



Why should children's universities strive to strengthen the children's self-efficacy?

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The article aims to familiarize the reader with activities of the Children's University Foundation undertaken while participating in the international STEAM4U project. The project aimed at strengthening the children's self-efficacy, and thus promoting equity and diversity in science. Based on the source materials, the author also wants to draw attention to the problem of insufficient equity and diversity in the world of science and to describe the knowledge gained as part of the project. The study presents selected data derived from investigating self-efficacy in children, carried out within the scope of the project.

Introduction

The Children's University Foundation has been organizing workshops and lectures for children conducted by scientists and other professionals since 2007. It is a non-governmental organization acting in the field of non-formal education, which provides classes for children aged from 6 to 16. Development of the creative and intellectual potential of children, so that they can understand the world around them and are able to act using the richness of their talents, knowledge, and abilities constantly remains the mission of the Foundation. The participation in the STEAM4U project enabled the Foundation to take on new challenges posed by international cooperation and sensitize to a specific problem. The primary goal of the project was to strengthen the self-efficacy of children aged 10–14 in the area of STEAM (Science, Technology, Engineering, Arts, Mathematics). It is worth to emphasize the universality of this concept in the field of education. The project partners intended to develop those aspects of their everyday activity which could contribute to enhancing the children's self-efficacy. Participation in the international project revealed that there is a strong need to develop confidence in the youngest in the STEAM area, and thus, the necessity to promote equity in science, does not refer only to Poland.

What is self-efficacy?

The concept of self-efficacy, as explained by Augustyn Bańka quoting Albert Bandura means *a specific assessment of one's own competences, the possibility to perform various tasks in a given field, so it is an individual judgment of one's ability to cope with specific tasks* (Bańka, 2016, p. 9). It can therefore be said that this is a subjective belief, which amounts to saying, 'I know that I can do it,' 'I know I can cope with it.' Self-efficacy refers to the possessed skills and some kind of certainty that one can face a given task. This concept is especially important when we look at it in the context of education. By strengthening the children's self-efficacy, one can shape their belief that they can cope with learning, that is, they can manage to do tasks that previously seemed impossible for them to undertake (regardless of social stereotypes or the social capital that a child has). It is worth noting that the self-efficacy is closely related to the aspirations of individuals and the goals they set for themselves. As Bańka emphasizes, people with a higher self-efficacy are less afraid of new challenges and are more willing to undertake them (Ibidem, p. 10). This is especially important when we take into account the school period, i.e., the time when we are just discovering what we like, what we can be good at, the period which indirectly influences the subsequent choices and, in the longer term, the choice of professional path. It is worth, therefore, while acting in the area of education to use from the very beginning such strategies that will enhance in children the conviction that they are good in some area, that they possess proper skills to face, for example, a mathematical or technical task.

In the Polish teaching context, that issue seems to be particularly important. As the report from research on the school textbooks shows, many pieces of content included in them strengthen gender stereotypes concerning, among others, social roles or professions

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(ICBPKiT, 2015, p. 7). According to the authors of the report (...) *in the case of the analyzed textbooks, one can notice a significantly more frequent representation of men in the professional roles at the top of the hierarchy – senior management, non-technical intelligence, freelance professions. Women are in turn significantly overrepresented in professions related to office work, to trade and services. More often than men, they are presented as people outside the working world – unemployed or studying* (Ibidem, p. 20). In this context, the appropriate attitude of teachers and other people conducting classes with children can complement the necessary message about the gender equity issue. It may help to educate children about the fact that both boys and girls can meet in the future their objectives in exact sciences and also act professionally in the field of science and consequently choose the same career path.

Striving for equity in education

The indicated problem can be tackled from the perspective of unequal representation of women and men as well as people of various social backgrounds in the world of science, which in principle should be available to all researchers, regardless of their origin or gender. The STEAM4U project drew attention to the need of addressing the problem of inequity in science and underlined the importance of enhancing children's self-efficacy as the activity that would reduce these disproportions in the future. Strengthening in children the belief that scientific activity is for them, making them aware of their skills, may in the future pay off with the fact that they will boldly aspire to professions and fields of science that stereotypically seem to be reserved only for people of specific sex, origin or social status.

The aforementioned problem of insufficient equity in the world of science can be confirmed by data from the Central Statistical Office, which indicate a significantly lower involvement of women in the world of science in Poland. As these data show, in 2005 the academic titles of Professor granted to women constituted 27% of the total titles awarded in this category (CSO, 2007, p. 120). On the other hand, doctoral and postdoctoral degrees awarded to women constituted 49.5% and 36% of all titles successively (Ibidem, p. 119). More than a decade later, GUS data from 2016 show a similar percentage distribution of women's participation in the world of science. The doctoral and postdoctoral degrees granted to women constitute respectively 53% and 43% of all titles (CSO, 2017, p. 160), whereas the title of professor 33% of all titles awarded in this category (Ibidem, p. 161). The indicated problem seems to arise, at least partially, from prejudices deeply rooted in university structures. It can be exemplified by the experiment, referred to in the article written by Anna Tylikowska for 'Polityka' (Tylikowska, 2017, pp. 88–91). The experiment involved 100 science employees and was conducted by the team of a psychologist, Corinne Moss-Racusin, from New York's Skidmore College. The researchers

created a fictitious CV of a person applying for the position of a research laboratory manager. The CV had two versions, differing only in the candidate's gender. The researchers proved that the professional biography of a man was more often assessed positively by the scientists. Thus, it turned out that the identical achievements presented in the CV were additionally assessed, perhaps unknowingly, through the gender perspective of the candidate.

There is still a need to promote equity in the world of science and increase the participation of women in the STEAM area. This problem can also be extended to other categories different than gender – such as origin or ethnicity. Well-designed programs and activities that will facilitate women's scientific work can constitute an answer to this challenge. At the same time, it is also worth focusing on the earlier stage of children's education and starting at the level of primary school to strengthen their belief in the value of their skills, to know that they can aspire high.

So what kind of action should be undertaken in education to strengthen the children's self-efficacy? Is there any place for that in the activity of children's universities? The participation in the STEAM4U project caused the need to reflect on how the activities of organizations or institutions related to education can affect the increase of children's self-efficacy.

Experience from the STEAM4U project

Observing the activities of the Children's University Foundation, one may spot that it is the meetings of children with scientists and specialists that make students of the Children's University feel more confident in STEAM area. The first task in the project was to analyze the activities of each of the partners. It was to indicate the essential aspects of this activity in terms of affecting the children's self-efficacy. The areas worth strengthening in the Foundation's actions proved to be, on the one hand, the student-teacher relationship, and on the other hand, shaping a positive learning environment/atmosphere affecting the participants. That indicates essential features that distinguish children's universities, which are meetings with scientists on a university campus, the use of laboratory equipment or exploiting methods of work other than those used during the lessons. All these elements can affect the participants of the course and translate into a different perception of their skills and abilities.

What is more, a meeting with representatives of the world of science can demystify that world sometimes perceived by children as the world reserved for a stereotypical scientist 'in a white apron.' Getting to know real scientists, their passion or attitude, experiencing them the way they are and how they work can encourage participants to acquire scientific knowledge. The young students can, therefore, create their own picture of scientists and the world of science based on their personal experience gained during the classes. Thanks to this, they can more easily attempt to identify themselves as future scientists.

The aim of the Foundation in the STEAM4U project was, first of all, to focus on those aspects of its activities that might help children appreciate their skills. Another important goal was to create a learner-friendly environment and to prepare the lecturers to work with children. The latter aspect, namely building a friendly scientist-child relationship, was treated as a priority. The role of the course instructors was to teach children that mistakes accompanying scientific research are nothing unusual neither wrong and they do not indicate someone's inability to cope with the task. Just the opposite – the errors and one's attempts to correct them can be a valuable lesson in solving problems. The scientist thus becomes a guide in the world of science. Also, an appropriate interpretation of errors and mistakes allows children to learn how to deal with failures. Another strategy of action that can be included in the teaching process is the right way to motivate children and comment on their work. Encouragement through praise, emphasizing commitment and work or providing proper feedback is highly advisable when working with children.

As part of the project, the Children's University Foundation prepared materials for the teachers conducting classes with children. They contain additional knowledge on how to strengthen the self-efficacy in young learners. Graphical elements support the presentation of the selected pieces of information on how to motivate and comment on children's work. Additionally, two video materials dedicated to the lecturers were developed. In the first recording, the lecturers at the Children's University describe their impressions after lectures and share some tips on how to talk to children. The second video directly concerns the concept of self-efficacy and justifies why it is essential to strengthen it in children. Another material developed as part of the project is a film dedicated to children. Its role is to show children what the day of a scientist looks like and what features are important in his/her work. Thanks to this recording children can learn, among other things, that in the world of science, everyone speaks a language specific for that world, regardless of their gender or origin. Therefore, it may be concluded that the world of science should not depend on such divisions. All materials are available in English, which increases the reach of recipients and facilitates the dissemination of knowledge on the discussed topic.

The materials developed within the project can be used both in formal and non-formal education (i.e., the children's universities). It is worth to be mentioned that each partner of the project worked on the materials aimed at different groups of the recipients (e.g., parents or volunteers). Such an approach extended the variety of strategies that can be used to enhance the children's self-efficacy.

Evaluation of activities

The Foundation's task within the framework of the project was to check which elements of the activities are most meaningful to children in terms of the enhancement of their self-efficacy. At the same time, from the Foundation's point of view, it was interesting to learn whether the classes at the Children's University contributed to increasing the sense of the effectiveness of their participants. The study was carried out among the students of the 'Master and Apprentice' program (12–13 years) of the Children's University. The program for this age group covers five cyclical meetings in one semester with a scientist of a selected specialization. Children also participate in various additional lectures. The survey consisted of three parts – a pre-test questionnaire (before the start of the first classes), a mid-test after three consecutive meetings, and a post-test questionnaire (at the end of classes closing the selected specialization).

The pre-test yielded answers from 192 students ($N_{\text{girls}} = 73$, $N_{\text{boys}} = 119$), 155 students participated in the post-test ($N_{\text{girls}} = 60$, $N_{\text{boys}} = 95$). The data were collected in the first semester of the 2017/2018 academic year on the selected specialties, including seminars on genetics, microbiology, and electronics.

The first group of questions referred to the general reception of classes by children (whether the classes were interesting to them or not) whereas the second part aimed to clarify which topics or aspects of the activities the children liked most. Additionally, the questionnaire included questions related directly to the level of self-efficacy associated with the tasks such as: conducting experiments, searching for solutions to the given problem, collaborating with others or presenting results and conclusions. For the Foundation, the children's answers constitute a source of knowledge about the areas in which the strengthening of the participants' self-confidence can actually be seen. It may also be assumed that at least some participants of the course while answering the questions in the surveys asked themselves whether they felt that after completing the course they knew more – which may be considered a kind of 'monitoring' the competences.

By juxtaposing data from the pre-test and post-test, a declaration of an increase in self-confidence in some categories can be noticed (to varying degrees among boys and girls). The data also allow for checking if the participants feel that their sense of agency in particular aspects has increased. Additionally, the data enhance the identification of those elements of classes at the Children's University, which are the most significant for the participants in terms of influencing their self-confidence.

The collected data have been analyzed and the results described in the case study created as part of the project¹. The data presented in Figures 1. and 2. come

¹ More information about the project could be found at: <https://steam4u.eu/homepage/steam4u-on-line-guide/>

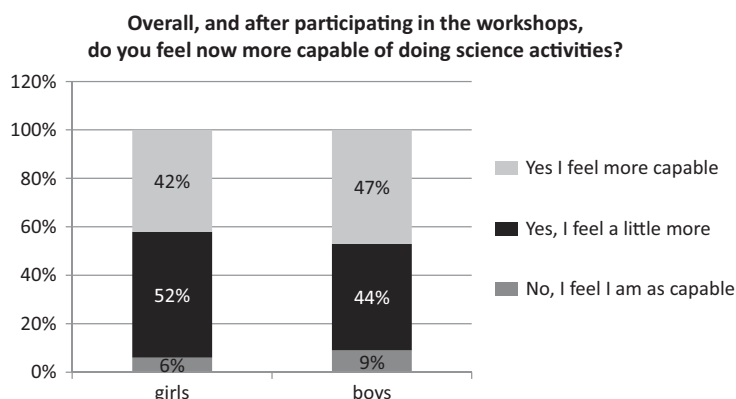
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from the analysis of the answers to two questions from the post-test questionnaire. The first question directly concerned the student's assessment of self-confidence (the question: 'Overall, and after participating in the workshops, do you feel now more capable of doing science activities?'). The second question aimed to indicate which aspects of the classes could influence the assessment of self-confidence by students (the question: 'Which of the following characteristics of the workshop have made you feel more capable of doing science activities?'). Figure 1. illustrates the study in terms of self-efficacy in children, providing an answer to the question whether it increased after the entire cycle of classes. The presented answers show that both girls and boys declare that their self-confidence increased. However, the differences between them are visible at the level of selected categories of answers. The option 'Yes, I feel a bit more capable'

was indicated by 52% of girls and 44% of boys. The responses show a difference of 8 percentage points between the indications of boys and girls. However, the category 'Yes, I feel more capable' was chosen by 47% of boys and 42% of girls, which gives 5 percentage points difference.

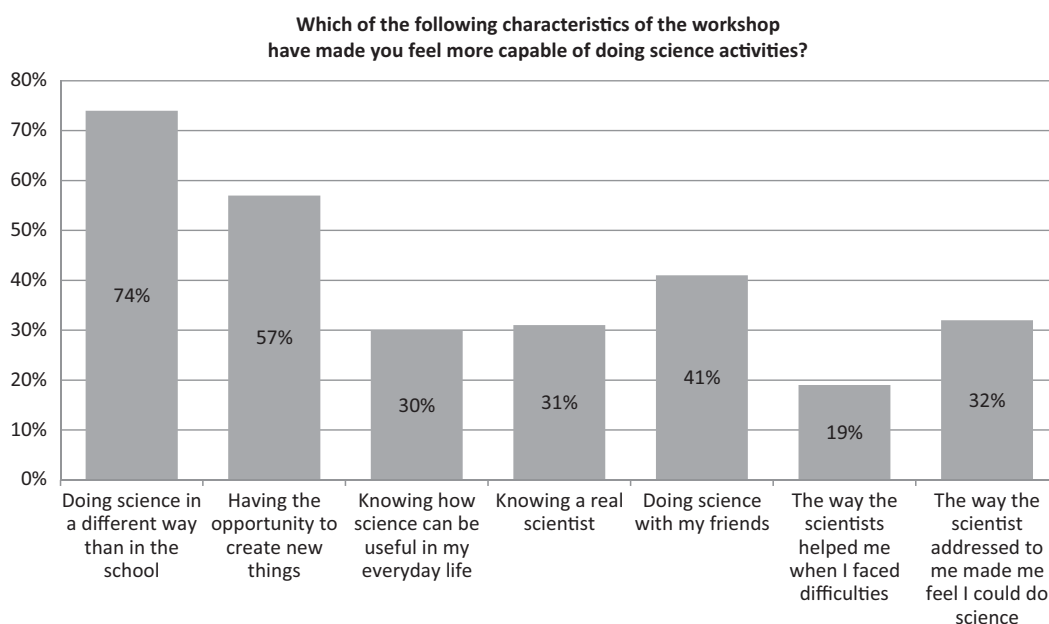
The factors that can affect the children's confidence constitute another aspect of analysis. Figure 2. presents the distribution of children's answers to this question. The data show that for children the opportunity to use during the classwork methods other than at school and the possibility to create new things were the most significant. It is these elements of classes that appear in the participants' declarations most often. Other aspects, such as getting to know the scientists or the way in which the lecturer encouraged for work continuation were less significant and less frequently chosen as answers.

Figure 1. Children's assessment of self-efficacy



Source: Author's own study.

Figure 2. The analysis of factors influencing children's assessment of their own skills



Source: Author's own study.

Thus, the main factors influencing the enhancement of self-confidence in children are active classwork and the feeling that they create something new. Independent work and problem solving allow participants to see the immediate effect of their actions and tangibly feel that they can do something or create something new. Thanks to this, they feel that they have coped with the task, which strengthens confidence about their own skills. Although the impact of scientists on the sense of effectiveness in children has not been clearly justified during the study, it seems that the person who leads the course may significantly affect the way in which the participants interpret their own actions and mistakes. The influence of the lecturer themselves seems to be a long-term process, which may affect the way in which participants will assess themselves (however no direct relation was found). Therefore, scientists should be supported in the preparation process for conducting classes with children, to make them sensitive to the concept of children's self-efficacy so that they could express the proper attitude or feedback to strengthen the 'I know I can' belief in the youngest. The method used by the teacher (in the case of children's universities, a scientist conducting classes for children) to affect his students is described by Czesław Kupisiewicz. *Students fascinated by the personality of a good teacher see in him/her a model worth following (...). And vice versa, a less ambitious teacher (...) will not encourage people to 'go beyond mediocrity,' will not set targets for them that are worth pursuing and should be pursued* (Kupisiewicz, 2012, p. 224). It illustrates the teacher-student relationship in which the teacher can be a catalyst that encourages students to learn and take on challenges.

Conclusions

The STEAM4U project drew the Foundation's attention to the necessity of including the concept

of children's self-efficacy as part of educational activities. The examples in the first part of the article illustrating an inadequate representation of man and women in the world of science prove that the issue of gender equity in that world should be promoted from the early level of school education. Such activities could help students to appreciate the value of the skills and competences they possess so that they can choose their future career path based on the unbiased evaluation. The experience gained through the participation in the project allowed the Foundation to learn in what a manner its activities can strengthen the child's self-efficacy. It was also an opportunity to exchange experiences, knowledge and good practices with other partners. The analysis presented in the article only highlights the problem and may constitute an invitation to other educational organizations and institutions to enhance their activities with methods that strengthen the children's self-efficacy.

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Abstract

The article originates in the experience of the Children's University Foundation gained during the participation in the international project STEAM4U, implemented as part of the Erasmus+ program. The aim of the study is, on the one hand, to explain the concept of self-efficacy in the field of education. On the other hand, it outlines the problems of gender and origin inequity in the world of science. The author of the article describes the project initiatives undertaken by the Foundation that enhance children's self-efficacy and presents selected teaching strategies that can be applied to the activities of children's universities or other educational institutions. The study presents selected data derived from the research on the children's self-efficacy, carried out as part of the project activities. The data allow for answering the question of whether the classes at the Children's University strengthen the children's self-efficacy and for indicating what types of activities are greatly appreciated by children. The participants' answers reveal that the most significant factors influencing the enhancement of self-confidence in the area of STEAM are active involvement and the use of learning methods other than those exploited at school. The experience described in the text may be an inspiration for other educational initiatives, encouraging them to enrich the teaching process with strategies oriented on developing the children's self-efficacy.

Key words: self-efficacy; non-formal education; children's universities; equity in science; STEAM

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