Ivana M. Milić
University of Kragujevac
Faculty of Education in Jagodina
Department of Didactics and Methodology
Jelena M. Mladenović
Department of Mathematics and Informatics

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FROM PLANT MORPHOLOGY TO RHYTHMIC PATTERNS (OF MUSIC): A STEAM APPROACH TO STUDYING RELATIONS IN MATHEMATICS[1]

Abstract: In this paper, innovative procedures in working with students, applying the STEAM approach, and the possibilities of improving the quality of university education are reviewed from a theoretical perspective. The modernization of university teaching implies following global trends, with the primary goal being the formation of versatile, competent students who will be able to respond to the modern demands of society and participate in the exchange of information related to current scientific achievements while constantly strengthening their own capacities. During university education, it is necessary for students to develop their potential and competencies, have positive attitudes towards their future in the educational profession, and understand the importance of their teacher role when choosing an approach to educational work in kindergarten.

The competence of the preschool teacher, as well as students, is reflected in the implementation of activities, activation of children's potential, enrichment of children's experiences, encouragement of creativity, and close exposure to phenomena and processes in the fields of science and art. Therefore, it is important to familiarize students with innovative approaches to educational work in kindergarten because they will be able to transform and properly apply the acquired knowledge later in their future work in order to ensure the holistic development of children.

The paper presents an example of an activity that integrates the contents of the subjects of mathematics, natural sciences, and music, with the aim of highlighting the possibilities of improving university teaching through different approaches. Presented examples can be applied during the education of students (future teachers), which would strengthen their competences for working with children of preschool age.

Keywords: rhythm, botany, mathematical relations, STEAM approach, students preschool teachers.

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ivana.milic75@gmail.com

INTRODUCTION

The modernization of university teaching implies following global trends, where the primary goal is the formation of versatile, competent students who will be able to respond to modern demands and participate in the exchange of information about scientific achievements, while constantly strengthening their capacities. The expected outcomes of the modernization of university teaching are that students become aware of their potential and competencies, recognize the importance of the teacher's role in choosing an approach to educational work in kindergarten, and develop a positive attitude toward their future in the educational profession. They must understand that, according to the *Foundations of the Preschool Education Program* (*Godine uzleta*), the profession of a teacher is a unique profession compared to all others; it is ethical and reflexive in its essence and is based on complex and unique competencies.

The teacher is the one who directs the process of learning and enriches the experiences of children in kindergarten. Children primarily learn from their own experiences, interactions with other children, and conversation, through which they come to conclusions. For this reason, the primary role of the teacher is to support the children in the process of acquiring knowledge and experience by creating a stimulating environment. At the same time, they will develop their personal competencies over time, such as evaluation of personal practice, observation, and documentation of children's activities and knowledge of scientific concepts.

Therefore, it is important for students to be familiar with innovative approaches to educational work in kindergarten. There is a need for examples of good practice, so that they could transform and properly apply the acquired knowledge in their future professional work.

Nowadays, the need to integrate content from different fields – including the natural sciences, social sciences, and even art – and to observe and understand the essential connections and relationships between them, is increasingly being adopted. We found the initial connection in the theoretical relations of mathematics, natural sciences, and music. According to Despić (1997), "mathematical laws in music allow us to describe the metrics and development of a musical piece in precise language, including the passage of time in it". Other examples that indicate these connections can be found; the time signature in music is represented by a fraction, as in mathematics. The principle of dividing a whole into parts in mathematics is also applied in music if the even division of the whole note is observed (Despić 1997). Rajić, in his paper, concludes that "just reading durations and ratios regarding the duration of notes requires basic knowledge of mathematical fractions. In this way, the connection between mathematics and music is highlighted once again" (Rajić 2019: 80).

Also, in describing natural phenomena and processes, even the characteristics of living beings, the use of mathematical language is a necessity.

THE STEAM APPROACH IN EDUCATION

In recent years, modern educational practices have seen the integration of two terms that were previously considered separate. According to scientists, the established term STEM, an acronym for science, technology, engineering, and mathematics education, should have been expanded. STEM education emphasized theoretical understanding of solutions to real problems. Although invisible at first glance, art has always played an important role in STEM education. That's when STEAM, a term that included art, was born (Swe Khine, Areepattamannil 2019).

Scientific inquiry as a method of scientific research conveys claims based on facts. This research, like art, is based on creativity and curiosity. For solving scientific, but also technological, engineering and mathematical issues, flexibility in choosing the appropriate methodology is of key importance. Thereby, it is necessary to establish the roles played by the teacher and the student so that the research goes in the right direction. A teacher should provide direction that points to a solution, but not offer a solution. The teacher is there to teach the student how to learn. The student should have an active role in the learning process. Unlike traditional methods, inquiry-based instruction requires full student engagement. When designing a problem-solving method, it is important to consider the level at which the student can take on such a role and gradually guide the research process (Swe Khine, Areepattamannil 2019).

It is often common for students to find STEM classes boring. It can be transformed by implementing the arts (STEAM). Also, the advantage of introducing art subjects into the educational process is the balanced emotional, psychological, and intellectual development of each individual, as well as society as a whole (UNESCO 2012).

STEAM is an evolving educational model that demonstrates how traditional academic subjects such as science, technology, engineering, art, and mathematics can be structured into an integrative curriculum planning framework. As a pedagogical framework, STEAM often includes educational frameworks and practices in which a set of disciplines is considered the core of the learning experience or is seen as the primary and only subject that uses another discipline to achieve its goals (Mejias et al. 2021). STEAM fields have multidisciplinary, interdisciplinary, and transdisciplinary approaches, and are suitable for achieving learning outcomes. Such an approach includes general development as well as development specific to an individual discipline and is related to integrative or holistic education. Research on these and similar educational relationships of individual disciplines (science and art) is currently present in the world as a way to find common education goals (Yakman 2010). There is a need to connect the individual discipline with others in a structure that can accommodate many combinations of disciplines.

However, there is controversy among experts dealing with this approach as to how it should be implemented in the education system. On the one hand, there are those experts who recommend that this approach be developed in a transversal way from all areas of the curriculum, enabling teachers to present integrated lessons. That way, students would learn while doing (working on the problem). On the other hand, there are opinions that it is impossible for one person to teach STEAM transversally through the subject because she or he doesn't possess knowledge from other areas of the curriculum. There are also efforts to establish an area within the curriculum to ensure a common methodological line between subjects (Duo-Terron et al. 2022).

With the help of modern technologies, the range of teaching aids and materials used has been significantly expanded. Several techniques can be used in STEAM education to improve pedagogical effectiveness, encourage scientific thinking, and raise the appreciation of science. Some of them involve multisensory creativity in different environments and active participation of individuals (children, students). STEAM is an increasingly popular pedagogical approach to enhancing students' creativity, problem-solving skills, and interest in individual STEAM fields. It emerged in response to the need to increase students' interests and skills in science, technology, engineering, and mathematics (Perignat, Katz-Buonincontro 2019).

With the STEAM approach, opportunities are opened for students to develop competencies by mastering morphology, as well as phases in setting the rhythm, and educational procedures for developing concepts about certain spatial dimensions.

In the example activity presented in this study, students need to recognize the plant species and be able to describe its morphological characteristics, then structurally connect it with the rhythmic patterns and the performance of different note durations (certain rhythmic figures). Only then the student will be able to successfully transform his knowledge to form the notion of size relations (in this example, *big–small*) in children. This is the key element that characterizes the STEAM approach because natural and mathematical contents are not studied individually, although certain discipline-specific knowledge is necessary, but integrated with music.

Students are expected to find contents within three different subjects that are suitable for connection and to transform and present them so that the knowledge of plant leaves morphology (botanical aspect) is placed in relation to size (mathematical aspect) and forms rhythmic patterns (musical aspect). In this way, rhythmic patterns are represented by rhythmic images, which allows students to transform complex phenomena into concepts that are close and comprehensible to preschool children. Further expert guidance on this "transformation of image into sound for following the rhythmic flow when reading musical notation" (Vasiljević 2006: 199) with notes, which children acquire in the field of musical literacy only in elementary school, will contribute to children mastering music verticals in the period of conscious musical literacy, and facilitate the performance of the written rhythm.

As in the native language, we translate visual symbols into sounds, and by looking at letters and connecting them into words, we move on to reading. Therefore, by looking at the shapes of leaves and determining the relations between them (without naming the spatial dimensions, but by directly transforming the acquired knowledge), we audibly perform rhythmic patterns.

More specifically, from the aspect of teaching rhythm, the STEAM approach in this way introduces students to one of the most complex pedagogical tasks in the field of rhythmic reading: *parlato*. The students must have the ability to read and keep a regular rhythm pulse, move their gaze forward along the rhythmic pattern while maintaining the tempo, and develop the skill of "following the musical text along the difficult wide horizontal line system" (Vasiljević 2006: 200) in all forms of music performance in their professional work. In this way, they will be able to identify the same abilities in children later in their work.

THEORETICAL CONCEPT OF RHYTHM

The basic expressive elements of music are melody, harmony, and rhythm. In music theory, rhythm is the alternation of notes, rests, and silences in time. Rhythm consists of sound, silence, and accents in music. When a series of notes and rests repeats, it forms a rhythmic pattern. Musical rhythm also determines how long notes are played and with what intensity. This creates different note durations and different types of accents. Rhythm allows the music to move forward, animates the piece of music, gives structure to the composition, and affects the character of the music. Most classical musical ensembles include percussionists, the so-called *Rhythm Section*, who maintain the rhythmic backbone of the ensemble as a whole, regardless of the fact that all members of the musical ensemble bear equal responsibility for their own rhythmic performance, the performance of musical measures, and the rhythmic patterns indicated by the composer of the piece of music.

In order for children and students to be able to identify rhythmic durations, it is expected that they possess a certain level of rhythmic abilities. It is necessary for the teacher to know the elements of rhythmic abilities and then to state a child's developmental stage of certain rhythmic abilities at a specified age.

It is important that students, through the process of university education, learns which elements of rhythmic abilities they could and should foster in preschool children. That is the starting point.

In general, from the perspective of rhythm methodology, we represented which elements of rhythmic abilities can be taught:

- Ability to remember tempo (the perceived frequency of musical pulse with a perceived pulse or beat);
- Ability to adapt to a given tempo and correspond to changes in tempo;

• Ability to perceive and perform different rhythmic types;
• Ability to recognize agogic nuances of rhythm;
• Ability to polyphonically follow different rhythmic relations between voices when the musical lines are rhythmically differentiated (Vasiljević 2006).

Furthermore, with the correct methodical solutions, it is possible to nurture rhythmical pulse and grouping into units through moving in a circle, marching, performing, dancing, and singing songs with children of preschool age.

However, the ability to adapt to a given tempo and correspond to changes in tempo, as well as the ability to perceive and perform different rhythmical types, is not possible to develop without a sufficient professional teacher. Meanwhile, the ability to polyphonically follow different rhythmic relations between voices when the musical lines are rhythmically differentiated could be developed only through education in a music school. Therefore, at preschool age, the teacher can monitor and influence the development of only certain rhythmic abilities.

Finaly, professional guidance is necessary for improving and consciously developing skills for keeping an equal pulse, maintaining rhythm, and developing a sense of dynamics until children begin school.

A positive result from such directed development and accumulated unconscious reception of musical influences and sound layers (Vasiljević 2006) will not be absent. Continuous and spontaneous experience and performance of different rhythmic patterns in the phase before musical literacy is of great importance for children's later awareness of certain phenomena (Plavša, Popović, Erić 1961).

Therefore, through university teaching, it is necessary to direct students' activities towards personal and professional development.

BOTANICAL ASPECT

According to the program for the education of preschool children, one of the goals is for children to be familiar with the living world that surrounds them. To be able to achieve such a goal, they need to learn to recognize characteristic species of plants or animals according to certain rules, learn to notice details specific to individual species, and compare important characteristics to be able to conclude what species it is.

It is clear that, above all, children should have a competent teacher who can teach them that. For this reason, one of the goals in the curricula of subjects dealing with these topics is to enable students, and future teachers, to recognize certain species from the immediate environment. In this sense, students should know specific plant species and have the competence to transfer this knowledge to children of preschool age.

Knowledge of plant morphology, the science that studies the external appearance of plant species, i.e. the appearance of plant organs such as leaves, is useful in describing plant species. Although the external appearance and size of the leaves of different plant species is not the only characteristic based on which the species can be identified, describing their appearance, observing details, and noticing similarities and differences in the appearance of the leaves is a good starting point for studying (and describing) the plant world and the environment.

When describing plant species, it is necessary to observe as many details as possible that characterize the given species. Such details can sometimes go unnoticed, so students should be trained to spot and identify those details and then direct the dialogue with the children properly. So, for example, some species differ among others in the size of the leaf or in the shape of the leaf, or the way the leaves are attached to the stem. When describing, quantitative properties are used, which in mathematical language belong to size relations – *height*, *length*, *thickness*, and so on (Egerić 2006; Najdanović 2012). Children notice such relations by comparing objects of the same shape, or in this case, plant leaves. Based on this, they adopt concepts that are opposite in meaning: *big–small*, *high–low*, *long–short*, *wide–narrow*, *thick–thin*, and *deep–shallow* (Egerić 2006; Najdanović 2012). The relations *up*, *down*, *in front of*, *above* and so on are also described, which belong to positional relations. After noting the details based on the observed characteristics, the given species is classified into a certain category of affiliation (taxonomic category) and identified as a specific species. Mathematically, this would correspond to an inclusion or subset relation.

Familiarity with the plant world begins at an early age during preschool education and continues during further schooling. Numerous teaching aids are available today, such as botanical atlases, laboratory manuals textbooks, natural or digital herbariums, as well as live plant material help children and students get to know the diverse plant world. For children to be able to distinguish one species from another when describing the essential (key) characteristics of species and comparing those characteristics, they need to be familiar with certain mathematical relations such as position relations, size relations, or inclusion relations.

To present the STEAM approach to students and show through a practical example how to apply it in work with preschool children, we chose a plant: the plantain. Plantains inhabit children's immediate environment in meadows, city parks, and lawns, so they are familiar with it visually, but they cannot identify and distinguish it from other similar species by certain key characteristics.

In the flora of Serbia, several plant species which bear the common, folk name plantain are known. These are mostly herbaceous perennials, less often bushy plants from the flowering plant's clade (Magnoliophyta), with a cosmopolitan distribution. Most often, they can be found in the composition of plant communities of meadows and pastures in lowlands, mountain grasslands, and subalpine shrublands. The plantain genus (Plantago) has over 200 species (Tabašević et al. 2021).

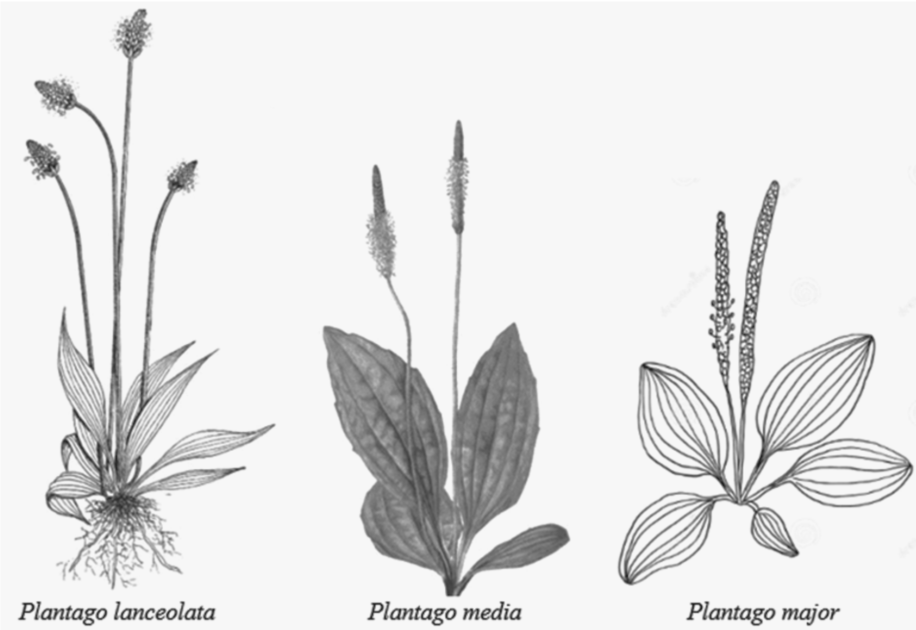
What most species of this genus have in common is the position of the leaves: an alternate arrangement at the base of unbranched stems in the form of a ground rosette. Because of that characteristic way the leaves of some lie flat on the ground, this genus bears the scientific name Plantago, derived from the Latin word for the sole (foot-sole-like, feminine termination of planta, ancient Latin, plantaginem) (Gledhill 2008).

Considering that it is difficult to determine the phylogenetic affiliation within the genus as well as in higher taxonomic categories based on morphological characteristics alone, modern science applies analyses based on DNA sequences and chemotaxonomic research. This is because the species of this genus are characterized by specific chemical compounds and in folk medicine, they are known as plants with medicinal properties. If we exclude those analyzes and get to know the plant world during the education of preschool children, individual species of this genus can be distinguished by the shape and size of the leaves. The shape, size, and structure of leaves vary considerably from species to species of plant, depending largely on their adaptation to climate and available light, as well as other ecological factors (Janković, Gajić 1974).

Plantago lanceolata, *Plantago media*, and *Plantago major* can be found in our meadow ecosystems (Picture 1). *Plantago lanceolata* is known by several common names: narrow-leaf plantain, ribwort plantain, lamb's tongue, buckhorn, and, in Serbia, male plantain. *Plantago media* is known as the hoary or medium plantain, while *Plantago major* is known as the broad-leaf plantain, white man's footprint, greater plantain, or, in Serbia, female plantain.

The narrow-leaf plantain (*Plantago lanceolata*) has elliptic to lanceolate-shaped leaves, pointed at the apex, with a smooth margin. The basal leaves are lanceolate spreading or erect, scarcely toothed with 3–5 strong parallel veins narrowed to a short petiole. The medium plantain (*Plantago media*) has finely-haired leaves that are broad, elliptic, or ovate in shape, usually twice as long as they are wide, sessile, apetiolate (without a leaf stalk) or at the base narrowed into a short and wide petiole. In the broad-leaf plantain (*Plantago major*), the leaves are broadly ovate to elliptic in shape, with an acute or blunt apex and round base, with a smooth margin or toothed in the lower part and distinct petiole almost as long as the leaf itself or longer. There are five to nine conspicuous veins over the length of the leaf (Mišić, Lakušić 1990). Due to the shape and size of the leaves, which are larger than those of other Plantago species, it was given the scientific name *major*.

Picture 1. Illustrations of different Plantago species



THE PROCESS OF ACQUIRING KNOWLEDGE ABOUT RELATIONS OF SIZE

Because children of preschool age have great potential to form elementary mathematical concepts and raise them to a higher level (here we distinguish the spatial dimensions of the subject), that period should be used in the best way. In mathematics, the cognitive process takes place through experiences and the senses, in which two phases can be distinguished: the perceptual phase and the phase of thought processing, in which the idea of a concept is created. Therefore, the formation of a mathematical notion is a process of knowing where a sensory experience is invoked in thought processing, a reminiscence of memory that children already have (Egerić 2006).

In that regard, it is necessary to choose the correct methods and various work approaches to gradually, through play and fun, influence and mathematize the appropriate notions of relations by noticing and emphasizing important mathematical features (Najdanović 2012).

In mathematics, relationships and connections between elements represent relations. From the earliest age, in everyday life situations, children are exposed to and surrounded by those relations. Through the activities organized by the teacher, children through play can observe the important characteristics of objects that are in a certain relationship. To describe their observations, they use terms from everyday speech close to them. Through the educational process, those terms will become notations and symbols for appropriate relations. With the professional guidance of the teacher, children will gradually adopt the terminology of mathematical notions and build clear ideas about their meaning.

When developing initial mathematical notions, children's activity, initiative, and communicativeness are of particular importance. To determine the spatial dimension (where objects are located) and to express their differences in size (*big* and *small*), children spontaneously come into contact with relations. At preschool age, children have certain ideas about relationships in their spatial environment. They already, in everyday communication, use sentences in which they express these relations; for example, size relations: the cat is *bigger* than the kitten; the chicken is *smaller* than the hen; Emilia's apple is *bigger* than Sofia's; Dimitrije has a *smaller* flower than Xenia; Vasa and Mata have balls of the *same size*, etc.

Those specific examples, which are the object of children's interest or represent situations from their lives, should be used and expertly transformed into a conscious understanding of relations. It is necessary to stimulate the thinking activity of children through well-organized play and a proper selection of didactic materials so that familiarization with the notion of relations flows from the concrete to the abstract. This is the primary task of the teacher, who is expected to carefully formulate questions that will guide children to find answers and solutions on their own. With this kind of organization, children are not deprived of the beauty and pleasure of discovery. Therefore, it is necessary to support students, future preschool teachers, and offer them the best possible solutions for managing activities while following the children's interests.

In a practical example, we chose plant leaves from the children's immediate environment (the leaf of the plantain) and placed them in mathematical relations, so that the children understood the concept of rhythm. We aspire to encourage students to innovate their approaches in future work by applying previously acquired knowledge.

PRACTICAL EXAMPLE – FROM PLANT MORPHOLOGY AND RHYTHMIC DURATIONS TO THE SIZE RELATIONS

The results of study in that field (Blatnik 1988) have shown positive effects of the visual perception field on children's cognitive processes when solving problems, more effective learning and understanding of content, and greater motivation and level of critical thinking. In general, the formation of notions requires the conscious engagement (activity) of children, because they acquaint with the world around them through their senses, practical actions, and mental operations. Here it is important to point out that children have already been exposed to certain (musical, mathematical, biological) experiences, and from a musical point of view, they possess certain rhythmic, perceptual, and reproductive abilities.

The senses of hearing and sight are considered by certain authors to be more perfect, superior senses because they perceive color and three dimensions (lines, surfaces, space) and have a common role in the auditory and grafic notation of tone (Vasiljević 2006). Because the visual field dominates human communication, by visualizing concrete content in this way, we can directly indicate the essence of the topic or unit that is articulated in the work plan. For “non-musicians” in the process of auditory perception of the musical flow, “concretization” in the form of a visual is necessary (Vujošević 2017).

Rhythmic images within the music-pedagogical practice represent a surface-spatial system, in which a certain melodic or rhythmic motion can be represented by visual symbols (Plavša 1989).

In the given example, we indicate a synergy action of the auditory and visual through the STEAM approach creates the possibility of multi-layered perception, not only of the rhythmic flow but also the perception and understanding of the contents of the other two areas. In this particular case, it will be presented to students as a way to successfully structurally connect the contents of three different subject areas: Development of initial mathematical concepts, Musical preschool education, and Kindergarten Natural Sciences.

Acquiring knowledge about the mentioned notions begins with observing “pictures, drawings, models”, directing children to “manipulate” them and to perceive common features while keeping them in their minds. “Thinking operations that process sensory experiences in the cognitive process of a concept” (Egerić 2006: 18) are analysis, comparison, synthesis, abstraction, identification, and generalization.

Children’s mental operations, in the given example, should be focused on all three areas using the STEAM approach.

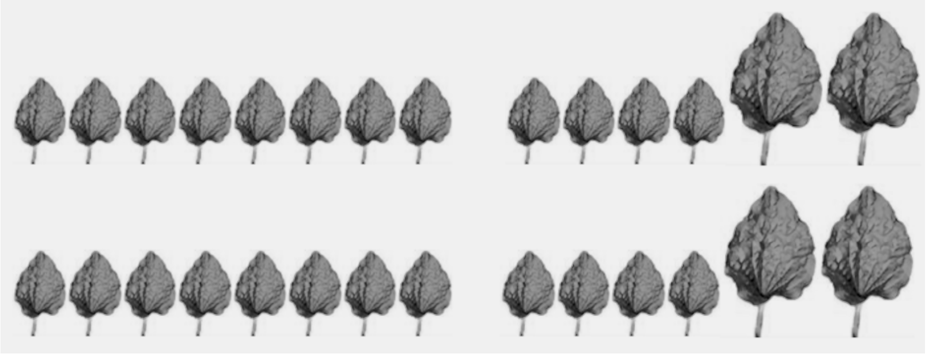
Children observe the presented plants, and we expect them to be able to recognize and name them (classify them based on morphological characteristics), describe what the leaf of a given plant looks like, and even illustrate it. They then connect those visual representations with the auditory perception of longer and shorter rhythmic durations (musical aspect), compare them, and notice differences and similarities. It is necessary to explain to the students that, with direct questions, they should make the children perceive and connect the observed properties into meaningful wholes, from all three aspects. After that, with their expert guidance, direct the children’s thought operations to single out only the essential properties, which are, from the mathematical aspect, quantitative relations and spatial shapes. The process should flow in the direction that the properties of the material nature, which are concrete, become abstract (Dejić, Egerić 2006). Observed mathematical relations of size, by mental transmission, should be perceived as grafic notes and rhythmic durations, which represent preconceived rhythmic patterns.

By encouraging children to perceive certain quantitative properties in an organized manner, we form the notion of size relations. Thus, in Example 1, by comparing plantain leaves, which are of the same shape, but different sizes, and therefore from the mathematical aspect opposite in meaning such as *big* and *small* (or in some other examples they can be *high–low*, *long–short*, *wide–narrow*, *thick–thin*, *deep–shallow*, *heavy–light*), and from the musical aspect they are rhythmic images that represent rhythmic patterns (eighths and quarter notes), the notions of all three subject areas will be adopted.

Given that the terms *big–small* have a relative meaning (Egerić 2006) and that we do not tie the selected rhythmic images to one constant symbol but form a system of symbols according to each specific situation (Plavša 1989), we find a space to represent them through the plant leaves. The application of adequate illustrations, visual representation when adopting certain notions, and application of technology (dynamic mathematical software) provide better opportunities in designing visual and dynamic models in work (Milikić, Vulović, Mihajlović 2020).

It is necessary to establish and perceive relations during the auditory perception of longer and shorter note durations and relations between plant leaves when visually perceiving the appearance of a plantain leaf, and then distinguish and name *big* and *small*, which means understanding the elementary concept of the size relation. Students are expected to pose a problem to the children, which they will be able to solve only gradually, in stages, and connect all three subject areas through the STEAM approach.

Picture 2. Example 1. Rhythmic images represented by a plantain leaf in big–small relations



Rhythmic images will present rhythmic patterns, placed along an imaginary horizontal line on the surface or in space. For the auditory performance reading the rhythmic patterns, the student can choose the syllables of the plant name.

Rhythmic durations are represented by plantain leaves in two different sizes, in an approximate ratio of 1 : 2. A quarter note is a longer note duration and is represented by a big rhythmic image, a big leaf, and an eighth note is a shorter note duration and is represented by a small rhythmic image, a small leaf. In further work in the field of rhythm, we can include body movement, where rhythmic images would be shown by hand, and associatively enforce precisely defined rhythmic durations to be performed.

Students can pre-design a rhythmic notation as in Example 2.

Picture 3. Example 2. Rhythmic Notation

Moreover, we can set an additional creative task for the students: to create a literary text by themselves for the mentioned rhythmic patterns or to choose a thematically appropriate counting-out rhyme, thus introducing another subject area (speech development) as was done in Example 3. The metric of a literary text (sylabical durations) directly determines rhythmic durations and facilitates the notation of rhythmic images.

Picture 4. Example 3. Counting-out rhyme "Bokvica"

The main goal of using music and mathematics together is to use the power of music to engage children to make mathematical relationships by the use of music stimulus. We must begin by developing an activity that facilitates the construction of mathematical knowledge by encouraging the children to think mathematically and then add musical elements to enhance the activity (Mazzocco, Feigenson, Halberda 2011).

In the Example 4 children should create numerical patterns with flowers and place as many flowers as the number of claps they hear (Picture 5). We performed lyrics of the song named "Visibaba" (engl. Snowdrop – lat. *Galanthus nivalis*) and children have the task of listening to rhymes and a beat (pulse) in music which we clapped and place the specific number of Snowdrop flowers as they hear in the first vase. There are eight vases – as many as there are measures in the song. Every vase represents one measure and rhythmical pattern. Furthermore, in this example, children form mathematical sets by grouping Snowdrop flowers in vases and by visualizing the object. At the end, after the task has been solved, we could ask children to count flowers. In the first vase/measure children count to four, because there are four eighth notes, in the second children count to two, because there are two quarter notes and etc. In this case, a motivational musical environment is vitally important and can enhance future abilities in mathematics. We could provide new tasks for children such as counting numbers or grouping and comparing the groups of flowers by noticing the quantitative difference between the groups (more/less), or the quantitative ratio between flowers sorted out by the height criterion (tall/short). In every task it is very important to use correct mathematical language. We can also perform certain rhythmical patterns on some of Orf's instruments (wooden claves, maracas, wooden blocks) instead of clapping.

Picture 5. Example 4. Song "Visibaba"

Furthermore, in some other new example, we could show how students would practice the children's skill of counting by performing appropriate music games or rhymes and songs that mention numbers. Every practical example that we presented helped students strengthen their competencies for professional work.

CONCLUDING REMARKS

In accordance with modern tendencies in University education, it is necessary to use the potential of various approaches. Each approach may allow students to see their achievements and contributes to the improvement of their teaching practice (Semoz 2020). Although not all aspects of the STEAM approach have been seen in practice yet, we can point out that it contributes to the quality of students' knowledge, encouraging creativity and holistic education in general.

• Contemporary aspirations in early and preschool education pose many challenges to teachers that must be answered with decisive steps in innovations.

• It is possible and necessary to raise to a higher level the competencies that the future teacher should possess and develop through lifelong learning. Among others, these are to be dedicated to working, engaging, and finding creative solutions to problems. Furthermore, to be a collaborator, organizer, innovator, researcher, lover of music and science, and initiator of all projects to ensure the quality of the pedagogical climate, because their expertise and creativity influence the holistic development of each individual in the group (Milić 2016).

• Guidelines need to be given, as well as methods of work organization, didactic aids and materials, and examples of potential solutions that can support the student for the application of the STEAM approach in future work in pursuit of the acquisition of STEAM skills. The whole width of the space for possible new examples of STEAM activities that can be implemented with children in kindergartens (with clearly identified learning outcomes) should be perceived. Difficulties in implementing this approach can be overcome with professional guidance.

Our goal was not only to promote the methods and procedures of the STEAM approach but to highlight that university teaching is an open concept, whose processes inevitably require constant improvement and quality growth through access to different approaches.

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Ивана М. Милић

Универзитет у Крагујевцу
Факултет педагошких наука у Јагодини
Катедра за дидактичко-методичке науке

Јелена М. Младеновић

Катедра за природно-математичке и информатичке науке

ОД МОРФОЛОГИЈЕ БИЉАКА ДО РИТМИЧКИХ ОБРАЗАЦА (У МУЗИЦИ): STEAM ПРИСТУП ПРОУЧАВАЊУ РЕЛАЦИЈА У МАТЕМАТИЦИ

Резиме: У овом раду су са теоријског аспекта сагледани иновативни искораци у раду са студентима, применом STEAM приступа, и могућности унапређивања квалитета универзитетског образовања. Модернизација универзитетске наставе подразумева праћење глобалних трендова, при чему је примарни циљ формирање свестраног, компетентног студента, који ће моћи да одговори савременим захтевима друштва, и да учествује у размени информација у вези са актуелним научним достигнућима уз стално јачање сопствених капацитета. Током универзитетског образовања, потребно је да студенти развију своје потенцијале и компетенције, формирају позитивне ставове према будућој васпитачкој професији, и схвате значај улоге васпитача приликом одабира приступа васпитно-образовном раду.

Компетенције студената, будућих васпитача, испољавају се кроз реализацију активности и огледају се у активирању дечјих потенцијала, обогаћивању дечјих искустава, подстицању креативности и приближавању научних чињеница (појава и процеса) и феномена у области природних наука и музичке уметности. Управо је зато важно студенте упознати са иновативним приступима васпитно-образовном раду, јер ће стечена знања моћи да трансформишу и правилно примене касније у свом будућем раду како би обезбедили холистички развој деце.

У раду је представљен пример активности где су интегрисани садржаји три различите области – математике, природних наука и музичке уметности, а све у циљу унапређења универзитетске наставе кроз различите приступе. Примери приказани у раду могу се применити током образовања студената, будућих васпитача, чиме би се ојачале њихове компетенције за рад са децом предшколског узраста.

Кључне речи: ритам, ботаника, математичке релације, STEAM приступ, студенти-васпитачи у предшколским установама.