro:Bit without its battery attached. At this point, it is important to highlight that the device was pre-programmed with the code the students would develop later on in the activity. This step was implemented for time-saving reasons. Since the Micro:Bit did not have the battery attached, the students would not discover it already contained code and could focus on exploring its features.

FIGURE 2: Implementation of Grammar:Bit in the classroom

The participants were introduced to the Micro:Bit and informed about its many possibilities. Namely, that it is a mini-computer that can be turned into a step counter, digital watch or a game console. However, today we were going to create a game with it. Holding the device in their hands, we asked the students to tell us what they observe when looking at the device's front side. This part of the session aimed to enable the students to understand the Micro:Bit has. Thus, before continuing with the next step, we underlined the 4 features the Micro:Bit has¹¹:

The button A

¹¹ For this activity we will be focusing only on the features that are in the front side of the Micro:Bit
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The button B

The buttons A+B when pressed simultaneously is the third button

Shaking the Micro:Bit is also a feature. We named it the "invisible button"

Then, we presented the students to the following table and asked them if they are familiar with the prepositions depicted in the table.

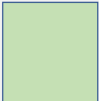
aux		A+B
au		Button B
en		Button A
à		?

FIGURE 3: Table 1 uncompleted version

At this point, the students were reminded of the grammar rule "Les prépositions devant les noms de ville et de pays" and explained to them that each preposition is represented with a symbol. Next to each preposition, we see how we can create this symbol in the Micro:Bit so that it shows up in the LED lights. After having studied Table 1 carefully the students concluded that:

- when buttons A+B are pressed a diamond appears on the display which represents the preposition **aux**.
- when button B is pressed a square appears on the display, which represents the preposition **au**.
- when button A is pressed a triangle appears on the display which represents the preposition **en**.

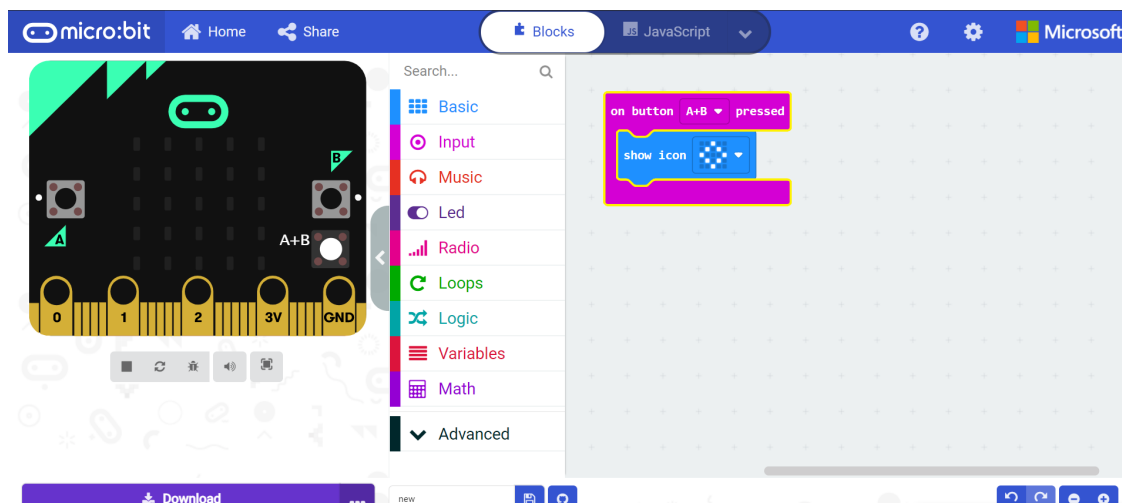
We continued by asking the students how they could create a heart on the display of the Micro:Bit, which would represent the preposition **à**?

Since a lot of students had difficulties answering this question, we tried to help them by reminding them of the "4 features" a Micro:Bit has. As soon as the students came to the right conclusion of the problem in Table 1, we filled in the gap by erasing the question mark and wrote down "shake".

Thereupon we showed the students how they can create the first part of the table, by opening the site of: <https://makecode.microbit.org/>

- Click on Basic and select “show icon”. Scroll down until you find the icon named “diamond” and click on it.
- Click on Input and select “on button __ pressed”. Click on the gap and select A+B.
- Drag the two lego blocks so that they fit each other.
- Click the button A+B in the Micro:Bit simulator to check if the code is correct.

This is how the final result looked like:



FIGURE

4 : Creation of the first preposition/ algorithm of Table 1 in MakeCode

Following the brief instructions, it was time for the students to create the other 3 codes, to complete the table. Considering there was only one laptop available, we asked each student to think and create one solution for one of the three remaining codes. When all 4 codes are completed the final result looked like this:

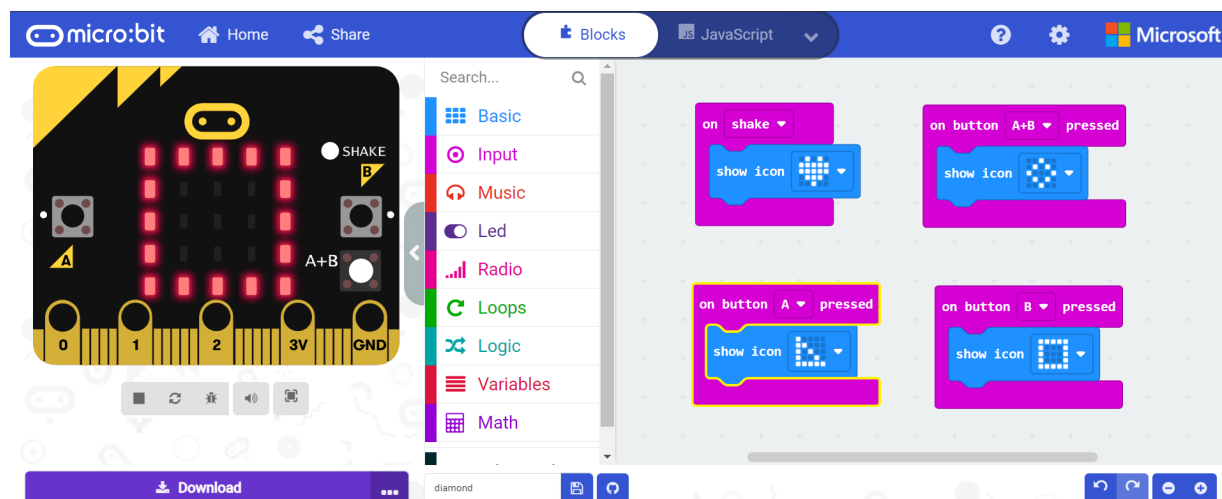


FIGURE 5: Creation of all prepositions/ algorithms of Table 1 in MakeCode

Having solved the task, we explained to the students that the code they just created had already been downloaded in the Micro:Bit but we skipped the code download process, to save time.

Considering the code is already in the device, we attached the battery to the Micro:Bit, and asked the students to press the different buttons, to confirm that their code is working.

2.6 The game

We gave a copy of Table 1 to the students, to help them not confuse the different symbols and prepositions.

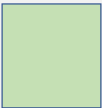
aux		A+B
au		Button B
en		Button A
<u>à</u>		shake

FIGURE 6: The completed version of Table 1

Then, we formulated the task:

"I will say aloud some phrases that will contain gaps. You need to fill that gap with the right preposition".

For exemple: "Je vais __à__ Paris".

"Look at the table on the board. Which symbol stands for à?"

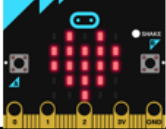
- "The heart".

"According to the table, how can we create the heart symbol on the Micro:Bit?"

- "By pressing the Button A."

“So for every phrase that I am going to give you, I want you to look at the table and press the correct button(s) or shake the Micro:Bit, to show me which preposition is the right one.”

“I will give you an example with my Micro:Bit.”

“Mark et Maria vont  Paris”

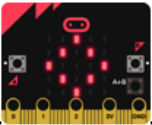
“Je vais  Pays-Bas”

FIGURE 7: Example of the Grammar:Bit game

3. Results

To measure the data of our research, we used the assessment criteria and two debriefing questions. The former was answered by the team of researchers after each group had finished the activity, whereas the latter was answered by the students after the last part of the activity was completed.

A. Were the students engaged? 1-6

The vast majority of the students were engaged, with 4 of the 7 groups reaching the highest score. Furthermore, in group 7 the student p_021 joined in the middle of the activity, as she was not in the classroom when the teacher selected the team members. In order for the participant to be integrated into the team, we asked the students to explain to the new team member what we were doing. The student p_021 understood quickly the concept of the activity and although she was a bit hesitant in the beginning, after a few minutes she was fully engaged with solving the task.

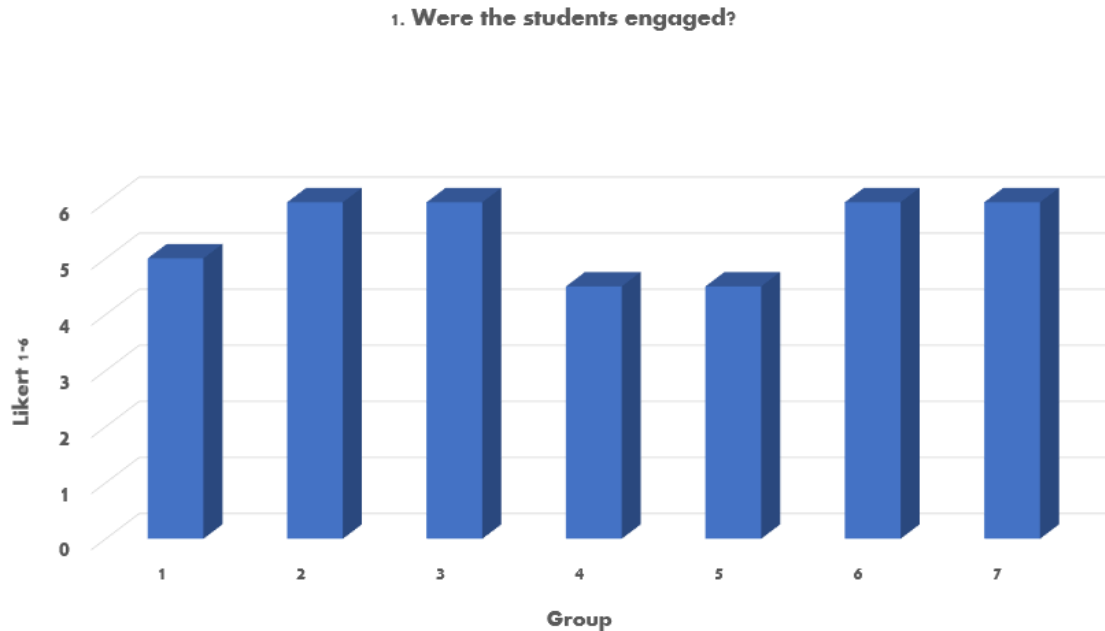


FIGURE 8: Student engagement chart

B. Did the majority of the students participate? yes / no

In this question, each of the 7 groups was qualified with the answer yes.

C. Were the groups collaborating in a positive atmosphere? 1-6

We observed a positive collaboration in all groups. However, in groups 3 and 4 we noticed some tension when the students took turns to complete the coding in MakeCode. More specifically, in group 3 participant p_007 took the initiative to assign turns to each team member so that every student has the chance to contribute equally to the task. Although this was a mature action, we witnessed how it disturbed the balance of the group, putting the other students under pressure. The reason group 3 was given only half the score for collaborating in a positive atmosphere was the quote of participant p_007 to his fellow team-member p_009: -"Hurry up, the other day it was you again who had problems again". Nevertheless, after a few moments, the students were laughing again and collaborating to solve the task.

3. Were the groups collaborating in a positive atmosphere?

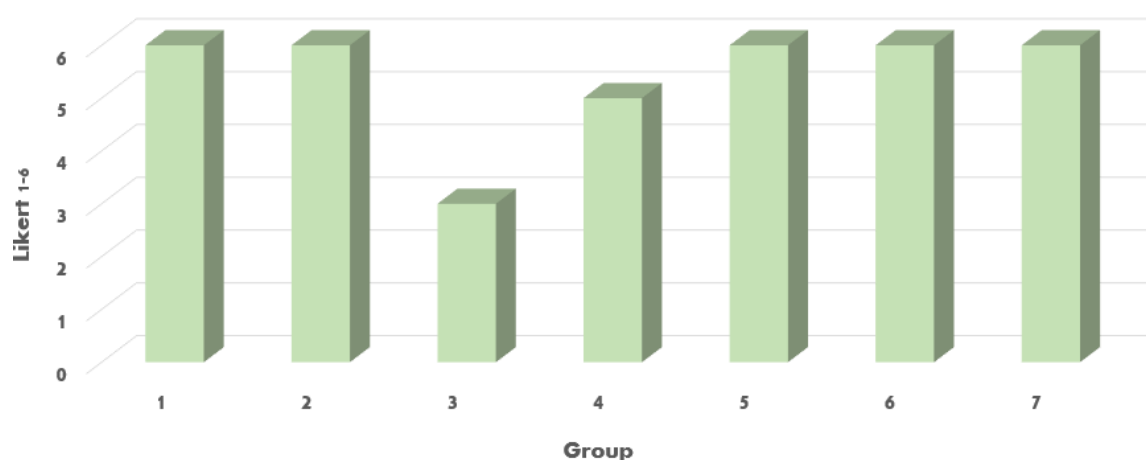


FIGURE 9: Positive collaboration chart

D. Has the group reached the desired result? 1-6

We were pleased to witness that every group reached the desired result, namely building the codes in MakeCode and understanding the game with the questions. At this point, it is important to mention that the students did receive some guidance in form of tips when facing some difficulties.

E. What kind of difficulties did the students face?

The following graph indicates the main 3 difficulties the 21 students faced when completing the activity. As mentioned above we helped the students overcome these difficulties by providing them with some tips. E.g. When we noticed that one or more students were not confident remembering the grammar rule of “Les prépositions devant les noms de ville et de pays”, we did a brief revision of the rule. Moreover, when the students were hesitant about answering how they could create a heart on the display of the Micro:Bit, which would represent the preposition à, we tried to help them by reminding them of the 4 features a Micro:Bit has. In groups 1 and 6 we had to provide the answer to the students, in order to continue with the next part of the activity.

As the graph shows, most of the teams had difficulties combining the blocks together to build the codes. Yet, their struggle was not in how the 2 blocks should be combined, but more of a practical nature. While the students knew exactly how the blocks should be put together, they were struggling to manipulate the mouse of the laptop. More specifically, they could not drag one block into the other. Therefore, in some cases, we thought it was appropriate to intervene and combine the blocks for the students, so as to continue with the next step of the activity.

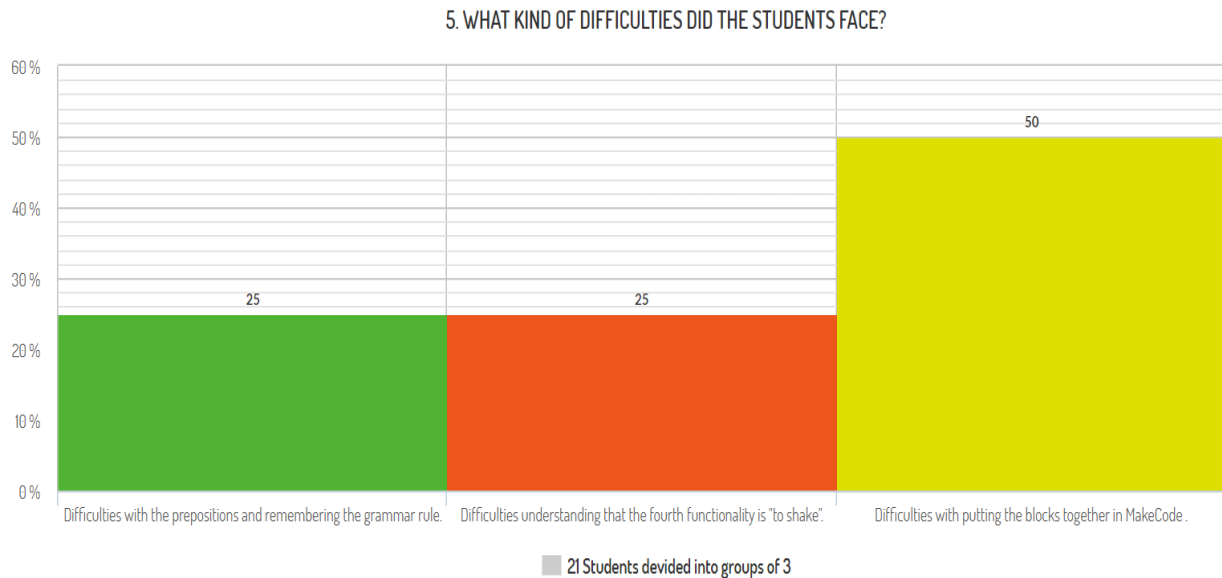


FIGURE 10: Overall difficulties chart

F. Was the group-oriented on the task? 1-6

As mentioned above, this question was added in the second visit to the school and was therefore answered from groups 6 and 7 only. In both teams, we observed that although the students were playful and enjoyed the game, each of their actions during the activity was focused on solving the given problem. Therefore, each team was qualified as task-oriented 6/6.

3.1 Debriefing

For this last part of the activity, we asked the students a) if they had fun doing this activity and b) what they have learned today. Although the most popular answers were that they learned the prepositions, how to programme the Micro:bit, how to programme a computer, some participants gave more surprising answers such as p_013 who responded: *"We learned how to program robots"* or p_014 who answered: *"We learned how to search on the internet"*.

In each case we made sure to complement the students' answers by highlighting that thanks to this activity they gain insights on:

1. The Micro:Bit and its features.
2. How to code a Micro:Bit.
3. How it is possible to combine grammar with technology.

4. Analysis

In this part we outline some of the students' unexpected responses-commentary while completing the activity and evaluate them relating to perceptions of the Micro:Bit and the coding.

After studying table one carefully with the students and clarifying the connection of the prepositions to the symbols, we proceeded with showing the students how to create the first code on MakeCode. This step required dragging two different blocks out and connecting them so as to create the correct symbol on the Micro:Bit simulator of the site. When developing the activity we expected that for each code the participants would follow the same pattern of steps, in order to create a new code/symbol. Therefore, we suggested the end result would look like the picture below.

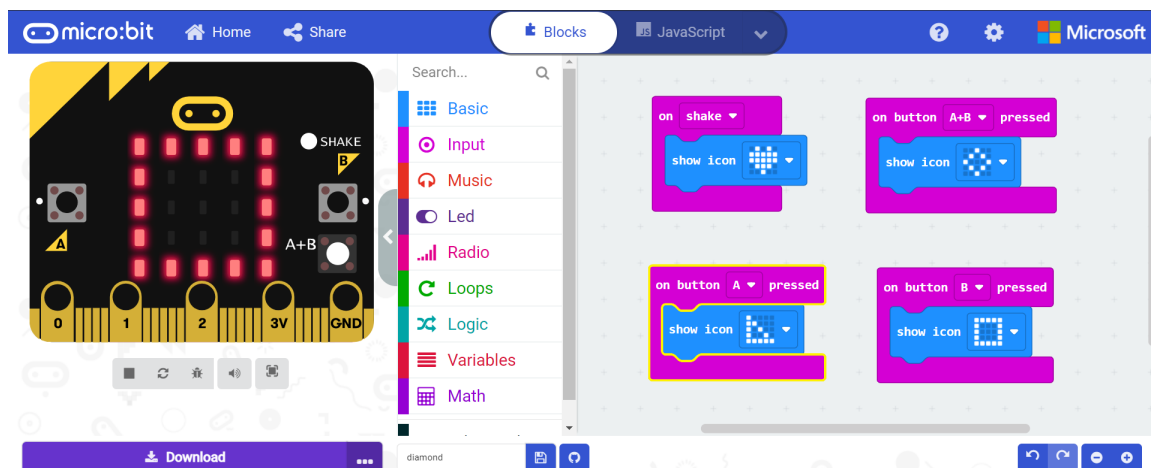


FIGURE 11: Creation of all prepositions/ algorithms of Table 1 in MakeCode

However, we were surprised when 3 out of the 7 teams came up with an easy alternative solution to the task. Instead of dragging two different blocks, the students decided to click on the button of the first code we already created for them for demonstration purposes, and just change another button. As the following picture shows, by clicking on the blank space of the "Input" block one can choose between 3 different options. Since all three options were necessary to create the remaining codes, the students opted to keep the existing blocks and to just alter the data of them.

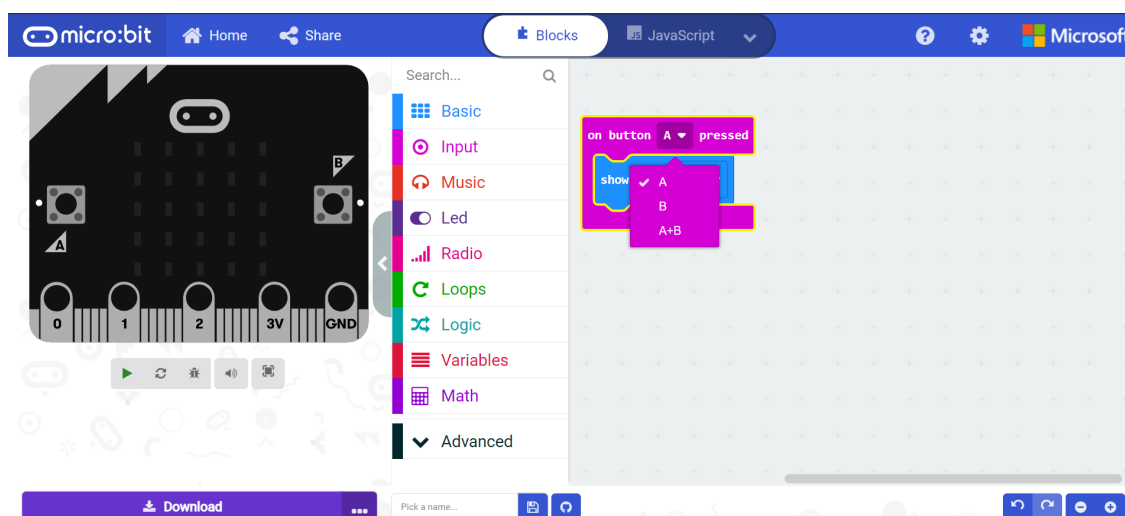


FIGURE 12: Students approach to the creation of all prepositions/ algorithms of Table 1 in MakeCode

Although we did not intervene in the process, before continuing with the next step of the activity, we made sure to highlight that in order for the Micro:Bit to contain all the information needed, all 4 codes must be downloaded to the device. Thus, all 4 codes should be present on the screen of the site. One student, p_012 even suggested that we could change table one, as it is not set that e.g. only the buttons A+B can produce a diamond shape, but then we could decide that another button can produce the same symbol.

Apart from the newly proposed solution, there were a variety of comments and questions the students asked regarding the Micro:Bit. More specifically, p_19 and p_020 were asking "What does this button do?" -while showing the backside of the Micro:Bit.

Furthermore, p_018 stated that: "We can program the Micro:Bit through the computer" prior to being introduced to the MakeCode platform. Some students even indicated that when we first showed them the Micro:Bit and explained that we were going to create a game using the device. P_010 said "You have to program it to make it work", p_012 " You have to plug it to make it work". The students were also creative when thinking about different uses for the Micro:Bit, complementing what we had already mentioned (a digital watch, a step counter), with p_007 adding that "play music" and "video games".

4.1 Future adjustments on the research protocol

Despite our positive experience during and after the session, we felt the need to make some adjustments to be even more precise regarding the data collection.

Although the students were collaborating to create the code in some groups it was observed that the students were taking turns on the computer and there was a common effort in building the code. Moreover, it was a matter of experiencing the putting together of the blocks and exchanging thoughts at the same time, which was more suitable in order to build the code. It was a common effort to achieve the final solution. Therefore we decided that in future testing the second assessment criteria: "Did the majority of the students participate?" yes/no would be replaced with the open question: "At which point are the students collaborating".

In addition to that, we came up with similar grammar rules in the German, English and Greek language. Expanding the languages would allow us to use this educational activity in a wider audience, as a tool for learning foreign languages.

5. Discussion

While the activity was welcomed by both students and teachers, there were many who expressed their concerns about its feasibility. More specifically, during a presentation of the activity to teachers conducting master studies in pedagogy, a lot of them shared the limitations they would face, if they were to carry out Grammar:Bit in their classrooms.

As funding is constrained for the majority of public schools, many classrooms lack technological means such as computers and projectors, not to mention Micro:bit. Thus, activities of the same nature would be impossible to be included in the curriculum. One possibility to overcome this obstacle would be to develop an unplugged version of the activity, using cardboard to create a simulation of a Micro:bit and different cards to represent the many variables of MakeCode.

6. Conclusion

In this paper, we presented an educational activity aiming to combine language learning and coding, by using BBC Micro:Bit. This activity was carried out in the classroom of a French primary school, where it became evident that interdisciplinarity assisted with technology leads to an impactful learning experience for the participants. We found that the Micro:Bit encourages students' creativity as well as its interesting hardware stimulates students' motivation to engage in the lesson.

The Micro:Bit is a meaningful way to introduce the logic of programming a connection between other disciplines such as language learning. Our research so far has shown that students liked participating in an educational activity in which they had the ability to work with a BBC Micro:Bit and consider this a playful and impactful way of learning. Besides, we witnessed how after the session the students were using the grammar rule confidently without barely making mistakes. The students as well as the teacher of the class consider work with BBC Micro:Bit as intriguing and shared with us that they are looking forward to engaging in other activities that include Micro:Bit.

7. Funding

This research has been subsidized by Erasmus+ Let's Steam! project (<http://www.lets-steam.eu/>) in collaboration with the ANR CreaMaker project (<https://creamaker.wordpress.com/>).

8. Acknowledgements

We are grateful to Despoina Schina and Ginna Kurmen for their support in the data collection.

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10. Annexes

Questions which we used for the practise of the grammar rule:

Je rêve d'aller ____ Grecque.

Je vais passer un mois ____ Canada.

Ils vont aller ____ Etats-Unis dans deux semaines.

Ils ont fait un séjour extraordinaire ____ Chine.

L'été dernier, il a fait un voyage ____ Angleterre.

Nous sommes invités ____ Paris.

Nous allons faire un séjour de deux semaines ____ Danemark.

Elle passe ses vacances ____ Irlande.

Tu vas trois semaines ____ Japon ?

Nous avons fait du camping ____ Bretagne.

Envie de voir des tulipes? Allez ____ Hollande.

Je pars demain matin ____ Normandie

Nous allons ____ Portugal cet été !

Elle est née ____ États-Unis et maintenant elle vit ____ Italie.

Tu es déjà allé ____ Mexique ?

Elle vient ____ Russie.

Ils viennent ____ Japon.

Ils voyagent souvent ____ Espagne.