ANALYSIS OF STEAM EDUCATIONAL ACTIVITIES FROM PRIMARY TO TERTIARY

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Abstract: One of the ways we can motivate young people is by implementing Children's Universities as a form of motivating young people for future studies in science and technology. Young people expect a wide use of information and communication technologies in education. They are eager to work actively and implement their own ideas. Children up to the age of 10 undoubtedly have a real but hidden interest in natural and technical sciences, they want to become scientists and explorers. However, after a few years of education at the primary level, the situation changes completely. Simple acoustic experiments included in the teaching from the lowest levels of the education system stimulate children from early childhood to explore and lead from initial play to subsequent experimentation and discovery of new knowledge. Initial playful experimentation that involves multiple child senses (hearing, sight, and touch) stimulates experimentation at the time of primary education and later at the time of secondary and tertiary education in technical universities motivates analysis and evaluation at higher levels of cognitive goals according to Bloom's taxonomy.

Keywords: STEAM education, motivation to study, acoustic experiments

1. INTRODUCTION

The project of the Children's University of Zilina (CHUZ), which is organized annually during the summer holidays at the University of Zilina (UNIZA) is intended for children attending primary school. This project is aimed at solving the current problem - the insufficient level of manual skills and intellectual abilities of students coming to study at universities of technical orientation. To address this issue, we want to motivate primary school pupils to study natural and technical sciences by experimenting in a university environment, and later offer technical lectures to secondary school students and allow them to experiment in laboratories. Through these activities, we want to help students coming to university overcome the misconceptions with which they come to study STEAM (Science - Technology - Engineering – Art and Mathematics) subjects at university.

2. METHODS

Acoustic experiments are a suitable tool that can be used from the early years of primary school to develop science literacy, which is seen as one of the key competencies in the PISA study. Even at a young school age, it is possible to attract children to science and technology by explaining to them, at their level of knowledge, the working principles of the apparatus they encounter. This gives children the opportunity to become scientists, if only for a little while so that they can experiment, discover, and investigate the devices and phenomena on which machines operate today. At the same time, by experimenting, they improve their manual skills and develop their intellectual abilities.

The simple acoustic experiments implemented at CHUZ (Fig. 1) can be suitably incorporated into the teaching process at primary school

as demonstration experiments that familiarize students with basic natural principles at the knowledge level according to Bloom's taxonomy of cognitive objectives (HOCKICKO, 2010).

Fig. 1: Interactive acoustic experiments - Chladni Plates on exercise: Sound and ultrasound

In the upper grades of elementary school and later in engineering universities, these experiments can be used to prepare problem tasks, either with a well-defined problem or an incompletely defined problem. In this case, the problems will be solved at the higher levels of Bloom's taxonomy of cognitive objectives - analysis, synthesis, or evaluation.

For those who would like to see and try experimenting at home, we have prepared a set of experiments in collaboration with international partners and universities, which can be accessed on our YouTube channel: https://www.youtube.com/@films4edu607/videos. A video can be found on that channel: Chladni Plates | ACOUSTICS: (Fig. 2).

For primary and secondary school teachers we have prepared scripts on USB (HOCKICKO et al, 2023), on which, in addition to the aforementioned videos prepared at UNIZA, they will also find scenarios, descriptions, and explanations of the principles and laws of physics for individual experiments.

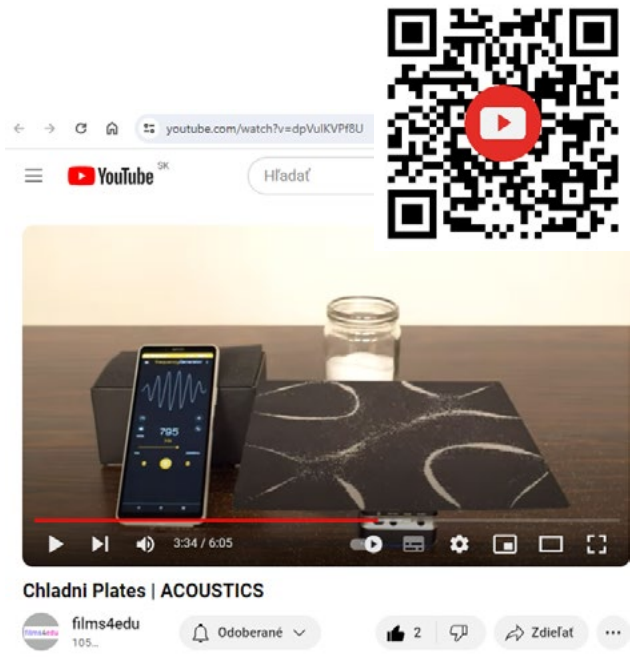

Fig. 2: Chladni Plates - a video accessible via YouTube created within the Films4edu project

3. RESULTS AND DISCUSSION

As shown by questionnaires completed by children after attending CHUZ summer activities over 17 years (Figures 3, 4, 5, 6) (in 2020 and 2021 only the online CHUZ model was implemented due to COVID-19), children attending primary schools would like to see more playful teaching, more hands-on demonstrations and experiments presented, and more work on experiments in laboratories with pupils' own activity (HOCKICKO et al, 2020).

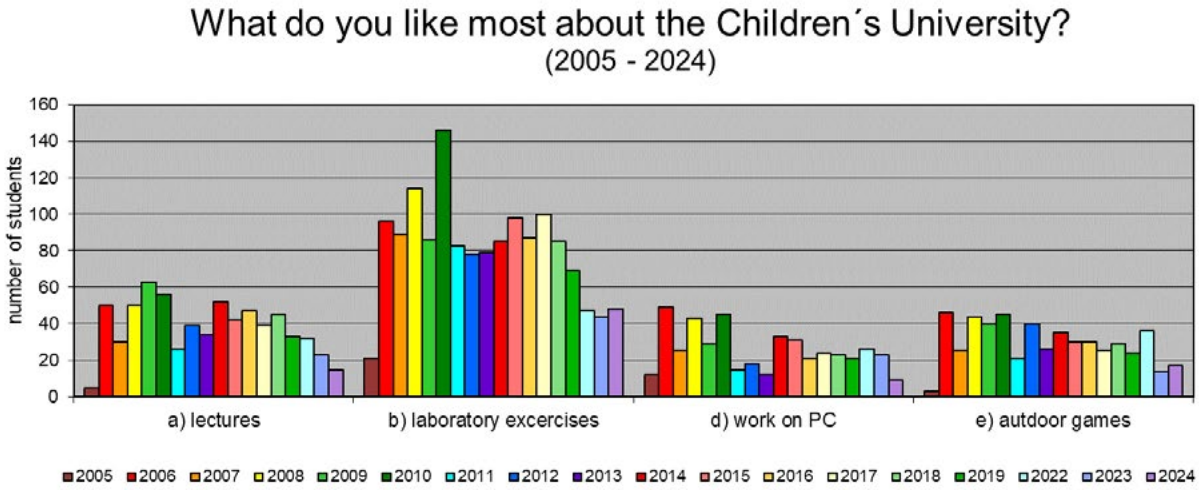

Fig. 3: Some of the results from questionnaires in CHUZ

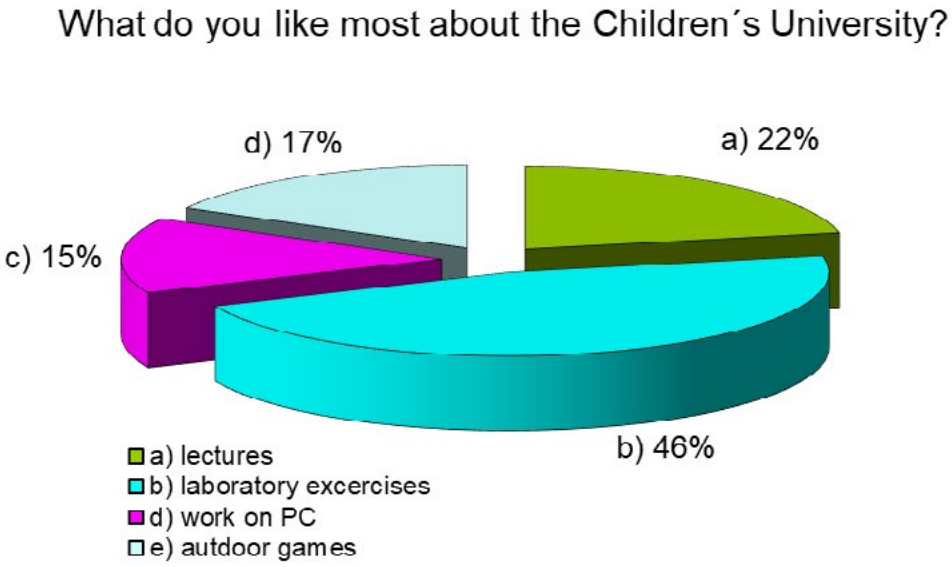

Fig. 4: Some of the results from questionnaires in CHUZ

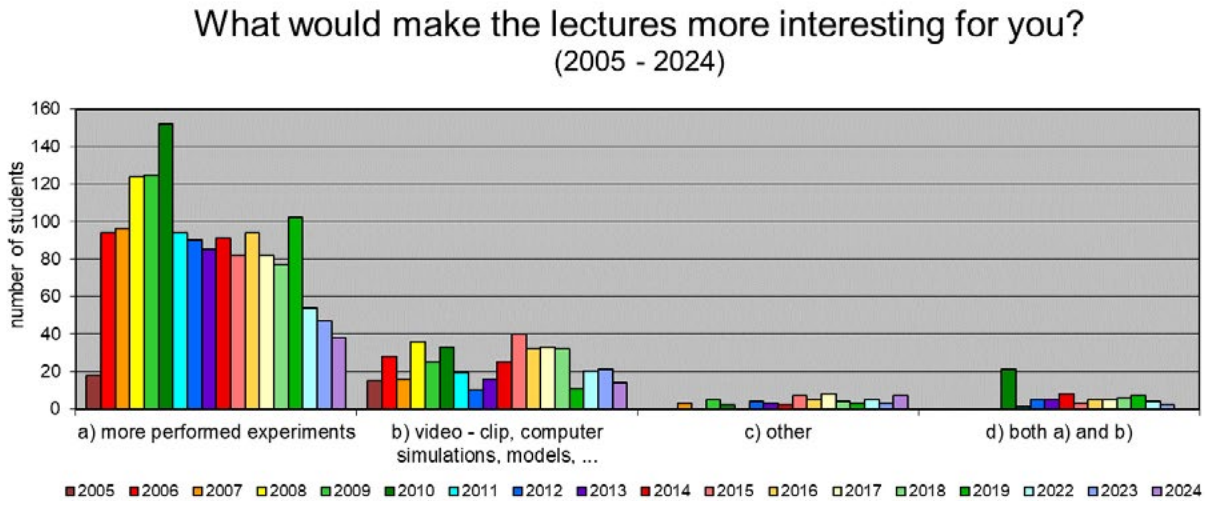

Fig. 5: Some of the results from questionnaires in CHUZ

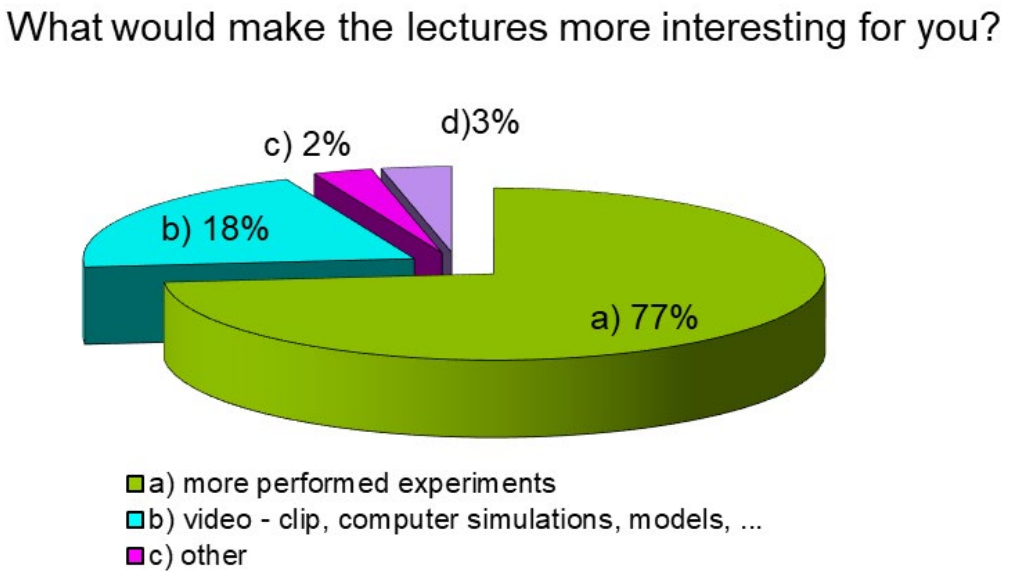

Fig. 6: Some of the results from questionnaires in CHUZ

Children like classes in which they can realize their own ideas and work actively and creatively (Figures 7 and 8). As colleagues from TUZVO (Technical University Zvolen), who participated in CHUZ 2024 with the lecture "Sounds and Noises" in the summer, said, the biggest problem in preparing the special tool "charinga" was for the children to thread the string through the hole and to make a bow or a knot. Similar experiences were had by colleagues from the interactive exposition "Land of Waves" when cutting, gluing and making camera obscura. Today's children lack manual skills. The absence of such skills may not only be the fault of schools and teaching, although in recent years subjects that were also related to manual work have been disappearing from teaching. Absence of skills can also be related to upbringing in the family. A certain group of parents do not pay enough attention to their children and spend their time passively, e.g. are played on PC or other devices. For example children are not guided to such things as threading a needle, because "I don't need to sew anything", because "I'll buy a new one". One way to remedy this, or at least improve it, is to build makerspaces in schools to help build and develop children's manual skills in the creative process itself. It will certainly come in handy later when they come to the labs at university as regular students.

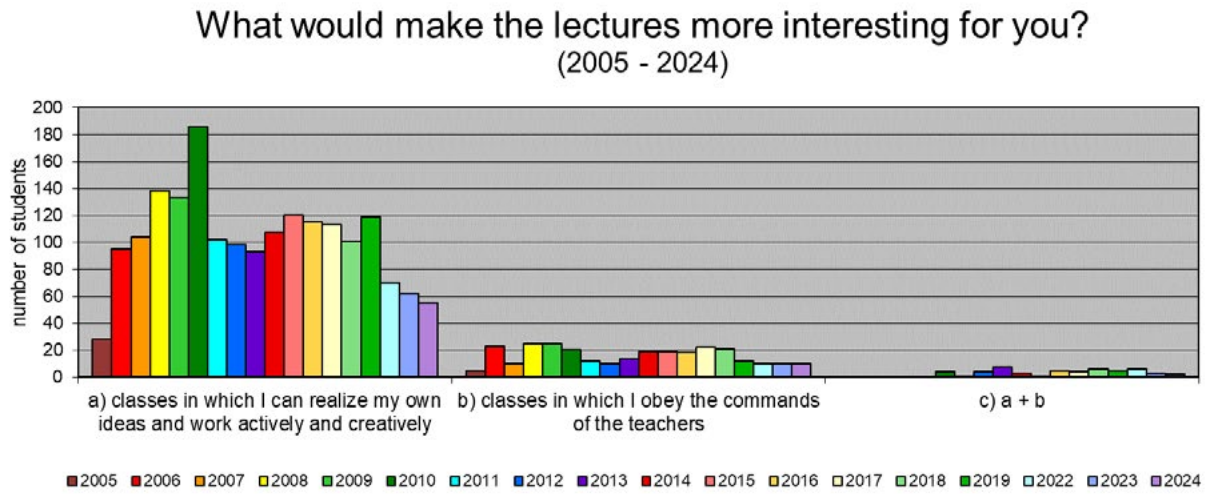

Fig. 7: Some of the results from questionnaires in CHUZ

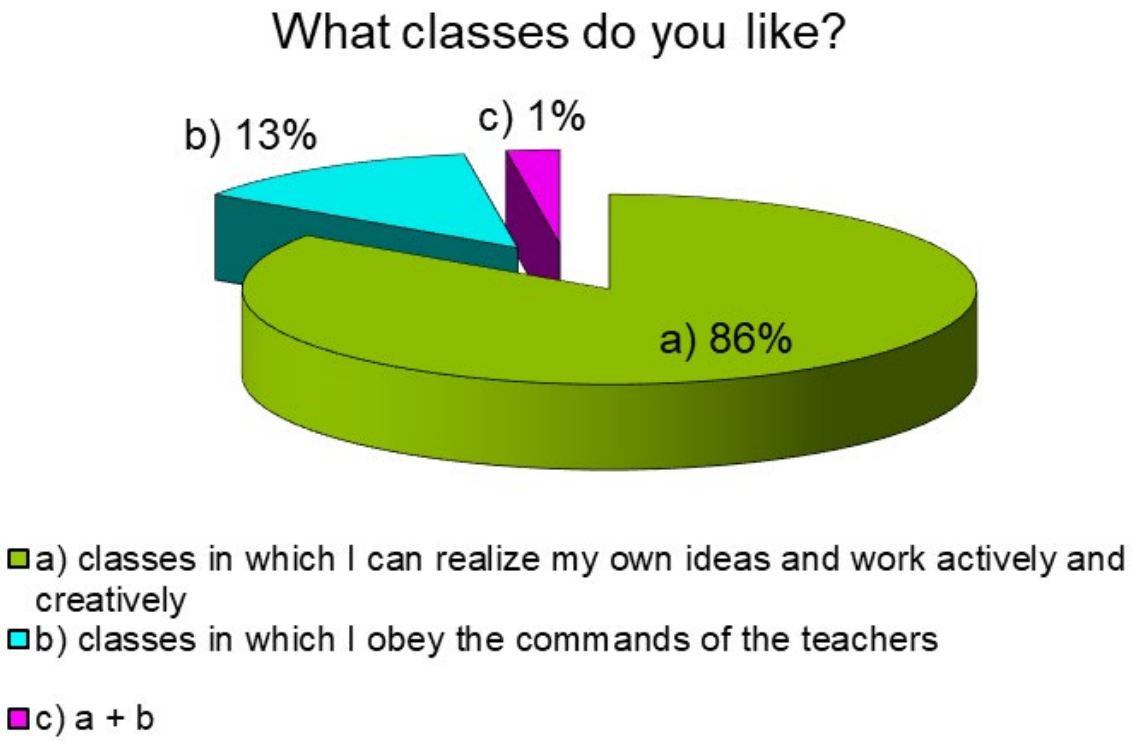

Fig. 8: Some of the results from questionnaires in CHUZ

As we can see in Figure 9, more of the children prefer work in the group – team work.

4. CONCLUSION

One of the ways we can motivate young people is by implementing Children's Universities as a form of motivating young people for future studies in science and technology. Young people expect to make extensive use of information and communication technologies in education. They are willing to work actively and

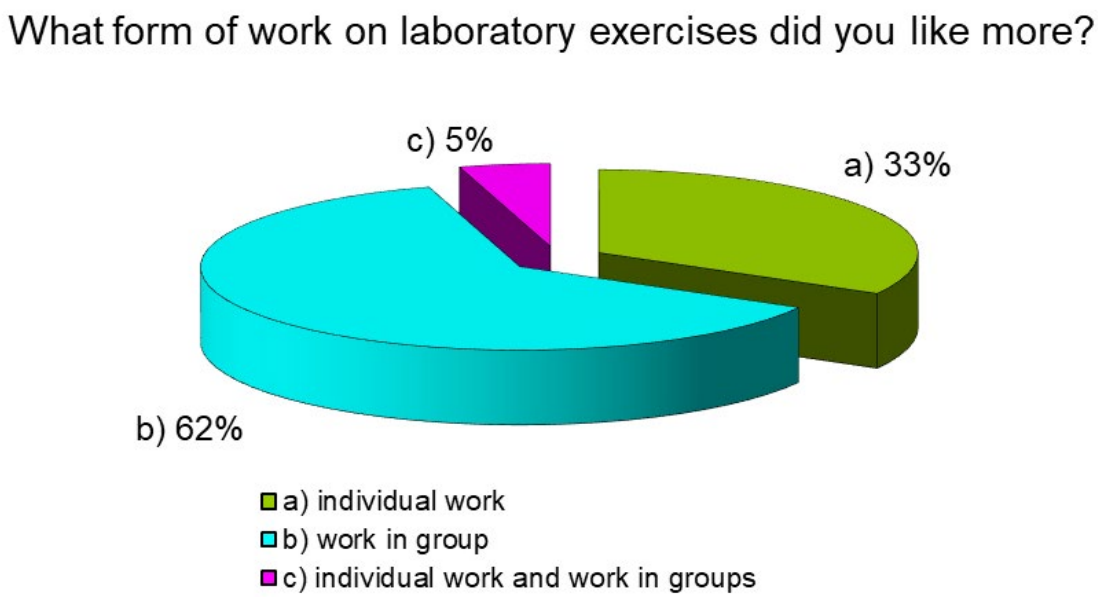

Fig. 9: Some of the results from questionnaires in CHUZ

implement their own ideas. Children under 10 undoubtedly have a real but hidden interest in natural and technical sciences, they want to become scientists and explorers. However, after a few years of education at the primary level, the situation changes completely.
Simple acoustic experiments included in the teaching from the lowest levels of the education system stimulate children from early childhood to explore and lead from initial play to subsequent experimentation and discovery of new knowledge. Initial playful experimentation that involves multiple child senses (hearing, sight, and touch) stimulates experimentation at the time of primary education, and later at the time of secondary and tertiary education in technical universities motivates analysis and evaluation at higher levels of cognitive goals according to Bloom's taxonomy.

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Gabriela Tarjányiová was born on 18.8.1978. She graduated (MSc.) from the Faculty of Mathematics, Physics and Informatics at the Comenius University in Bratislava in 2001. In 2010 she defended her PhD. Thesis in the field of Theory of Teaching of Physics at Pavol Jozef Šafárik University in Košice. Since 2002 she has been serving as a lecturer at the Department of Physics, Faculty of Electrical Engineering and Information Technology at the University of Žilina. Her responsibilities include the administration and organization of teaching activities at the Physics Department. She is interested in research of improving the teaching methods in Physics.