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The impact of the use of technology on student engagement and motivation in the music classroom

ABSTRACT

This article explores the use of a technological tool, the Makey Makey, in the music classroom, to support student engagement and motivation. An experimental, descriptive and correlational quantitative design was designed and done over a sample of 104 students at high school level. Pre- and post- measures of engagement and motivation indicators were collected and compared to a control group to explore and compare the impact of the use of the Makey Makey over these indicators. The research findings indicate a significant difference between the experimental and control group in relation to their levels of engagement and motivation, suggesting that the use of technological tools in the music classroom can have potential benefits over these indicators. The results also show that are the affective and emotional dimensions that have more incidence over the student engagement, suggesting that educational interventions aimed at improving student engagement and motivation should focus on nurturing their emotional engagement. However, the results from this study cannot be generalized due to the study’s limitations, which make evident the need for more experimental studies and further

KEYWORDS

ICTs
innovation
music education
robotics
meaningful learning
collaborative learning
academic performance
exploration of the impact of technology in student engagement and motivation indicators.

INTRODUCTION

Technology has a predominant role in our daily life (Belmonte et al. 2020). The digital alphabetization process has been carried out by the younger generations almost instinctively, as they use these tools with formidable ease and dexterity (Berea et al. 2019; Belmonte et al. 2020). In the field of education, this new scenario dominated by the use of technology is affecting and changing both the learning process and the students’ and teachers’ role in it. As a result, there is a growing interest to investigate new models and learning experiences that reflect and adapt to the new forms of a digitalized society (Navarro 2017).

It is evident that research on different pedagogical and methodological approaches that include the use of ICT is essential, as there is evidence that the technologies themselves do not necessarily produce educational improvements, but rather depend on how these are applied and taught (Belmonte et al. 2020; Carriedo-Cayón et al. 2020).

Thus, the goal of this research is to explore if the use of a technological tool in the music classroom, in this case the Makey Makey, has an impact on student engagement and motivation. The logic behind this idea stems from new research studies that show how technology easily captures the attention of students and connects with their interests and motivations (Marín-Marín et al. 2020). These studies also suggest that technology is a tool that facilitates the integration of knowledge in a collaborative and participative way (Aznar et al. 2019; López-Belmonte et al. 2020).

The Makey Makey is a technological tool created by Jay Silver and Eric Rosenbaum at the Massachusetts Institute of Technology in the United States. Its appearance is similar to a traditional video game console. Once connected to the computer, the Makey Makey offers the opportunity to establish new ways of interaction between the user and its surroundings, encouraging several capabilities such as creative thinking, imagination and the ability to design new interactive projects (Marín-Marín et al. 2020).

Different studies suggest that the Makey Makey is a resource with high pedagogical potential for use in schools, as it promotes key capabilities such as participation, concentration, motivation, cooperation and meaningful learning, as well as improving students’ academic performance and autonomy (Flokides and Papoutsi 2019; Lozano and Eduardo 2020).

LITERATURE REVIEW

Engagement and motivation

From a theoretical perspective, student engagement explains both dropout and school achievement (Appleton et al. 2008). Student engagement means more than merely assisting the class or achieving good marks; the engaged student strives, persists, self-regulates his or her behaviour and enjoys challenges and learning (Klem and Connell 2004). Student engagement is a multi-dimensional concept that requires an understanding of the various affective connections within the academic environment (e.g. adult–student relationships or peer relationships) and the active student behaviour (e.g. attendance, participation, effort and social behaviour) (Appleton et al. 2008). Thus, student
engagement is not an individual attribute, but rather an alterable state that is highly influenced by the ability of the school, family and peers to provide consistent expectations and support for learning (Reschly and Christenson 2006). Student engagement depends on both the interaction with the teacher and the learning opportunities in the classroom, that is, the context and the individual (Appleton et al. 2006).

In recent years, there has been an increase in the use of measures with appropriate psychometric properties that assess student engagement. These have consolidated the power and value of student engagement as an effective variable for educational decision-making (Appleton et al. 2006; Betts et al. 2010; Darr 2012; Fredricks et al. 2016). Still, to advance the emerging construction of the concept of student engagement and to develop efficient school interventions and programmes, there is a need to achieve greater conceptual clarity and methodological rigour (Appleton et al. 2008). Along these lines, a particular concern is the apparent overlap and confusion of student engagement with motivational variables. How does motivation differ from engagement?

The next section aims to review the literature that discerns motivation for engagement, establishing the theoretical basis of this research.

**Conceptual approaches on student motivation and engagement in the classroom**

As mentioned above, motivation and engagement are fundamental factors of the teaching and learning process (Appleton et al. 2008). Among the conceptual approaches that differentiate motivation and engagement, there are several perspectives such as the self-determination theory (SDT; Ryan and Deci 2000), the achievement goal theory (Elliot 1999), the attribution theory (Finn 1989), the dynamic systems theory (Lewis 2000), the social cognition theory (Bandura 2001, 2010; Zimmerman and Schunk 2012), the humanistic perspectives (Maslow 1968) and the ecological perspectives (Bronfenbrenner 1992), among others. All of these emphasize that it is motivation that encourages engagement (Ainley 2012).

Thus, motivation differs from engagement in that the former comprises private, unobservable, psychological, neuronal and biological factors, and, in contrast, engagement comprises public and observable behaviour (Appleton et al. 2008). Pekrun and Linnenbrink-Garcia (2012) propose a model of engagement that is based on five components: the motivational (e.g. goals), the cognitive (e.g. attention and memory), the behavioural (e.g. effort and persistence), the cognitive and behavioural (e.g. self-regulation) and the social behaviour components. In contrast, Anderman and Patrick (2012) describe three types of engagement: cognitive (e.g. self-regulation), emotional (e.g. positive feelings about school) and behavioural (e.g. effort). Despite the different models proposed, all authors agree that motivation precedes and sustains engagement, and not the other way around (Reeve 2012; Cleary and Zimmerman 2012; Pekrun and Linnenbrink-Garcia 2012; Ainley 2012).

In addition, these authors emphasize the importance of context in motivating and engaging students. For example, Reeve (2012) points out that for motivation and engagement to be nurtured, students need an environment that supports them. In this context, the importance of positive relationships between the teacher and the student is emphasized. Voelkl (2012) also highlights other contextual factors that have an impact on student motivation.
and engagement, such as the need for students to feel safe and for students to feel that they are treated fairly. In addition, Anderman and Patrick (2012) describe how the goals set by the class have an effect on individual perceptions of meaning and purpose on the tasks to be executed, thus influencing their motivation and consequently their engagement at a cognitive, emotional and behavioural level. Other contextual factors that influence motivation and engagement are the family, the socio-economic and sociocultural level and peer influences (Schunk and Mullen 2012).

**Different perspectives on the use of technology in education**

Technology is today a prominent feature in educational practices. Mobile telephony, the use of the internet and other forms of technology are everyday tools that are often used in both the individual and professional spheres. Now, governments in almost every country have set political agendas that seek to encourage and support the use of digital technologies in schools and universities. So far, there has been a slow process of introducing technological resources into the classroom, but it has not yet been established precisely whether these tools are effective in developing and improving student motivation and engagement, and whether they can be easily integrated into the curriculum (Sánchez-Garcia and Galindo-Villardón 2018).

The new generations of students has grown up in a digitally rich environment. However, the actual use of these technologies for academic purposes is under ongoing debate. It is yet not clear whether the constant use of technology facilitates or hinders learning experiences and academic performance. The scientific literature shows contradictory results (Rashid and Asghar 2016). For example, Fonseca et al. (2014) indicate that through the use of technology, students were more participatory and showed higher level of interaction with the proposed content, which consequently had a positive impact on academic performance and student motivation. Another study by Cheng et al. (2015) describes how students showed improved long-term content retention, greater engagement and better academic performance through the use of technology in the classroom. Using a longitudinal design, Gulek and Demirtas (2005) provided substantial evidence that the use of technology improved students’ learning and academic achievement. Similarly, Trimmel and Bachmann (2004) found that students who used technology in the classroom had higher levels of participation, a greater interest in learning and a greater motivation to perform well compared to students who did not use technology.

In contrast, several studies show negative or non-significant relationships between the use of technology and academic achievement (Rashid and Asghar 2016). Fuchs and Wossmann (2004), who surveyed students from 31 countries, stated in their results that there was an absolute ubiquity that technologies hindered learning experiences rather than facilitating them. Along these lines, Sana et al. (2013) suggested that the use of technology in the classroom had a negative effect on academic achievement.

Despite the various results, there is a clear growing interest in exploring the use of technology as an educational tool and its influence on student academic performance, motivation and engagement (Rashid and Asghar 2016).

**The use of technology in music education**

As Gembris states, the rise of new media technology contributes to an increasing variety of musical development in the fields of composition,
The impact of the use of technology on student engagement …

performance and listening (2002: 489–90). It is fair to say that the history of music technology has not been fundamentally driven by any interest in musical development and learning, but instead it has been guided by the practical needs in music production, technical achievements in hardware and the internet. 1

The importance of encouraging children to create their own music is a recent topic of interest related to the field of music technology (Webster 2016). Compositional thinking as a strategy for teaching music has become a point of interest in music education. Different authors such as Hickey (2012), Kaschub and Smith (2009) or Webster (2016) explore and suggest different theories for teaching composition that first involve the exploration of music material and imitation.

This is the case of the Makey Makey, a technical achievement that has the potential to serve as a tool to encourage children to create their own music, as it allows them to draw upon these theories and to explore sound, imitation and creation.

### Student engagement through the use of technology in the classroom

Research suggests that technology provides a source of interactive tools for academic purposes (note-taking, participation in discussion forums, access to additional resources, software and applications) and facilitates student–student and student–teachers interactions. Thus, it is common to think that it can also encourage their engagement (Mehdinezhad 2011).

However, although much has been written about student engagement and the use of technological tools in the classroom, there is not much research done on the intersection of the two (Rashid and Asghar 2016). Thus, the essential question posed in this research is: Does the use of technology as an educational tool lead to greater student engagement?

### Educational considerations about the Makey Makey

One of the emerging innovations that has gained momentum in the field of education is robotics (Belmonte et al. 2020; Camilleri 2017; López-Gil and Bravo 2019). Its use as a pedagogical resource contributes to the improvement of certain educational indicators, such as autonomy, creativity, attention and motivation (Bravo and Guzmán 2012; García 2015; Vivas and Sáez 2019; Belmonte et al. 2020).

At a didactic level, the use of robotics assists in the development of digital skills and fosters cooperative work, self-regulated learning, interest and participation, critical attitude and even the expression of feelings and emotions (López et al. 2019). At a pedagogical level, robotics has the potential to develop computational thinking, understood as one of the most important skills in today’s society (Belmonte et al. 2020).

The Makey Makey is one of the robotic devices that can be used in education. This device can be used without any knowledge on robotics, programming or electronics. Several studies based on innovative experiences with this resource have found that this tool contributes to concentration and motivation, as well as enhancing cooperative learning, improving relationships between peer groups and contributing to the achievement of meaningful learning (Lozano et al. 2016; Chaves et al. 2018; Belmonte et al. 2020).

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1 For a more detailed description of the history of music technology as it relates to music teaching and learning, Webster (2016) explores these topics in more depth.
The *Makey Makey* consists of several components. First, at the top, it has a USB port that allows the user to connect the device to a computer. The front part (Figure 1) has the necessary functions to control the object with which it interacts. At the back (Figure 2) are the processor and the control board programmed in an Arduino language, which allows changes in the programming of the device. Finally, there are seven cables with tweezers (Figure 3) at each end that connect the *Makey Makey* with the material chosen by the user, through which the sound will be made.

In the field of music education, several authors have argued that the use of technology in the classroom can serve as a supplement and incentive to optimize the teaching of the subject (Eyles 2018). Different aspects such as musical creation and improvisation can be addressed through the implementation of ICTs, and these can serve to create innovative spaces that foster creativity (Serrano 2017; Belmonte et al. 2020).

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*Figure 1: Front of the Makey Makey.*

*Figure 2: Back of the Makey Makey.*
There is a recent study by Reyes-Rojas (2018) that used the Makey Makey to promote music creation and performance in a hospital setting where the participants had mobility problems. The results from this study suggest that at an educational level, this tool allows for the diversification of teaching and learning strategies, which improves the pedagogical experience of both teachers and students. At an artistic level, the tool allows us to explore new methods for musical creation, and it allows the inclusion and accessibility of new, rich educational experiences.

Another study by Calvillo-Castro (2019) states the potential benefits of using the Makey Makey for teaching music, as it can be used to create any musical instrument capable of reproducing any sound, existing or recorded by the student. It can be used for creative purposes such as storytelling and for creating non-conventional musical scores using drawings, among others.

**Study goals and research questions**

Previous studies such as Belmonte et al. (2020) have shown the potential of the Makey Makey on improving academic indicators such as motivation, autonomy, collaboration and student participation in the classroom. However, this study focused on engagement, which was mediated by motivation. Therefore, the main goal of this study was to investigate whether the Makey Makey was an effective tool in enhancing student engagement in the music classroom.

This study was guided by the following research questions:

a. Does the use of technology in the music classroom enhance student engagement?

b. If so, which dimensions of the concept of engagement contribute to its improvement?

In order to answer these questions, a quantitative and experimental research was carried out that evaluated the levels of student engagement at a cognitive, psychological, emotional and behavioural level.
METHODS

Theoretical framework

In order to investigate and understand the concept of engagement and its dimensions, this study is based on a conceptual perspective from Newmann et al., who define student engagement as ‘the psychological engagement (e.g., mental, cognitive and emotional) and the student effort (e.g., behaviours) directed towards learning, understanding, and mastering the knowledge and skills that academic work seeks to promote’ (1992: 12). Key in this definition is the multidimensional perspective that involves psychological and behavioural factors and connects them with educational outcomes. Thus, this perspective considers four subtypes of engagement: academic, behavioural, cognitive and affective. Academic engagement is defined by the set of behaviours that aim to achieve academic tasks (e.g. the student asks appropriate questions in class; the student does the assigned tasks; the student succeeds in passing the subjects). Behavioural engagement is defined by those behaviours that demonstrate dedication and bonding with the school (e.g. the student attends class continuously; the student participates in extracurricular activities; the student does not exhibit atypical or unusual behaviours). Cognitive engagement is defined by the investment in thinking and mental processes that are related to the learning process. Finally, affective engagement is defined by feelings of identification or affiliation with the school and is related to the emotions experienced during the schooling stage (Christenson et al. 2012). Both cognitive and emotional engagement are assessed through student perceptions and are less observable than academic or behavioural variables (Appleton et al. 2008).

From this perspective, the relationship between engagement and motivation is treated, which is perceived as necessary, but not sufficient, for the engagement to occur at all four levels (Appleton et al. 2008). Engagement operates within a motivational framework and depends on psychological processes such as autonomy, belonging and competence or ability (Wellborn 1992; Christenson et al. 2012). However, engagement represents the action that derives from motivation, which depends on the relationship between the student and the context (Reschly and Christenson 2006).

In musical terms, this study is guided by the five pedagogical principles identified by Juntunen (2017) that guide the process of finding new pedagogical solutions for applying technology in a music classroom. These principles are: (1) everyone is creative, (2) gaining musical knowledge through embodied learning, (3) enhancing social cohesion and inclusion through group music activities, (4) composing as a collaborative and self-regulated process and (5) empowering agency and ownership through making a musical product.

Research design

This study was carried out using a quantitative methodology, through an experimental design, using pre- and post-test measurements. This was set to allow comparison between different groups of participants, namely the experimental groups that received the sessions with the Makey Makey from April 2021 and the control groups that had another music teacher and received a traditional music education. Data analysis was performed through the Statistical Package for the Social Science programme (version 25), taking a \( P < .05 \) as a statistically significant difference. The questionnaires that were used to measure variation in the mentioned variables were the Student Engagement Instrument.
The impact of the use of technology on student engagement …

(SEI) and the Engagement vs Disaffection Scale (Skinner et al. 2008). They are both validated self-report instruments designed to measure levels of student engagement at all levels: cognitive and psychological (SEI; Appleton et al. 2006) and emotional and behavioural (Engagement vs Disaffection Scale; Skinner et al. 2008).

The goal of this design was to investigate the levels of student engagement so far and to see if there was any change in the levels of this variable after using the Makey Makey in the classroom.

Participants

This study was carried out at the IES Madina Mayurqa High School, the centre where the author was doing an internship for the masters in teacher training. The selected sample consisted of 104 first-year students (N = 104; median age = 12), of which 52 were from the control group (groups D, E, F, G) and 52 were from the experimental group (groups A, B, C, H). The questionnaires were answered during the music classes by both groups to ensure that everyone answered them.

Instruments

The data collection process was carried out through two questionnaires that collected indicators of student engagement and motivation. These were the SEI and the Engagement vs Disaffection Scale (Skinner et al. 2008, 2009).

The SEI (Appleton et al. 2006) collects data on student engagement at two levels: cognitive and psychological. According to Appleton et al. (2006), measuring these dimensions of engagement is important as excessive emphasis has been placed on academic and behavioural indicators. In addition, the literature suggests that high levels of cognitive and psychological engagement are associated with positive academic outcomes and increased motivation (Fredericks et al. 2016).

Figure 4 shows a diagram of the indicators of different types of engagement, which are (1) academic, (2) behavioural, (3) cognitive and (4) psychological. Indicators of the cognitive engagement variable include aspects related to self-regulation, goal-setting and perception of the relevance of learning in school for the future. Indicators of the psychological engagement variable include feelings of belonging and identification with the school.

The full version of SEI has 30 items measuring cognitive engagement and 26 measuring psychological engagement. However, in this study, a reduced version adapted to high school students was used, which has a total of 35 items (Appleton et al. 2006). All items are evaluated on a four-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). This questionnaire shows internal validity and consistency in relation to six subscales, which are (1) teacher–student relationships, (2) control and relevance of school work, (3) support from peers, (4) aspirations and goals for the future, (5) family support and (6) extrinsic motivation (Appleton et al. 2006, 2008).

The second questionnaire used was the Engagement vs Disaffection Scale (Skinner et al. 2008, 2009). It collects data on student engagement taking into account four dimensions: (1) behavioural engagement, (2) behavioural disaffection, (3) emotional engagement and (4) emotional disaffection. The theoretical basis for this questionnaire is the conceptualization of student engagement and disaffection through their active participation in class activities (Skinner
The underlying idea is that quality and meaningful learning is the result of behaviours and emotions such as effort, persistence and interest, which reflect a motivation to master the academic material at hand (Skinner et al. 2008).

Figure 5 describes the different indicators that define the different dimensions of this concept. Behavioural engagement can be reflected in student behaviours such as effort and concentration. Otherwise, disaffection at the behavioural level is reflected in passive behaviours, little effort, care and attention and distracted behaviours, among others. Emotional engagement is identified by feelings of enthusiasm, interest, satisfaction, pride in one’s work and vitality. At the other end are feelings of boredom, disinterest, frustration, anxiety, worry, shame and guilt.

To respond to the four dimensions of the concept of engagement and disaffection, the questionnaire consists of four subscales, which assess different indicators that evaluate student engagement at the behavioural and emotional levels (González-García et al. 2018). Students answer 24 questions using a four-point Likert scale, where 1 means that the item is not true at all, and 4 that the item is very true for the student. The items are organized into four subscales: (1) behavioural engagement (five items, with a .72 reliability index), (2) behavioural disaffection (five items, with a reliability index of .70), (3) emotional engagement (five items, with a reliability index of .84) and (4) emotional disaffection (nine items, with a reliability index of .84) (Skinner et al. 2008).
The impact of the use of technology on student engagement...

Procedure

The study took place during the third term of the 2020–21 academic year, with the acceptance of the music department and the principal’s office at the IES Madina Mayurqa. Once the proposal was accepted, the research procedure was initiated, which consisted of a first stage of data collection to establish the students’ baseline levels of engagement and motivation. Then six sessions were carried out using the Makey Makey. Each session was organized into three parts. The first consisted of an activation activity such as a dance or body rhythm activity. Then, at the core of each session and in groups of four or five people, the activities with the Makey Makey were carried out. The goals were to create a musical instrument with the material selected by the students, for them to differentiate between acoustic and digital sound, to create short musical fragments with selected musical notes and to perform a short music piece with it (see Appendix 2). Finally, the sessions closed with another body rhythm activity and a written reflection on the session, which participants had to write in their notebook and hand in at the end of the session. Once the sessions were over, a second phase of data collection was conducted through the same questionnaires to analyse whether there was any change in the levels of student engagement after the intervention. Finally, the data was entered into the SPSS programme to meet the stipulated objectives. The anonymity of participants was respected in both data collection and data analysis.

Figure 5: Motivational conceptualization of engagement and disaffection in the classroom (Skinner et al. 2008).

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<th>DISAFFECTION</th>
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<td>Behavioral Engagement</td>
<td>Behavioral Disaffection</td>
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<td>Action initiation</td>
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<td></td>
<td>Effort, Exertion</td>
<td>Giving up</td>
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<td>Attempts, Persistence</td>
<td>Withdrawal</td>
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<td>Intensity</td>
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<td>Attention, Concentration</td>
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<td>Absorption</td>
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<th>MOTION</th>
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<tr>
<td></td>
<td>Emotional Engagement</td>
<td>Emotional Disaffection</td>
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<td>Enthusiasm</td>
<td>Boredom</td>
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<td>Zest</td>
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2. See Appendix 2 for a more detailed description of the musical goals of the didactical unit.
Data analysis

Once all the data was collected, a quantitative analysis was performed with SPSS. Before proceeding with the analyses, the distribution of all variables was explored in relation to asymmetry, kurtosis, normality and atypical or extreme scores. The Kolmogorov–Smirnov normality test and the PPlot histograms and tests showed that the results did not deviate significantly from normality, except for the SEI questionnaire of the control group (pre- and post-intervention), which deviated significantly from normal, $D (52) = 0.188$, $P <.001$ (pre-intervention) and $D (52) = 0.213$, $P <.001$ (post-intervention). However, as recommended by Field (2018), normality indicators are not as important with small samples, as in this case the tests lose reliability and strength to detect deviations from normality (Field 2013: 346).

After testing for normality, the data was analysed using a paired sample test. This allowed us to compare the results of the questionnaires completed by the same participants at different times (Field 2013). In this case, the means of the SEI questionnaire and the Engagement vs Disaffection Scale questionnaire in the control group at the time before the intervention were compared with the means of the same questionnaires in the experimental group at the same time (pre-intervention). This procedure was repeated after the intervention (post-intervention).

A correlational analysis was conducted to understand which dimensions of the concept of engagement had the greatest impact on student engagement, assessed with the SEI and Engagement vs Disaffection Scale questionnaires. From the Pearson’s correlation test, we saw that it was the components of emotional ($r = .416; P <.001$) and affective ($r = .379; P <.001$) engagement that had a greater impact on student engagement. In addition, from the correlations of the SEI subscales, we observed that it was the support of the family that had a significantly greater correlation on the variable of affective engagement ($r = .734; P <.001$).

RESULTS

Appendix Table 1 shows the results of the paired sample test, which specifies the mean, the number of participants ($N$), the standard deviation (indicates whether the data is far from or close to the mean) and the standard error of the mean (indicates how likely the data is a representative sample of the population) of each group according to their status (experimental or control), the questionnaire used (SEI or Engagement vs Disaffection Scale) and the timing of intervention (pre- or post-intervention). Appendix Table 2 shows the results of the paired sample test, but in this case, it is specified whether the difference in means is statistically significant, that is, $P <.05$.

Consider the first research question: Does the use of technology in the music classroom help improve student engagement? The descriptive statistical data provided by high school students showed a significant difference between the means of the control and experimental groups, highlighting that the levels of engagement in the experimental group were higher than those of the control group after the intervention using the Makey Makey.

What we can observe in the data is that in the pre-intervention stage, the means of the control group (mean = 3.24 and 3.21 for the two questionnaires, respectively) and the experimental group (mean = 3.22 and 3.13 for the two questionnaires, respectively) did not show a significant difference. However, the comparison of means in the post-intervention stage showed
that the experimental group had a significantly higher mean than the control group. What is interesting to note is that in the post-intervention stage, while it is true that the mean of the experimental group increased, that of the control group also decreased. This fact shows that the difference in means was not only due to the intervention that was done in the experimental group but also due to a change in the means of the control group that went from 3.24 to 3.01 in the SEI, and from 3.21 to 3.00 in the Engagement vs Disaffection Scale.

Thus, taking this into account, what can be observed is that although the use of technology in the classroom had its role in increasing student engagement in the experimental group, it could not be concluded that the difference in the control group was solely due to the lack of intervention.

Now consider the second research question: *What dimensions of the concept of engagement contribute to its improvement?* From the data it can be observed that the dimensions with the greatest impact on student engagement were the emotional ($r = .416; P < .001$) and affective ($r = .379; P < .001$). Indicators of these dimensions include enthusiasm, interest, pleasure, satisfaction, pride, vitality, enthusiasm, self-awareness and regulation of one’s emotions. These results show that it was the emotional dimensions that had the greatest impact on student engagement.

In the following section, the significance and implications of these results will be analysed to then state the implications for future interventions and research.

**CONCLUSIONS**

As we have seen in the literature review, the expansion of technology in all areas of education has meant the transition from an analogue to a digital age, in which technological tools can cover a number of academic needs (Hrastinski et al. 2020). However, we have also seen that the integration of ICT in the classroom does not always imply an improvement in teaching–learning processes (Rodríguez-García et al. 2018). This is because the use of these resources must always be accompanied by efficient methodological and pedagogical principles and a joint effort by teachers (López-Gil et al. 2019). It is for this reason that the pedagogical approach that guides the integration of ICT in education remains a key issue that needs more research, as a paradigm and methodological approach is required focusing on achieving active, social, collaborative and meaningful learning (Chen et al. 2020). In order to achieve this, it is imperative to work and improve the training of teachers so that they have the necessary skills to facilitate the incorporation of ICT in the classroom in an efficient and effective way (Marín-Marín et al. 2020).

Along these lines, the use of robotics (e.g. *Makey Makey*) has been identified as a pedagogical resource that can improve autonomy, creativity, attention and even the development of social relationships between students (López-Belmonte et al. 2019). In addition, from a pedagogical point of view, it has the potential for developing computational thinking, improving cognitive processing and developing artistic skills and competencies (Gonzalez-Martinez et al. 2018; Marín-Marín et al. 2020).

This study aimed to investigate whether the use of technology in music classroom had an impact on student engagement and motivation. To do so, a robotic tool, the *Makey Makey*, was implemented as a pedagogical tool in the experimental groups and their levels of engagement were compared – before and after the intervention – to those of the control groups that did not
receive the same educational experience. In this case, the experimental groups had higher values in all the dimensions of engagement that were studied, compared to the control groups that received a more conventional method of instruction. On the other hand, there was more dispersion in the responses of the control group than in the experimental group, showing that there was more agreement in the group where an innovative educational experience was applied.

From the lenses of music pedagogy and the five pedagogical principles of Juntunen (2017), this study supports earlier findings that the use of technology in teaching motivates student participation by empowering agency through making a music product, enhancing social cohesion and inclusion and gaining musical knowledge through embodied learning. This tool allowed the students to explore the difference between acoustic and digital sound, collaboratively create their own musical instrument and musical fragments and perform a short musical piece. This study responded to the educational goals the author had set before starting the unit.

However, it is difficult to determine whether the difference in means between the two groups was due solely to the experience with robotics. To clarify this, it would be interesting to carry out a mixed-methods research to analyse, through qualitative methods and in more depth, which variables relating to the technological experience can have an impact on the engagement and motivation of students and why these occur.

On the other hand, in this study it is the emotional dimensions that had the greatest impact on the levels of student engagement. This fact is important when designing educational methodologies and interventions focusing on involving students on an emotional level and not just cognitive.

The perspective on the use of innovative methodologies in education seems positive in the sense that it allows future professionals to recognize how technology can contribute and play its role in education, especially to improve motivation, engagement, collaborative learning and creativity (Marín-Marín et al. 2020). However, this research has its own limitations. First of all, it is important to be aware that no sampling techniques were applied, as access to the sample was for convenience. Second, the person who applied the teaching method with the Makey Makey is the author of this study and also the one who carried out data collection. Finally, a quantitative study may not reflect all the dimensions and factors that affect the variables studied in this research design, and it would be interesting to conduct qualitative research to elucidate other aspects that influence student engagement and motivation.

**RECOMMENDATIONS FOR FUTURE RESEARCH**

With regard to future lines of research, we suggest that this teaching method be applied to other contents and educational areas with students of different ages. This will let us know its viability in other types of content, ages or educational stages. The fact that it can be applied to other contents and to students of different ages makes it interdisciplinary and versatile, offering endless possibilities for teaching and learning.

Despite the potential of this instrument as a methodological tool, more rigorous research is needed using experimental designs and quantitative and qualitative research methods to understand which other variables play an essential role in student engagement and motivation. Moreover, more research grounded in music pedagogy and music literature is needed.
## APPENDIX 1: TABLES

Table 1a: Paired samples statistics.

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APPENDIX 2: MUSIC GOALS

Educational goal 1: To use technological resources for music creation

- To create a musical instrument from day-to-day materials
- To create and present the instrument

Rubric scale

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</table>

Educational goal 2: To differentiate between acoustic and digital sound

Delivery of the classroom journal

Rubric scale

The student recognizes the basic elements that differentiate digital from acoustic sound.

The student keeps track of classroom activities and reflects on them.

Educational goal 3: To use different technologies to explore the possibilities of sound and for emotional and conceptual expression

To experiment – with some degree of autonomy – with the technological resources to discover the possibilities of sound and to create small musical fragments

Systematic observation

Anecdotal record

The student performs musical excerpts from the technological resources in the classroom.

The student participates in performing activities with a proactive attitude.

The student listens respectfully to classmates’ ideas.
REFERENCES


The impact of the use of technology on student engagement...


The impact of the use of technology on student engagement...


SUGGESTED CITATION

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