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ARTS BRIDGE: THE ART-LANGUAGE-MUSIC-MATHEMATICS PROJECT

Andrea Kárpáti

Though mathematicians are supposed to have a talent for music, this fostering relationship does not seem to work automatically the other way around. Children gifted in various genres of arts often have huge difficulties mastering the thinking patterns, facts and rules of science. In the early eighties, the Zoltán Kodály Institute for Music Education in Kecskemét, Hungary recognized this problem and invited a group of art educators, lead by the author of this paper, to develop an interdisciplinary curriculum for fine arts, music, drama and mathematics. The worldwide-acknowledged Kodály system of music education that has always made use of folk dance, tales and plays, served as an excellent platform for experimentation. The project lasted for four years, involved about 800 children for six to eight hours weekly, and fostered interdisciplinary ways of problem solving to help diminish negative attitudes of children aged six to twelve towards the realm of numbers. Results were published in textbooks for teachers on the method based on structural similarities observable in arts, nature, and science and manifest in children's improvisations in sound, image and movement.

Experiments with arts and science projects ensued and two decades after the initiation of the first arts and science project, in 2001, a national conference showcased more than 30 workshops of interdisciplinary nature. The method became standard practice. Children involved in them may not have been madly fond of mathematics, but experienced science as an integral whole with the arts, as an understandable, even enjoyable constituent of their culture. The paper describes methods and experiences of the "ART-LANGUAGE-MUSIC-MATHEMATICS" project, demonstrates tasks with student work, and describes how interdisciplinary arts education fits in contemporary Hungarian educational system and our National Curriculum.

Interdisciplinarity - a Key Principle in the History of Progressive Hungarian Education

The story of education through arts in Hungary is similar to countries all around the world: developing our national industry needed people able to read plans and execute decorative patterns. Drawing as a practical skill thus was useful for a variety of trades and introduced in education. In the 18th century, a natural integration pattern of (applied) arts, science and technology integration evolved. Educators thus emphasized draughtsmanship as a skill necessary for the practice of various industrial professions, set up utilitarian curricula, and established a chain of drawing schools for those who wanted to polish their skills in visual rendering.

László Nagy, the founder of the *Hungarian Child Study Movement* was the first influential Hungarian art educator who opposed the “industrial arts” trend. He was devoted to the ideas of *John Dewey* and decided to reform Hungarian education according to their principles. Nagy believed in the aesthetic value of child art and decided to elevate it to the ranks of high culture. It was the intricate developmental process of the child he wanted to reveal, not the evolution of the realistic image. In his work on child art development, he described the developmental stages as phases of development that are satisfying for the child and should be pleasing for the adult who should encourage rather than correct and interfere with natural growth (Nagy, 1905). Nagy believed that the world of experiences should be enriched to give food to more sophisticated expressions. He was not trained in art but trained himself in the study of children’s *visual language*. As a very influential chief inspector for Budapest, he called for the use of this language in mathematics and science and thus came close to the total integration concept developed by his contemporary, *Rudolf Steiner* in the *Waldorf Schools*. Nagy started a campaign against the dominant Prussian type of education that ignored the creative instinct in the child and considered art, music and drama secondary to science and mathematics in schooling.

Sándor Karácsony, an educational reformer and intellectual guru for Hungarian avant-garde artists and educators, further popularized ideas of *Rudolf Steiner*. The most important feature of this model was the *key role of the arts* in the learning process of all subjects — also mathematics and science. *Sándor Karácsony* approached the teaching of mother tongue not from the traditional linguistic viewpoint. He considered verbal communication a primarily psychological phenomenon that has to be taught on the basis of the understanding human relationships. *Karácsony* encouraged children to confront their lessons at school with real life, to imagine what they hear and clarify what they cannot imagine. (Kárpáti & Gaul, 1998) The *interdisciplinary learning experience* he discovered in *Rudolf Steiner*’s ideas became one of the most important innovations.

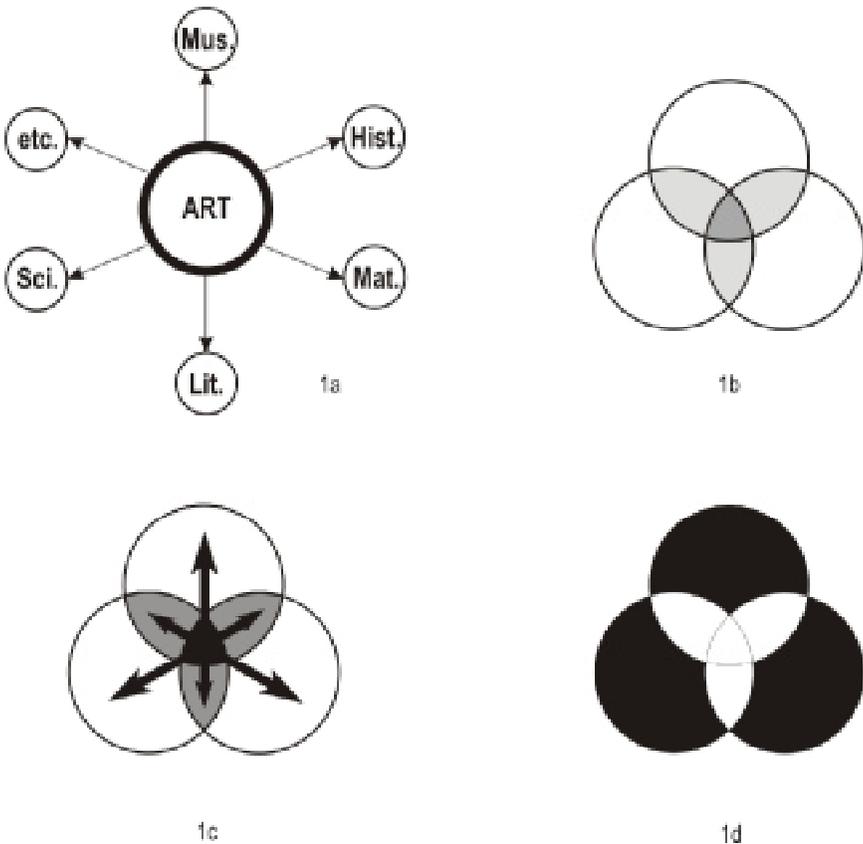
Maria Vida Székács, the first painter to achieve a Ph. D. in psychology and another one in education in Hungary, introduced aesthetic education in Hungary. Besides the work of Zoltán Kodály, Japanese education was another impetus for her to base her teaching programs on the folk art heritage. Another important feature was the *combination of writing and drawing, the intertwined symbolism of letters and images*. The art of calligraphy and the meaning attached to scroll paintings by poems written on them by consecutive collectors and art lovers opened up for her new models of integrating the arts for a more effective, more meaningful teaching. Her work gave inspiration to the integrated arts projects by the author of this paper described below. (Kárpáti, 1998)

The legendary “*polyaesthetic*” *seminar on artistic development (of perception and creation)* conducted by Maria Vida Székács in the 1970s at Eötvös Loránd University, ran for 10 academic terms and became a lifetime experience for many scholars and educators who now are shaping the face of Hungarian aesthetic education. The author of this paper is fortunate to be able to recall the spirit of these fully interdisciplinary encounters from personal experience. The seminars were advertised as an introductory course into the psychology of creativity. The participants were students of literature, music, fine and folk arts and art history as well as psychology and education. They all were prepared to share personal experiences and engage in creative exercises as well as give short talks on the relevance of the issues raised for their own disciplines. First, *basic signs, symbols and structures of the languages of the arts were described and demonstrated through composition and expression games*. We were asked to show movement in song and painting, color in music and dance, rhythm in speech and sculpture. We assembled objects from the natural and man-made environment and arranged them to represent concepts, patterns and compositional laws. Then, we gave talks on what these structures meant in our own disciplines. We recalled *aesthetic experiences from early childhood, recurring sensations of adolescence and analyzed biological, social and mental factors responsible for the formation of our tastes and attitudes towards beauty in art and nature*. *Comparative analyses of works of visual arts, music, literature and drama* followed and we soon realized that the successful acquisition of a genre of art might be facilitated and enriched by these integrated experiences. When planning our experimental teaching programs, memories of these seminars shaped our thinking.

Another major source of inspiration for progressive Hungarian artists and educators, *Ferenc Lantos* united the constructivist and folklorist tradition in Hungarian aesthetic education in a model based on *structural similarities*. As a Constructivist painter of the second half of the 20th century, he developed an interdisciplinary arts and science education method called “*Nature – Vision – Creation*.” (Lantos, 1994) The music teacher *Mária Apagyí*, who developed a

music and arts curriculum based on the structural principles revealed by Lantos, further enriched his *polyaesthetic* model. (Apagy, 1984). The two methods were soon integrated and are still being practiced in the Secondary School for the Arts in Pécs, a university town in Southern Hungary famous for its artists' colony and collections of contemporary arts. The essence of this integrative model is a set of similarities – *common laws of arts and science* – that have to be acquired in order to appreciate the peculiarities of each of these cultures. Lantos suggests that creation and perception of the arts are basically interrelated. In fact, the creative act is an analysis of the world of vision, sound or movement in itself. In order to understand the *principles of rhythm, harmony and composition* that constitute the ultimate link, it is insufficient to perform a vertical analysis deep into the heart of one culture, it is equally important to analyze similarities of meaning, pace, structure or non-formal qualities horizontally.

Figure 1: Structural similarity model of integration suggested by



Lantos and Apagy as opposed to traditional models of integration based on differences. (Source: Lantos, 1994, p. 14)

Mária Apagyi teaches music the same way, always asking her students to analyze style and mood through dissecting and rebuilding basic sound patterns. The students of art and music regularly engage in exercises using the language of the other art form and thus deeper understanding their own.

“...our work was built upon structural relations and spiritual roots that are the same for nature, fine arts, folk arts and science. Essential elements were identified, systematized and made conscious through a series of visual, musical and kinetic exercises, designs and musical compositions built on structural principles conforming to them.” (Lantos, 1994, p. 43)

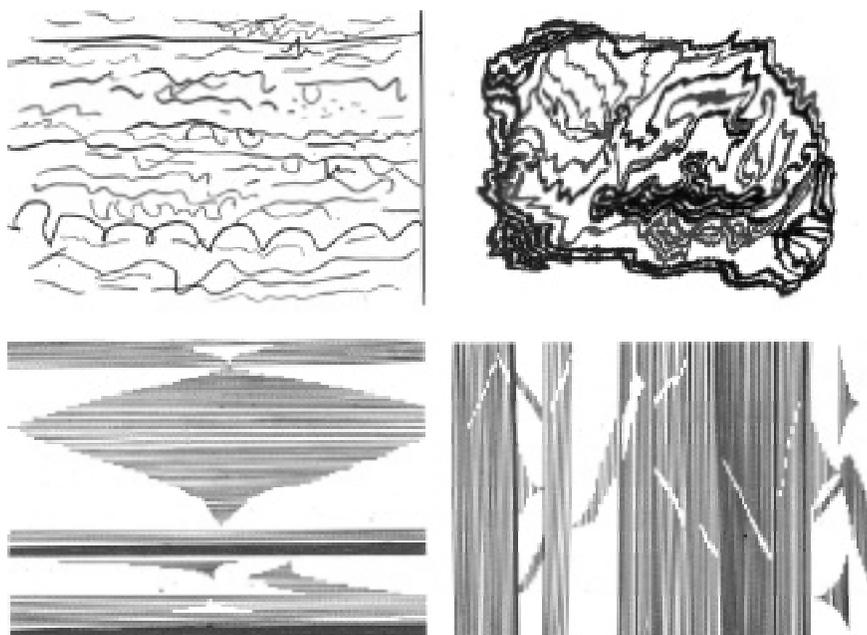


Figure 2. Improvisations in black and color ink using point, line and plane to recreate musical patterns played on the piano previously. Work by students of Ferenc Lantos and Mária Apagyi, Pécs, Apáczai Education Center. (Source: Lantos, 1994)

Interdisciplinary Aesthetic Education at the Core of the Kodály Music Education Method

“Music education of the child should start nine months before her birth!” – goes the famous saying of the world famous composer and music educator *Zoltán Kodály*. He often spoke about the importance of *the musical mother tongue of*

the child: folk songs that should create the basis upon which a flexible and varied music culture may be built. He was outraged at the falsified folk songs that teachers “adapted” to the supposed “needs” of the child. Kodály began composing musical exercises for children in 1925 and utilized the repertoire of his folk song collection to teach about structures and forms of classical music.

Zoltán Kodály, a contemporary and inspiring friend to *Béla Bartók*, became the most important figure in aesthetic education of post-war Hungary, who reformed music education not just in Hungary but also in many parts of the world. His views on kindergarten music education laid the foundation for all other branches of arts in education. *Maria Vida Székács* coordinated a national survey of effects of the Kodály System of music education with the participation of leading developmental psychologists *Ilona Barkóczi* and *Csaba Pléh*. (**Barkóczi & Pléh, 1977**).**ADD TO REF LIST** Between 1967 and 1970, her role was to prove that integrated development of creative skills in art, drama and music enhances creative thinking and fosters the mental development of socially handicapped children who, according to previous research results, benefited less from regular enrichment programs based on verbal and mathematical tasks, and required a high level of competency in these languages. She revealed the key developmental role of the *Kodály system*, considered by many educational policy-makers as elitist and unsuitable, to become a part of general education and thus underlined the importance of aesthetic education for the underprivileged.

Kodály introduced relative *solmisation*, a structural denotation system as a tool for the scientific analysis of music, has helped generations of young Hungarians (Americans, Japanese, Germans – to quote only those nations where his methods are most widely spread) to understand the laws that unite the world of arts and science.

Another important result of the Kodály system of music education was that it turned the attention of a large group of young musicians towards folk culture. They decided to enter the path first traveled by the young composers-ethnographers Zoltán Kodály and Béla Bartók in the 1930s and continue collecting folk music with the intention to share it with friends and recreate the atmosphere of village dancing and singing. The musicians, who collected authentic folk songs in remote villages also acquired the manners of performance from village people: long forgotten singing techniques, manners of fiddle play, steps and variations of dances, gestures and improvisatory patterns of tale narration. They performed their newly acquired skills and an alternative folk music and dance culture started to emerge in concert halls. The Hungarian folk art movement thus developed a new model for integrating the arts and sciences (Kárpáti, 1999). Folk art – an organic unity of simple scientific and technological

knowledge and experiences, embodied in polyesthetic rituals combining poetic language, drama, music and visual arts, provided another important model for integration in Hungary.

Avant-garde fine artist also undertook visual communication research to relate the meaning of signs and symbols in folk art and “high art,” to observe their transformations in everyday communication, and to use these three sources to establish a unique Hungarian imagery of Constructivism and Lyrical Abstraction. From the early seventies, several members of the Hungarian avant-garde art movement turned to folk art for new inspiration. Abstractionist and constructivist artists studied museum pieces and/or village folk art to systematize and develop versions and variations of motives and compositional structures in their own visual idioms. The language they identified was one very similar to their own — constructivist in its solid compositions, abstractionist in its lack of superfluous details, conceptual in its ancient symbol system that underlined all the patterns used in everyday household objects and made them almost mythically meaningful.

Art and music teachers were quite responsive, but had no training— thus special arts and crafts studios were established in small towns and villages where authentic folk crafts could be practiced with the use of restored old machines and tools. At the artists’ colony of the famous wine region of Tokaj, in 1975, an educational experiment was undertaken to create a living environment inspired by folk culture. Students and young architects, lead by the now world-famous founder of the “organic architecture” movement, Imre Makovetz, erected and built a “gathering house” of wood practically by hand.

“Before and during the building I gave lectures on the cosmic laws structures that organize the central, circular compositions of folk art, about the rules of orientation in Asia and Celtic stone monuments and their relationships to the wooden gate guardians of Hungarian peasant dwellings. Besides spreading knowledge of cultural history, my aim was to change romantic ideas about folk art that generate in the 19th century, I intended to offer a model of organic architecture that evolves naturally from the genuine traditions of folk art of a nation and may contribute to the genesis of a living, organic community.” (Imre Makovetz, architect, in Bodor, 1981)

Folk arts and crafts have always been an issue of political concern in a country that, in the course of a century, lost about two-third of its territory and more than two-third of its inhabitants. (Kárpáti, 1999) Folk patterns appear in the first national curricula issued in the last years of the 19th century and continue to play an important role up to the present day when, in 1995, the National Core Curriculum was issued including, for the first time in the history of Hungarian art education, a separate discipline called design and crafts. Maria Vida Székács

was the first important educationalist in post-war Hungary to raise the issue of folk art as one of the key components of any art curriculum.

The Art-Language-Music-Mathematics Project

In the early eighties, the Zoltán Kodály Institute for Music Education in Kecskemét, Hungary recognized this problem and invited a group of art educators, lead by the author of this paper, to develop an interdisciplinary curriculum for fine arts, music, drama and mathematics. The Kodály system of music education, briefly introduced before, has always made use of folk dance, tales and plays and thus served as an excellent platform for experimentation. The project lasted for four years, involved about 800 children, in 52 primary schools for six to eight hours weekly. The major objective of the project was to foster interdisciplinary ways of problem solving and help diminish negative attitudes of children (aged 6-12) towards mathematics and science. On the other hand, the project aimed to improve the understanding of contemporary visual arts, drama and music through creative exercises in variation, combination, improvisation, happening, and performances and thus identify common roots of the arts and sciences. Curricula, lesson plans, experiences of the project and developmental achievements were published in textbooks for teachers on the method based on structural similarities observable in arts, nature and science and manifest in children's improvisations in sound, image and movement (Kárpáti & Rajz, 1983).

When we started our experiment, the model of integration was still totally alien to Hungarian education. The *Central Curriculum* that defined not only the framework but also the content and methodology of teaching consisted of secluded disciplines and was characterized by Prussian rigidity and discipline. The major problem we encountered was not the unwillingness of the teachers to change their teaching repertoire but scheduling the *slot for interdisciplinary studies* in the jam-packed school curriculum. Another problem was *teaching time*. In Hungary, periods last 45 minutes with 10-or 20-minute breaks in between. Grouping of disciplines that will be taught in an interdisciplinary manner turned out to be impossible, as they had to be scheduled taking in consideration several constraints (from classroom space to teachers' preferred timetables). For an integrated arts and science project, the only flexible time slot at school was the *afternoon daycare period*, attended by more than 90% of the pupils aged 6-10, as the majority of women in Hungary are employed and at work till four or five p.m. The school staff of the Zoltán Kodály Music School of Kecskemét, the major institution for the experiment carried out in 50 primary schools in the area, found it especially useful to not only develop a model for integrated arts education but also provide meaningful and, at the same time, enjoyable and refreshing activities for their tired from school work young pupils.

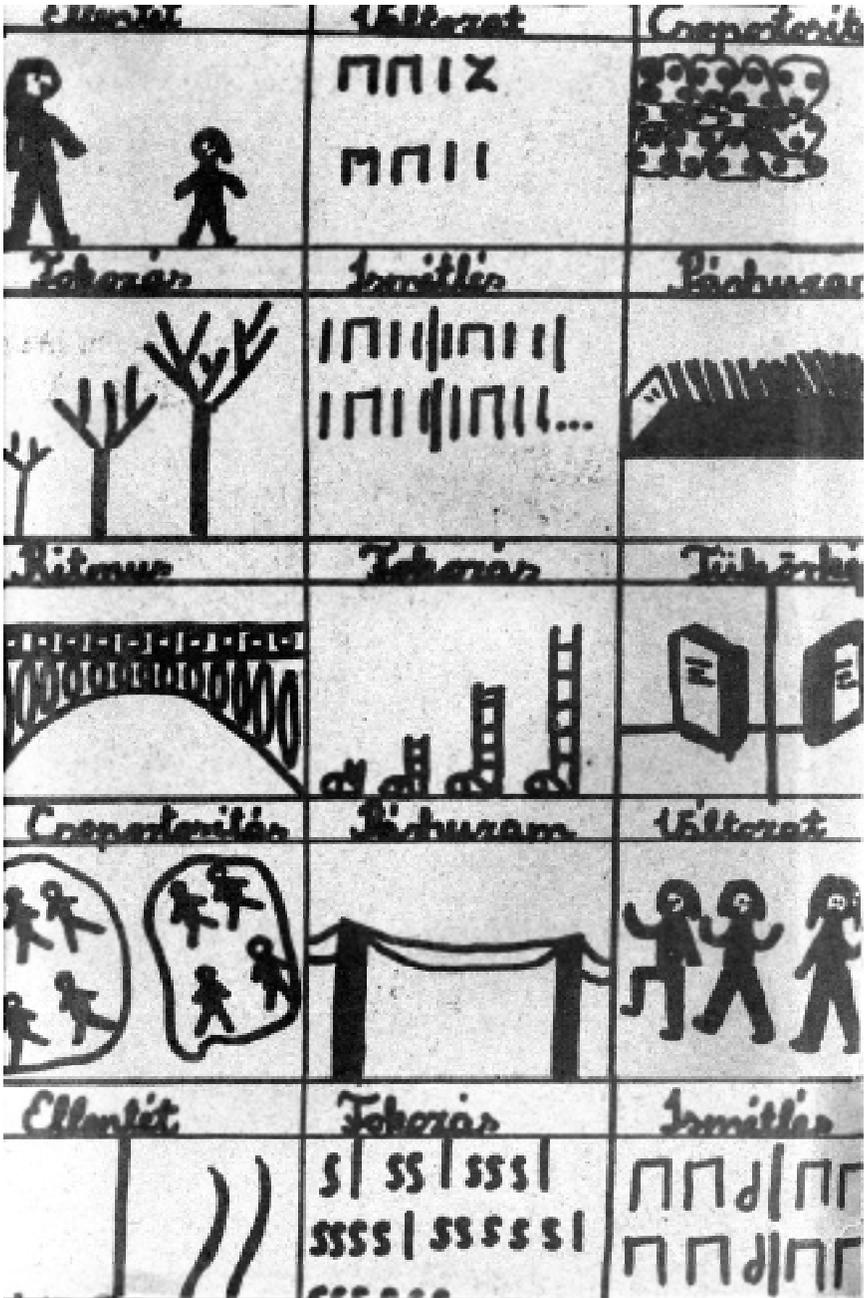


Figure 3. Symbolic representations of structural qualities by a 7-year-old girl. From left to right: Contrast, Variation, Grouping, Acceleration, Repetition, Parallelism, Rhythm, Acceleration, Mirroring, Grouping, Parallelism, and Variations.

Teachers of *music, visual arts, mathematics and the mother tongue* were involved in the planning and partly also in the execution of the project, while daycare teachers acted as facilitators for creative work and also performed some of the teaching tasks. Some famous representatives of the polyaesthetic model who conducted *demonstration classes* twice a month were the pianist and music professor Erzsébet Tusa, wife and intellectual collaborator of Ern Lendvai, the interdisciplinary analyst of music quoted above, jazz musician, critic and educator János Gonda) and the author of this paper, art historian by training. Teaching demonstrations at the Kodály School enriched monthly brainstorming and problem solving consultations of the project team. We called them *educational jam sessions* as they were regularly interpreted by musical, poetic or visual improvisations based on the mathematical or linguistic structure proposed for theme of the month.

Topics for the first three school years (ages of pupils: 6-9) of our four-year project included the following *interdisciplinary clusters*: Repetition and sequences, Variation, Combination, Complementarities and contrasts, Movement and Rhythm, Proportions – symmetry, asymmetry, anti-symmetry, the Golden Section etc., and Mood.

In the first two school years, a team of four teachers in each school taught the integrated project of basic organizational principles of the arts and sciences. The teaching team included an artist, a musician, a mother tongue specialist and a mathematician. As the focus of the project was the language of vision, the art teacher coordinated their efforts. Each project lasted for about a month and consisted of both discipline based and interdisciplinary lessons.

Topics for the fourth school year (ages of pupils: 10-11), the second part of the four-year project included the following *science and arts clusters*:

- Variations for a theme: the concept of change on arts, science and mathematics
- Where arts and science interact: design and architecture – features of two genres that shape our lives
- Arts and science of an age: the Renaissance court of King Mathias
- Folk art, folk wisdom with Zoltán Kodály and Béla Bartók in a Hungarian village (arts and science aspects of ancient Hungarian peasant life: customs, habits, life style, work and leisure).

Experiments with arts and science projects were carried on and, two decades after the initiation of the first arts and science project, in 2001, a national conference showcasing more than 30 workshops of interdisciplinary nature was held. The method became standard practice. Children involved in them may not be madly fond of mathematics but will experience science as an integral whole with the arts, as an understandable, even enjoyable constituent of their culture.



Figure 4. Variations for an unfinished symbol provided by the teacher (Works of an 11-year-old girl).

Several teachers conducted interdisciplinary lessons that often began with an artistic performance, such as a piano piece, a poem or a short, mostly improvised dramatic play or dance. Teachers invited children to observe the structure inherent in the piece and represent it in another genre: draw the rhythmic pattern of drama or dance, sing the melody inherent in movement, or improvise a poem based on the mood of music. Then, teachers of science and mathematics showed how to apply the same pattern or structure in their field and taught laws and rules related to them. At the end of the lessons, children formed pairs or groups and solved tasks that required the *generalization* of the principle observed during the lesson.

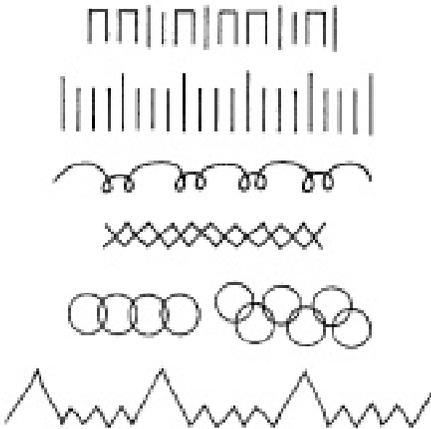


Figure 5. Representation of rhythmical patterns to be clapped and then sung with an improvised melody (Work of a boy, Grade, 3, age 8).

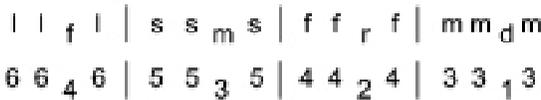
Project work also involved collection of signs, symbols, natural phenomena and images based on the structure observed. This task was in fact the exercise of *walking through the bridge* to reach science starting from art, music from dance, or mathematics from drama. Lessons in arts appreciation were included to summarize experiences and see how creative artists made use of patterns just observed in nature or in a mathematical task. These lessons were also used for linking interdisciplinary knowledge and discipline-based curriculum content and see how one task can be approached from a variety of angles.

1. What can the rule be?

- a) 2, 5, 8, 11, 14, 17, 20,
- b) 48, 24, 12, 6, 3, one and a half, three quarters
- c) 1, 2, 4, 7, 11, 16, 22,
- d) 1, 1, 2, 3, 5, 8, 13, 21, 34,
- e) 5535, 4424, 3313,



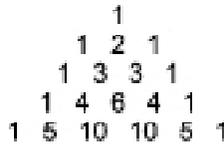
2. Sing the numbers ! Number the tunes !



3. Build a word pyramid !



4. Build a number pyramid !



5. Draw images using the rules in Task 1f, 3 and 4 !

Figure 6. A set of tasks to be carried out by 4th graders (ages 10-11 years).

Children were assessed both on disciplinary knowledge with *standardized national knowledge tests* and on creativity and intelligence using the *Raven Matrices Intelligence Test* and the *Torrance Test for Creativity*. Our findings proved that a well-organized and balanced interdisciplinary approach to arts, science and mathematics is beneficial for both knowledge acquisition and the fostering of intelligence and creativity. We found the most significant improvement in knowledge acquisition among boys aged 8, 9 and 10 years, while those who gained most in creativity as a result of the project were girls in all the age groups: from 6 to 10 years. Boys in pre-1989 Hungary often

encountered severe problems to adapt to the learning styles required by the overcrowded with facts and data central curriculum. Our approach offered them a way to use their creative instinct and intelligence to memorize facts and understand rules. Girls were first discouraged by creative tasks were no clear rules were set. Their primary school teachers in practically all disciplines were rigid. Soon the girls “re-learnt” their kindergarten playfulness and their creativity level started to increase.

The project lasted four years and was included in the educational practice curriculum of the Teacher Training College of Kecskemét, the major training center of the large prosperous Bács Kiskun County. Also in Budapest, at the home institution of the research team, Eötvös University, regularly offered seminars in Interdisciplinary Arts that teacher students of the Faculties of Arts and Sciences attended. Also experiments with arts and science projects were carried on (Kárpáti, 1992). Two decades after the initiation of the first arts and science project, in 2001, a national conference showcased more than 30 workshops of interdisciplinary nature.. The methods became standard practice. Children involved in them may not be madly fond of mathematics but will experience science as an integral whole with the arts, as an understandable, even enjoyable constituent of their culture. For this broad impact, however, a profound curriculum reform was necessary.

Interdisciplinary Aspects of Contemporary Hungarian Arts Curricula

From the middle of the 19th century, age of rebirth for Hungarian arts and design, throughout the history of Hungarian art education, artists and designers competed for dominance of the school art scene. They *manifested themselves as rival role models* — the fine artist and the designer, the creator of “non-utilitarian” beauty and the shaper of everyday environmental culture. The two camps finally suggested *a pluralistic conception of art instruction that they instituted in the National Core Curriculum (NCC) of 1994*, the central document of the new system of educational regulations in Hungary.

Disciplines in the National Core Curriculum include Mother Tongue [Hungarian], Foreign Language (not for juniors), Mathematics, Social Studies, Science and Ecology, Arts, Informatics & Library Usage, Everyday Life, Gymnastics, Geography, and Man and Nature.

The NCC defines interdisciplinary issues to be included in all disciplines: Communication, Learning to Learn, Healthy Lifestyle, Learning about Europe, Learning about the Hungarian People, International Cooperation, Protection of Nature and the Environment. All these areas require: 1) intensive co-operation of arts and science teachers already in the curriculum planning phase and 2) implementation of educational experiments like those described above material for thought and inspiration.

The disciplines that are supposed to teach aesthetics both in perception and creation are numerous and varied in Hungary. After the political changes in 1989, profound reforms in educational thinking took place and artists who had been banned even from exhibiting or performing in small and hidden places were now called to lead departments of art, music or drama education and train

the arts teachers of new Hungary. It is no wonder that the objectives for arts teaching are grounded in the Hungarian avant-garde education movement of the beginning of the 20th century lead by Zoltán Kodály, Sándor Karácsony and László Nagy.

Ā – school grades A – ages in years

GENERAL OBJECTIVES	Foundation level	Intermediate level
1. RESPOND TO WORKS OF ART	<ul style="list-style-type: none"> - observe formal qualities - express thoughts and feelings - acquire positive attitudes towards the arts - acquire audience behavior 	<ul style="list-style-type: none"> - acquire methods of criticism - observe expressive means - observe aesthetics in everyday life - experience works directly (concerts, exhibitions etc.) - respond to integrative aesthetic experiences - know about ages/epochs in the history of arts
2. EXPRESS IDEAS in an aesthetic manner, represent and create	<ul style="list-style-type: none"> - reproduce (music, drama, literature) - acquire representational techniques - experiment - utilize art appreciation knowledge 	<ul style="list-style-type: none"> - acquire rules and techniques - analyze and use genres and themes - create aesthetics in everyday life - realize the importance of arts in life
3. DEVELOP CRITICAL THINKING AND TASTE	<ul style="list-style-type: none"> - express value judgments - differentiate between beautiful/ugly, tasteful and tasteless and justify opinions 	<ul style="list-style-type: none"> - realize the importance of arts in life - differentiate historic and contemporary trends and styles - develop positive attitude and personal taste in arts

Chart 1: General objectives for the group of disciplines called “Arts”

A set of loosely formulated learning objectives, the NCC does not define learning content, and it only outlines areas that should be taught in the form of any discipline the management of the school finds appropriate. In the Core Curriculum, three separate subjects replace the school discipline “art” called “drawing” to mark its origin in geometrical representation. “*Environmental culture*,” “*visual communication*” and “*visual arts education*” are alternatives that can be taught separately or integrated in a unified art and design curriculum model. All of them include folk art as a teaching content in a variety of themes and techniques.

The Hungarian National Core Curriculum is integrative by nature and encourages interdisciplinary methods of teaching and learning. These methods have been introduced in the pre- and in-service teacher training system and are thus gradually finding their way into all school levels and disciplines of education.

The arts clearly serve as a catalyst as art teachers have enriched their professional potential having been among the first to embark on the use of computers and developed *media education* that integrates visual communication, music, drama and language arts. Art teachers are also active in the *project based teaching* movement and offer their cooperation to colleagues in science, mathematics and other branches of art. The spirit of “interdisciplinarity,” initiated by the reform pedagogy movement of the 19th century, has finally found its way in general educational theory and practice at the eve of the 21st century.

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[Titles are given in the language of publication. If this is other than English, a *translation* is provided in italics in brackets after the original title.]

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