European Proceedings of
Educational Sciences
EpES

www.europeanproceedings.com

e-ISSN: 2672-815X

DOI: 10.15405/epes.23056.28

ERD 2022
Education, Reflection, Development

CREATIVITY PEDAGOGY: STUDENTS' EXPRESSION THROUGH MUSIC AND PROGRAMMING

Marius Bănuț (a)*, Ion Albulescu (b), Anca Simion (c)
*Corresponding author

(a) Babes-Bolyai University, Faculty of Psychology and Educational Sciences, 7 Sindicatelor Street, Cluj-Napoca, Romania, marius.banut@ubbcluj.ro
(b) Babes-Bolyai University, Faculty of Psychology and Educational Sciences, 7 Sindicatelor Street, Cluj-Napoca, Romania, ion.albulescu@ubbcluj.ro
(c) National Academy of Music „Gheorghe Dima", 25 Ion I. C. Brătianu Street , Cluj-Napoca, Romania, ancasimion1@gmail.com

Abstract

Cognitive processes include creative thinking, and the practical aspects of competence reveal the creativity of the person. Imagination and creative thinking are interconnected, and these abilities favor the visibility of creativity because creativity is a concrete form which imagination and creative thinking lead to. Creative teaching, in essence, is a path to creative pedagogy, which has a much broader meaning. In the case of music education, the result of the student's imagination can be a musical creation. Composing digital music is a new way of creating music, and translating it into a creative activity in school is a relevant step for the digital age, for music and computer education and also for creating students' learning processes after the model of transposing creativity in the form of finished products. Programming, similar to interpersonal communication, is a way of communication with more and more objects around us that have a microprocessor and thus become smart objects, so that we could say about programming that it is a smart communication, in the sense of expressing ideas. The study aims to observe whether students, at the end of primary education, in the fourth grade, have the ability to express themselves creatively through music and programming. The participants in the educational project made a series of audio-digital products. The product analysis of the students' activity provides information about the fact that they have formed a creative way of thinking, as a result of the creative pedagogy determined by the music-programming curriculum they took part in.

Keywords: Creativity pedagogy, creative pedagogy, creative thinking, creative teaching, Sonic Pi

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

For children, a stick or a pencil is a magic wand, and toys have life. At an early age, this is not just an evanescent mood but a behavior, a creative habit. The creativity they prove could propel the training of future adults. “Everyone has creative thinking skills and ideas, but children have more because they are not yet fully aware of rigid logic and convergent views. They are divergent, open, inventive and playful, which are features of creativity” (Kampylis & Berki, 2014, p. 6). Therefore, children have important attitudes that can be capitalized on before they fade with age.

As a training perspective for future adults, “in the context of the European Qualifications Framework, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments)” (Vuorikari et al., 2016, p. 39). Therefore, cognitive processes include creative thinking, and the practical aspects of competence reveal the creativity of the person, which a professional, a qualified or a competent person needs. Within the educational process, which lays the foundations of skills and prerequisites for future stages in the development of the person, such as qualification on the labor market, “creative thinking is defined as the thinking that enables students to apply their imagination to generating ideas, questions and hypotheses, experimenting with alternatives, and to evaluating their own and their peers’ ideas, final products and processes” (Kampylis & Berki, 2014, p. 6). Therefore, imagination and creative thinking are interconnected, and these abilities favor the visibility of creativity because creativity is a concrete form which imagination and creative thinking lead to.

Creativity is also an issue that a teacher must insist on, and the way in which creativity supports learning objectives is highlighted in Anderson and Krathwohl's revised 2001 version of Bloom's original taxonomy from 1956 (Krathwohl, 2002). This now includes creativity in the structure of the importance of cognitive processes, placing it at the top of this structure, as the most refined ability to think. The revised version is structured on two dimensions, presented in Table 1, the nouns representing the dimension of Knowledge, and the verbs or action words, representing the dimension of Cognitive Processes. “These action words describe the cognitive processes by which thinkers encounter and work with knowledge” (Armstrong, 2010, p. 2).

Table 1. The Structures of the Dimensions of Knowledge and Cognitive Processes in the revised version of Bloom's Taxonomy (Krathwohl, 2002)

Knowledge Dimension	Cognitive Process Dimension
A. Factual Knowledge - The basic elements that students must know to be acquainted with a discipline or solve problems in it.	**1.0 Remember –** Retrieving relevant knowledge from long-term memory**.**
Aa. Knowledge of terminology	**1.1 Recognizing**
Ab. Knowledge of specific details and elements	**1.2 Recalling**
B. Conceptual Knowledge – The interrelationships among the basic elements within a larger structure that enable them to function together.	**2.0 Understand –** Determining the meaning of instructional messages, including oral, written, and graphic communication**.**
Ba. Knowledge of classifications and categories	**2.1 Interpreting**
Bb. Knowledge of principles and generalizations	**2.2 Exemplifying**
Bc. Knowledge of theories, models, and structures	**2.3 Classifying**
C. Procedural Knowledge - How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.	**2.4 Summarizing**
	2.5 Inferring
	2.6 Comparing
	2.7 Explaining

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

Ca. Knowledge of subject-specific skills and algorithms **Cb. Knowledge of subject-specific techniques and methods** **Cc. Knowledge of criteria for determining when to use appropriate procedures** **D. Metacognitive Knowledge** - Knowledge of cognition in general as well as awareness and knowledge of one's own cognition. **Da. Strategic knowledge** **Db. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge** **Dc. Self-knowledge**	**3.0 Apply –** Carrying out or using a procedure in a given situation**.** **3.1 Executing** **3.2 Implementing** **4.0 Analyze –** Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose**.** **4.1 Differentiating** **4.2 Organizing** **4.3 Attributing** **5.0 Evaluate –** Making judgments based on criteria and standards**.** **5.1 Checking** **5.2 Critiquing** **6.0 Create –** Putting elements together to form a novel, coherent whole or make an original product**.** **6.1 Generating** **6.2 Planning** **6.3 Producing**

As shown in Figure 1 and "like the original Taxonomy, the revision is a hierarchy in the sense that the six major categories of the Cognitive Process dimension are believed to differ in their complexity, with remember being less complex than understand, which is less complex than apply, and so on" (Krathwohl, 2002, p. 215). Thus, at the top of this hierarchical structure of cognitive processes, which ranks them to the highest degree of thinking skills, is creativity.

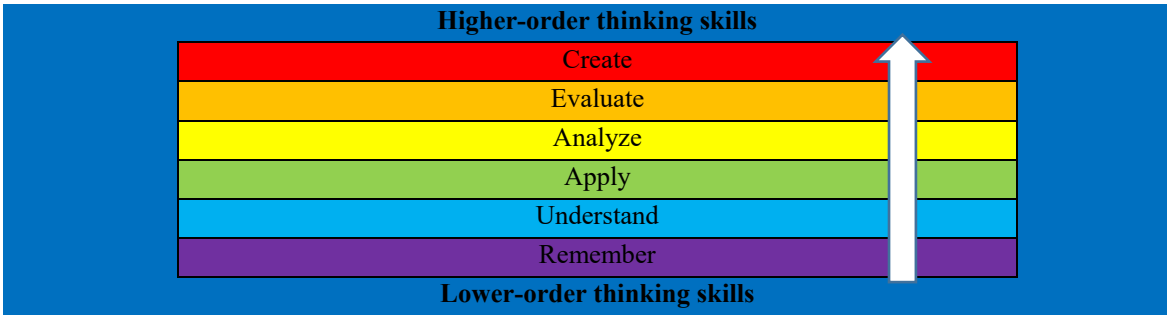

Figure 1. Hierarchy of thinking skills in the revised version of Bloom's taxonomy

In relation to higher-order cognitive processes, "the concept of creative thinking paved the way for creative pedagogy" (Aleinikov, 2013, p. 330). Creative pedagogy thus appeals to the verb to create to "find alternative ways to evaluate achievement and invent instructional objectives that are based on thinking, learning, and practical performance" (Hamza et al., 2000, p. 70), the practical performance being the one that will display the creativity of the students. Taking into account the aspects mentioned above, teachers have an important role in removing routine classroom activities and replacing them, through creative teaching, with experiences that have capitalized on students' imagination and encouraged original thinking (Muirhead, 2011).

Creative teaching, in essence, is a path to creative pedagogy, which has a much broader meaning. Like concepts, "as opposed to creative teaching, creative pedagogy is a philosophy, theory, and methodology with a theoretically predetermined sequence of activities that leads to the accelerated child's (or adult's) creative development – not just the teacher's own creative practice in the classroom"

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

(Aleinikov, 2013, p. 327). Therefore, a creative pedagogy goes beyond the limits of creative teaching because it allows the display of students' creativity and contributes to their development, since " creation processes involve cognitive change" (Koper, 2014, p. 13). Thus, "creative pedagogy is the science and art of creative teaching" (Aleinikov, 2013, p. 327), whose praxiological character aims at the effectiveness behind the act of teaching, in terms of increasing problem-solving skills, the development of creative thinking along with the expression of creativity through creative ideas and products.

2. Problem Statement

In order to connect the educational process to post-school life, for educational purposes aimed at the autonomy of future adults in the sense of creatively solving problems arising from the complexity of life "creative pedagogy teaches students to create their own learning processes for continuous success in their lives" (Aleinikov, 2013, p. 328). This means that in creating their own learning processes, students will discover and capitalize their imagination and creativity, and imagination and creativity are used with a well-defined purpose for the realization of tangible and final objects (Simion, 2022). Along these lines, creative thinking allows the application of imagination, and this leads to a creative product, a context in which creativity becomes evident. For example, in the case of music education, the result of the student's imagination may be a musical creation, in the sense that creativity takes the form of a product. The concrete form of the musical material is a consequence of the fact that:

> Creative thinking, then, is a dynamic mental process that alternates between divergent (imaginative) and convergent (factual) thinking, moving in stages over time. It is enabled by internal musical skills and outside conditions and results in a final musical product which is new for the creator (Webster, 1990, p. 28).

In this way, creativity has been revealed, only that, in terms of new music products, there is a trend that young people follow, listen to, being about electronic music, digital music. Composing digital music is a new way of creating music, and translating it into a creative activity in school is a relevant step for the digital age, relevant for music and computer education of students and also relevant for creating their own learning processes after this model of transposing creativity in the form of finished products.

Expressing creativity through creative products is a feature of creative pedagogy, and Kaufman and Beghetto (2009, as cited in Muirhead, 2011) have developed a four-category creativity prototype, called the *Four C Model of Creativity*. The first two categories *Big-C* and *Pro-C* are reserved for brilliant minds, geniuses, respectively professionals of a certain field of activity, but the last two are related to the teaching-learning process. Thus, the third category was called *Mini-C* and refers to personal creativity, a dynamic and an evolving process of building personal knowledge, and the fourth, *Little-C*, is inherent in the teaching-learning process, all students having a dose of creativity. The last two categories are subordinated to creative pedagogy, especially the *Mini-C* category, because these aim at building knowledge starting from personal creativity, this beeing a strong interrelation of the two dimensions of Bloom's revised taxonomy, the dimension of Cognitive Processes with the dimension of Knowledge,

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

meaning those possibilities through which creative thinking will participate in building the student's personal knowledge.

Today, assessment design is oriented to the lowest level of the taxonomy with a focus on what students can reproduce, this being the opposite part of problem solving that it doesn't measure any level of creativity and without linking the educational process to future performance (Ben-Jacob, 2017, p. 49). In the teaching-learning process, to foster the development of creative problem-solving skills, according to Sternberg (2003, as cited in Muirhead, 2011), it is necessary to minimize the time allocated to students to use lower-order thinking skills that put pressure on memory. Because the act of creating involves the highest form of thinking ability, then it is important to arouse creative thinking through education, and in this regards, Parnes (1992, as cited in Aleinikov, 2013) argues that creative problem solving is a basic pillar of creative pedagogy.

For this didactic problem and in trying to find an adequate homogenity in the cognitive processes triggered by the teaching-learning process, by challenging and increasing the creative manifestations, as a strong point that reflects an important feature of learning, we rely on creative thinking supported both by digital technologies, more precisely computer programming, as well as arts, respectively music. "Another important rationale is that coding skills help to understand today's digitalised society and foster 21st century skills like problem solving, creativity and logical thinking" (Balanskat & Engelhardt, 2015, p. 6). In terms of creativity, the presentation of digital competence in the EU Recommendation on Key Competences for Lifelong Learning emphasizes the importance of understanding "how digital technologies can support communication, creativity" (Council of the European Union, 2018, p. 9). Programming, similar to interpersonal communication, is a form of communicating with more and more objects around us that have a microprocessor and thus become *smart* objects, so that we could say about programming, in this way and in the sense of expressing ideas, that it is a *smart* communication. Programming is also a concrete expression of creativity, because it has the ability to turn conventional objects into *smart* objects (eg, programming has turned the ordinary watch into a smartwatch). In terms of programming and music, "creative thinking can be taught by providing children with chances to explore musical images and by applying them in problem solving tasks. Technology may play an important role in our teaching strategy" (Webster, 1990, p. 28). Webster's perspective fully resonates with the definition of specific sub-competencies in the *Digital Competence Framework for Citizens*, DigComp, where creativity is associated with problem solving. The last area of competences, *5. Problem solving*, includes *5.3. Creative use of digital technologies* competence, which involves individuals "to use digital tools and technologies to create knowledge and to innovate processes and products" (Vuorikari et al., 2016, p. 9). In fact, stimulating creativity leads to opportunities and implications for the development of all key competences, including digital competence, respectively programming, a distinct competence within the digital competence. Digital competence is most effectively developed through hands-on learning, but most often it involves learning to use some applications, which is a short-term gain, given that all applications are updated and modified at a fast and steady pace. "Therefore, students must also learn the logical, systematic thinking of programming and basic infornmtion systems theories in order to transfer domain-specific knowledge to newly acquired information-thus, connecting prior knowledge to new knowledge in a meaningful way" (Hamza et al., 2000, pp. 70-71), such as the transfer of conceptual and

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

procedural knowledge specific to programming in school, in different curricular areas or through interdisciplinary approaches, the context of composing audio-digital music being an example and in the same way, outside school, to a future job, programming offering creative solutions to problems of various contexts. In this sense, the age at which students can begin to express themselves through music and programming is an aspect to consider.

Music and digital technology present a meaningful perspective for learning experiences, in the sense that it highlights creativity, and this is a favorable circumstance for the teaching-learning process. Creative thinking as a superior thinking skill, stimulated with the help of digital technologies, can help students not only to evolve in the field of music and make audio products but also to use their imagination, multilaterally, making a much wider range of creative products. Rominger recalls that:

> This is congruent with the assumption that at later stages of the creative thinking process, prepotent, obvious, and common ideas are inhibited and memory content is integrated in the generation of new ideas, which presumably leads to more creative outcomes (Rominger et al., 2019, p. 1013).

In other words, creative thinking is like a snowball that takes on proportions as it is set in motion, and creative pedagogy that values and stimulates creativity integrates the content of memory into creative processes, which can lead to more valuable learning outcomes.

3. Research Questions

The research hypothesis starts from the presumption that if the teaching act capitalizes on students' creativity and imagination through music and programming, then an efficiency is identified in the development of students' creative thinking, which covers both dimensions of creative teaching and learning of creative pedagogy. In this sense, the research questions are:

i. Are characteristics of creative thinking reflected in the products made as a result of integrated music-programming activities?
ii. Are primary school students able to express themselves in a creative way through music and programming?
iii. Does the didactic approach transcend, through music and programming, beyond the act of teaching, towards the creative pedagogy, aiming at the creative development of the students through learning?

4. Purpose of the Study

The study aims to observe whether students, from the end of primary education, in the fourth grade, have the ability to express themselves creatively through music and programming. In order to observe characteristics of creative thinking in students, an educational project oriented to creative pedagogy was applied during Music and movement classes, shifting the focus from conventional learning activities such as listening and performing music with the voice to integrated music-programming creative activities, because music means not only training the voice or reproducing the works made by

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

other people (even if that are musical products from the cultural heritage), but it also means training the skills of creative thinking. In this regard, Váradi states, among other things, that "if children do not know the joy of creating, [...], than they will not be educated into music" (Váradi, 2018, p. 67). In the instructional design of music education "a requirement from the program is the use of musical toys in various forms, which is a contribution to the naturalness, exuberance, creativity and spontaneity of children in their musical manifestation" (Ministerul Educației Naționale [MEN], 2014, p. 10). For this purpose, a computer, which is a tool loved by children, can reproduce various instrumental timbres. That is why it can be turned into a musical toy. It becomes a context in which music and the computer can work together for the creative manifestation of students, needing only creative exercises. Because "creative exercises make learning relevant and foster an environment that promotes a life-long love for knowledge" (Muirhead, 2011, p. 1), learning methods based on practical action were used, the exercises being made through the Sonic Pi learning tool, application made in 2013 (Aaron et al., 2016), for a UK curriculum which at that time was oriented towards computing. The musical possibilities offered by the Sonic Pi application, beyond the advantages refering to a better knowledge of the computer, resonate with the educational requirements expressed through the curriculum of the discipline Music and movement that highlights the fact that "this stage of schooling represents an important moment for stimulating the flexibility of thinking, as well as the creativity of the student" (Ministerul Educației Naționale [MEN], 2014, p. 10), context in which the chapter on teaching strategies specifies what should be emphasized in the lessons, recalling that "the emphasis will be on the spontaneity and creativity of the students's ideas / messages / manifestations" (Ministerul Educației Naționale [MEN], 2014, p. 10). In order to stimulate the flexibility of thinking and the creative manifestation of the students, the predominant learning activity was the improvisation of some songs with the help of the Sonic Pi application.

To this end, in order to determine, stimulate and monitor creative abilities at fourth grade students, the first author designed and taught an music-programming curriculum, which integrated the content units of the curriculum related to the discipline of Music and movement, with contents specific to the IT field, especially being approached basic structures of programming languages. The curriculum had 24 lessons of one hour per week and was implemented during the Music and movement classes through a county educational project entitled Music and Programming. Development for life and for the future (Bănuț, 2020). The study aims to evaluate such a model of integrated education, music-programming, from the perspective of creative pedagogy, the projection of learning objectives aimed at higher cognitive processes along with the instructional design for a creative teaching, and quantifying the results learning about the creative development of students' thinking. The specific objectives, for the students who went through the creative curriculum based on practical-applicative learning activities, were:

i. To remember sound qualities, instructions and basic programming structures;
ii. To differentiate certain musical characteristics (pitch, duration) so that this can be assigned to computer instructions;
iii. To integrate elements of musical language into computer programming language;
iv. To create their own, age specific, melodic-rhythmic fragments using the computer as a musical toy;
v. To accompany their own songs, actively participating with body percussion;

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

vi. To appreciate their own creations, as well as the ones of their colleagues.

Based on the information concentrated by Bloom's revised taxonomy, the instructive-educational process was planned and carried out towards objectives from the top of the described hierarchy (objective O4), which involve the most refined cognitive processes that the present study aimed to observe. From this perspective, in Table 2, the 6 specific learning objectives listed above were examined. For this purpose:

> In combination, the Knowledge and Cognitive Process dimensions form a very useful table, the Taxonomy Table. Using the Table to classify objectives, activities, and assessments provides a clear, concise, visual representation of a particular course or unit. Once completed, the entries in the Taxonomy Table can be used to examine relative emphasis, curriculum alignment, and missed educational opportunities (Krathwohl, 2002, p. 218).

Table 2. Examination of specific objectives, depending on the level of cognitive processes involved, using the Taxonomy Table

Metacognitive Knowledge						O4
Procedural Knowledge		O5	O3, O5			
Conceptual Knowledge	O1					
Factual Knowledge				O2	O6	
Dimensions	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**

The oscillation along the variety of cognitive processes takes place because Objective 1, analyzing it, starts from cognitive memory processes which, in terms of sound qualities refers to knowing the categories of sound parameters and classifying the variability of these parameters, and in basic programming structures refer to the knowledge of the most popular structures of programming languages, both of which are subordinated to conceptual knowledge. Then, O1 is placed at the intersection of conceptual knowledge with memory. Objective 2 uses the action word differentiation, being placed in the fourth category of cognitive processes, analysis, and the differentiation of certain musical characteristics requires knowledge of their basic elements, which distinguish them from the rest and which belongs to factual knowledge. O2 is located at the intersection of factual knowledge with analysis. The key word in Objective 3, integration is synonymous with implementation, a cognitive process that belongs to the level of application. The integration of musical language elements into programming language is a matter of skills where procedural knowledge is involved. Therefore, O3 is common to the dimensions of procedural knowledge and cognitive processes of level 3, application. Objective 4 requires students to make their own musical products, original, specific to their level of development, setting in motion cognitive processes of creation, level 6. Making one's own melodic fragments through programming, in this case, means that the student will use what he knows, what he feels, what he likes and what he can achieve,

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

aspects whose accounting makes the internal portrait of his own person and whose awareness represents self-knowledge, an aspect that goes beyond the boundaries of procedural knowledge and is related to the category of metacognitive knowledge. Therefore, O4 is the meeting point of the dimensions of metacognitive knowledge with cognitive processes in the sphere of creative thinking. Within the Objective no. 5, the accompaniment of the audio material with body percussion requires the execution of certain movements, but for a successful mixture of movement with music it is necessary to interpret the audio result of their own musical creations. Therefore, execution and interpretation involve a combination of level 2 and 3 cognitive processes, understanding and application, which will lead this goal on two positions in the table. Although body percussion is a game-type practice, it involves the knowledge and correct determination of when it should be applied, elements characteristic to the category of procedural knowledge. This objective, in terms of resonance with two levels of cognitive processes, intersects understanding and application with procedural knowledge. In the last learning objective, the appreciation of one's own creations as well as those of colleagues represent actions of self-evaluation and inter-evaluation, ie cognitive processes in the field of evaluation, which involve a factual knowledge, alternating between knowledge of basic elements and details. Therefore, O6 is located at the intersection of cognitive processes characteristic of evaluation with factual knowledge.

The table with the analysis of learning objectives, in terms of knowledge and cognitive processes involved in the instructional-educational process, reflects the opportunities promised by the creative pedagogy of the music-programming curriculum. Trends in specific learning objectives largely involve cognitive processes associated to high levels of thinking, reaching the maximum level on this dimension through creative actions.

5. Research Methods

Participants in the county educational project, Music and programming. Development for life and for the future, have made a series of audio-digital products. These materials represent products of the integrated music-programming activity and, at the same time, creativity products of the research subjects. The materials were collected in a class portfolio, which will be used in conducting this research. Therefore, the research method is the analysis of the products of the students' activity, and the research tool, through which the data necessary for the analysis were collected, was the portfolio.

5.1. Participants and research design

The participants of this research were the students of a single fourth grade, from a school in the urban area (Cluj-Napoca, Romania). The class consisted of 25 students (N = 25), aged between 10 and 11 years, at the end of the educational project, which coincided with the end of the school year 2020-2021, and at that moment students had an average age of 10.64 years (M = 10.64).

The period of time the project took place in was November 2020 - June 2021, a period in which the 24 lessons of the project took place. The period was marked by the Covid-19 pandemic, and some of these lessons were conducted exclusively online.

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

During the 24 lessons there were 8 stages in which, based on the new assimilated knowledge, the students made individual or group melodic creations. The research aims to carry out a qualitative analysis of these products, taking into account aspects related to:

i. The final product: an audio-digital product, material ans also intellectual product;
ii. The process of making the product, in this case the way the data of the music program was processed;
iii. The teaching-learning process characteristic to creative pedagogy, the creative teaching approach and its effects.

5.2. Class portfolio

A total of 30 audio-digital products were made, in class, during the project and were uploaded on the Wakelet platform (Bănuț, 2020), which allows saving, organizing, publishing and distributing the content. Figure 2 is a screenshot of the page where the students' creations were published.

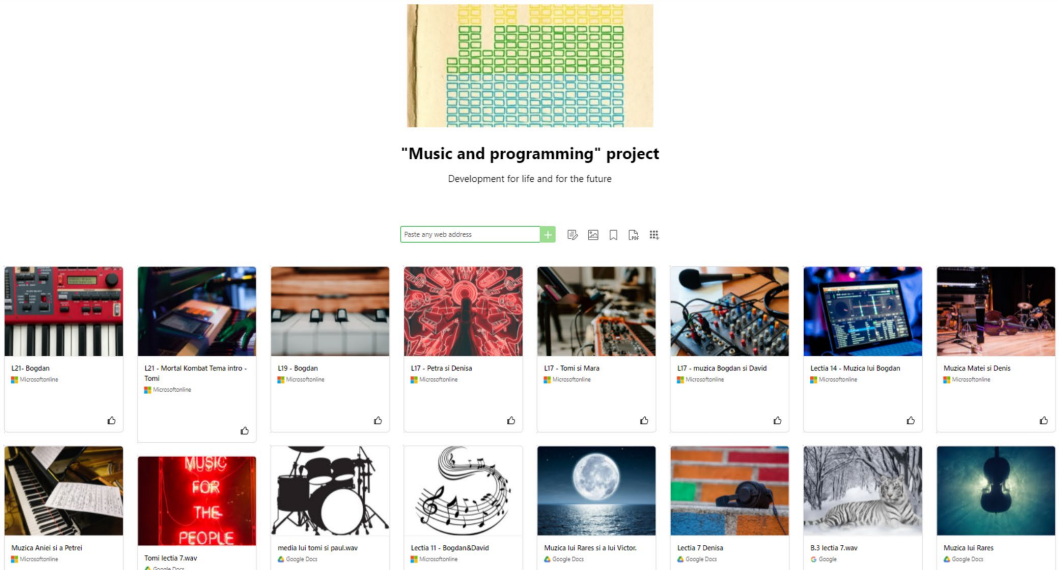

Figure 2. Wakelet portfolio page with the products of the integrated music-programming activities, available at the web address: https://wke.lt/w/s/ilbEek (Bănuț, 2020)

6. Findings

6.1. Analysis of the products of the students' activity as a musical product

Generally, children like to sing and dance. Fun and laughter are essential for well-being. Introducing children's music from an early age can help develop their positive feelings and trigger the process of creativity. Learning music and creating their own musical notes is in itself a creative process. Children who are well acquainted with the process from the beginning can be introduced to the creative path later in life, which also helps them to develop academically. Making musical products with the help of song creation programs will stimulate children's creativity. Improving musicality is one of those things that don't have a formula. Many people develop their own musicality with the guidance of a teacher;

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

however, we are seeing more and more cases of self-taught musicians doing their work and finding their voice in their own way.

During the music and programming classes through the game of music creation students can make a song starting from a given theme, anchor sounds: Do-Mi-Sol-Do2, words from the spectrum of universal emotions (eg love, sadness, joy) , images (eg nature), school or out-of-school events. At the same time, in order to make a coherent piece, a minimum set of rules will be taken into account: the framing in certain times to get an authentic product, the chosen theme, the number of instructions used in the text messages for the computer.

By getting involved in the evocative and suggestive language of music, a child's mind can open up in extraordinarily creative and imaginative ways. Children can also learn acceptance and flexibility, because two listeners will not hear the same message in a piece of music. Young people will gather amazing and equally valid things from learning how others hear music, opening the doors to the worlds inside them and strengthening empathy and imaginative collaboration.

Sonic abstraction gives children the chance to move into a unique world where they are encouraged to express themselves and make their own music. Mimicry and imitation in the early years turn into interpretation, improvisation, composition and critical listening. The ultimate goal is for each student to find their own inner voice, in terms of expressing imagination and ideas, as well as the musical ear through music.

In the analysis of the students' activity products, as a musical product, we started from the assumption that the musical value of the audio materials made by the students does not matter too much because they do not come from a vocational school, reason for which it will be difficult to obtain songs with stylistic value. Contrary to this assumption, it was found that the products made by students are above expectations. Some of them were whimsical. For example, in certain products students started from works belonging to cultural heritage, such as Ludwig van Beethoven's Ode to Joy, but through their own influences a product with a new vibe resulted, such as Muzica lui Rares or another version of the same product by simply changing the tempo (Muzica lui Rares si a lui Victor). Also, the music creation game was implied, starting from a theme from the children's universe, a popular video game among them, and the final product was published under the title L21 - Mortal Kombat Tema intro - Tomi. Other coherent songs, extraordinarily creative and wich left us an extremely pleasant impression, authentic in the final form are: L17 - Tomi si Mara, L17 - muzica Bogdan si David or media lui tomi si paul.wav. The creativity pedagogy triggered the process of creativity, and the project participants who were just over 10 years old expressed their imagination through music and programming in a surprisingly pleasant way, developing academically.

6.2. Analysis of students' activity products as a data operating process

Another assumption was that no matter what the audio product sounds like, the way it was obtained will certainly be valuable. So, beyond the musical value of the students' products, who proved through their musical improvisations that they were small musician amateurs, when we consider the process by which they obtained these audio materials, the exceptional thing is that they can obtain such products through a programming language, proving, in this way, that they are great digital artists. In order

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

to analyze the portfolio products as a data operating process, we will analyze the source code for one of the students' creations, following the processed sound information and the process of obtaining it. In this sense, the product with the name L17 – muzica Bogdan si David was selected, an audio material made in collaboration by two of the students included in the project and which has a brief code, but with essential and valuable information:

```
in_thread do
  loop do
    sample :drum_bass_hard
    sleep 1
  end
end

in_thread do
  loop do
    sample :drum_bass_soft
    sleep 0.5
  end
end
play 62
sleep 0.5

define :prima do
  2.times do
    use_synth :fm
    play 60
    sleep 0.5
    play 67
    sleep 0.5
    play 63
    sleep 0.5
    play 62
    sleep 0.5
  end
end
prima

define :adoua do
  2.times do
    use_synth :fm
    play 59
    sleep 0.5
    play 59
    sleep 0.5
    play 67
    sleep 0.5
    play 67
    sleep 0.5
    play 63
    sleep 0.5
    play 57
  end
end
adoua

define :atreia do
  2.times do
```

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

```
   use_synth :fm
   play 67
   sleep 0.5
   play 70
   sleep 0.5
   play 70
   sleep 0.5
   play 64
   sleep 0.5
   play 67
   sleep 0.5
   play 60, release: 0.75
  end
end

atreia
sleep 2
prima
sleep 1
adoua
sleep 1
atreia
```

In order to achieve the O4 learning objective, the creation of the presented musical fragment being part of this situation, it was necessary to objectify the learning results in terms of O1-O3, ie differentiating sound qualities along with differentiating basic programming structures, retaining them, as well as the integration of sound information into the instructions used in computer text messages. This way, students demonstrated the functionality of developed creative thinking, through this practical activity in which they used and transformed notions and elements of musical language, such as sound pitch (play 67), sound duration (release: 0.75) or sound timbre (use_synth :fm), in reliable information that can be perceived by the sensory system.

Regarding the synthesis of sounds in digital context, using programming as a technique for electronic generation of sounds, through sound parameters such as those presented earlier, certain basic programming principles and structures were used. In this case, the students put into practice a series of programming concepts, such as: threads (in_thread do […] end), repetitive structures (2.times do […] end), loops (loop do […] end) or functions (define :prima do […] end). But what is at stake with these codes? Exactly the same programming techniques, which students' musical fragments were obtained with, can be used to create websites or web applications. This aspect is also really important, because many jobs in the future will be occupied by machines equipped with artificial intelligence, and man, in this context, has the role of managing these machines, of programming them, the consequence being that the jobs of the future will rely on programming.

The analysis of the product of the students' activity, as a data operating process, provides valuable information for the digital competence developed by the students, as well as a transversal competence in this situation and, at the same time, provides information about the fact that they have formed a creative way of thinking as a result of creative pedagogy determined by the music-programming curriculum they took part in.

https://doi.org/10.15405/epes.23056.28
Corresponding Author: Marius Bănuț
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

7. Conclusion

Beyond the level of strict investigation of the creativity of the students' activity products, in the ascertaining form of analysis of the educational project portfolio, this research offers indicators about the whole process of educational activity characteristic to creative pedagogy, in which the creative teaching approach led to the students development effect from small musician amateurs to great digital artists.

Creative thinking is, this way, aroused through the music-programming curriculum and fixed within the limits of the school curriculum, through examples of creative pedagogical practices and interdisciplinary activities. The improvisation of audio materials incorporates creativity in the curriculum, trains superior thinking skills, and when put in motion through digital technologies, digital competence is also trained. The audio-digital content obtained is the finished product of creative thinking. Teachers can, among other things, evaluate students based on the creativity demonstrated in completing the task. “Educators need to refer to Bloom’s Taxonomy and focus on assessing the type of work that supports creativity and independent learning” (Ben-Jacob, 2017, p. 48).

Creativity sucessfuly processes the knowledge dimension of music and programming, fitting into the Mini-C category of the creativity model of Kaufman and Beghetto (2009, as cited in Muirhead, 2011), in which personal creativity leads a process of perpetuum mobile type, of building personal knowledge. In such a process, the audio-digital products from the portfolio analyzed by the present research were made, which, in fact, represent the concretization of students' imagination through music and programming and, to the same extent, represent the concretization of students' creative thinking. Thus, programming is a form of communication that works not only between programmer and computer, but also in various other situations, artistic communication and expression of ideas in this form being a remark of the analysis of the product portfolio. Personal knowledge, creativity, imagination or the expression of ideas are gateways to self-knowledge, a derivative of metacognitive knowledge which, together with creative thinking, represent the higher levels of the Knowledge and Cognitive Processes Dimensions and which can be attributed as replicas of creative pedagogy.

This power to create, in the human-computer relationship, is a binomial capacity to produce. People, unlike computers, are creative, and computers are able, unlike humans, to execute extremely many instructions in a second, but they only execute those instructions that man transmits to them and for this reason the human-computer relationship, which combines human creativity with logic and the performance offered by the computer, is a booster for productivity. The final audio-digital products made by students are, in fact, products of learning music and programming, situation in which the productivity booster produces effects in learning. In order to increase the creative thinking and display the creativity of the students, the O5 objective develops the learning activity, by accompanying their own creations with body percussion and emphasizes the expression of ideas through the finished products made by music and programming.

In the context in which “the ideas will become more popular due to the creative thinker's determination and skill at persuading others to value and accept the unique ideas” (Muirhead, 2011, pp. 2-3), the O6 learning goal promotes, through self-assessment and inter-evaluation, supporting unique expressed ideas. In conclusion, the learning objectives formulated previously present that praxiological

character of creative pedagogy, which through creative teaching determines increases or renewals of teaching effects in terms of increasing problem-solving skills, development of creative thinking, expression of ideas as a form of materializing students' imagination and developing the capacities of makeing creative products. The approach of teaching as creative teaching is as important as the taught contents, if it arouses creative thinking, and teaching an integrated music-programming curriculum determines learning experiences under the umbrella of creative pedagogy.

Acknowledgments

The authors would like to thank Daniela Oaida for her support, the teacher for primary education of the class where the filfillment of lesson plans and activities of the integrated music-programming curriculum took place, as well as the participating students.

References

Aaron, S., Blackwell, A. F., & Burnard, P. (2016). The development of Sonic Pi and its use in educational partnerships: Co-creating pedagogies for learning computer programming. *Journal of Music, Technology & Education, 9*(1), 75-94. https://doi.org/10.1007/978-3-319-63808-9_13

Aleinikov, A. G. (2013). Creative Pedagogy. *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship*. Springer. https://doi.org/10.1007/978-1-4614-3858-8_13

Armstrong, P. (2010). *Bloom's Taxonomy*. Vanderbilt University Center for Teaching; Vanderbilt University. https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Balanskat, A., & Engelhardt, K. (2015). *Computing our Future: Computer Programming and Coding. Priorities, School Curricula and Initiatives across Europe*. European Schoolnet, Bruselles, Belgium. http://www.eun.org/documents/411753/817341/Computing+our+future_final_2015.pdf

Bănuț, M. (2020). *"Music and programming. Development for life and for the future" - Project*. Wakelet. https://wakelet.com/wake/MjHmKmz4ohSyRf89i8BST

Ben-Jacob, M. G. (2017). Assessment: Classic and Innovative Approaches. *Open Journal of Social Sciences, 5*, 46-51. http://doi.org/10.4236/jss.2017.51004

Council of the European Union. (2018). Council recommendation of 22 May 2018 on key competences for lifelong learning (2018/C 189/01). *Official Journal of the European Union*. https://eur-lex.europa.eu/legal-content/RO/TXT/PDF/?uri=CELEX:32018H0604(01)&from=EN

Hamza, M. K., Alhalabi, B., & Marcovitz, D. M. (2000). Creative pedagogy for computer learning: eight effective tactics. *ACM SIGCSE Bulletin*, *32*(4), 70-73. https://doi.org/10.1145/369295.369335

Kampylis, P., & Berki, E. (2014). *Nurturing creative thinking*. Geneva (Switzerland): International Bureau of Education (UNESCO) in *collaboration with the International Academy of Education* (IAE). JRC81937

Koper, R. (2014). Conditions for effective smart learning environments. *Smart Learning Environments, 1*(1), 1-17. https://doi.org/10.1186/s40561-014-0005-4

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into practice, 41*(4), 212-218. https://doi.org/10.1207/s15430421tip4104_2

Ministerul Educației Naționale. (2014). Programa școlară pentru disciplina [The school curriculum for the object]. *Muzică și mișcare* clasele a III-a - a IV–a și aprobată prin Ordinul MEN nr. 5003/02.12.2014 [Music and movement, grades III – IV, approved by Ministry of Education Order no. 5003/02.12.2014]. http://programe.ise.ro/Portals/1/Curriculum/2014-12/28-Muzica%20si%20miscare_clasele%20a%20III-a%20-%20a%20IV-a.pdf

Muirhead, B. (2011). Utilizing Creative Pedagogy. *Journal on Educational Psychology*, *4*(4), 1-10.

Rominger, C., Papousek, I., Perchtold, C. M., Benedek, M., Weiss, E. M., Schwerdtfeger, A., & Fink, A. (2019). Creativity is associated with a characteristic U-shaped function of alpha power changes

accompanied by an early increase in functional coupling. *Cognitive, Affective, & Behavioral Neuroscience, 19*(4), 1012-1021. https://doi.org/10.3758/s13415-019-00699-y

Simion, A. (2022). Children's Emotional Health In The Context Of E-Learning. Parents' And Teachers' Perspective. In I. Albulescu, & C. Stan (Eds.), *Education, Reflection, Development - ERD 2021, vol 2. European Proceedings of Educational Sciences* (pp. 204-214). European Publisher. https://doi.org/10.15405/epes.22032.20

Váradi, J. (2018). Musical education in the primary schools of Hungary, Romania, Serbia and Slovakia. *Život i škola: časopis za teoriju i praksu odgoja i obrazovanja*, *64*(2), 67-75. https://doi.org/10.32903/zs.64.2.5

Vuorikari, R., Punie, Y., Carretero Gomez, S., & Van den Brande, G. (2016). *DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: The Conceptual Reference Model*. Luxembourg, Publication Office of the European Union, EUR 27948 EN. https://doi.org/10.2791/11517

Webster, P. R. (1990). Creativity as creative thinking. *Music Educators Journal, 76*(9), 22-28. https://doi.org/10.2307/3401073