**Report on the outcomes of the survey conducted within the Working package 1 of the project: 598367-EPP-1-2018-1-SE-EPPKA2-CBHE-JP –STEM**

**«Integrated Approach to STEM Teacher Training»**

The project team of Southern Federal University in collaboration with I. Kant Baltic Federal University and Belgorod State University has conducted a survey of three target groups in Russia intended to identify middle and high school (6th -11th) students’ attitudes towards STEM, specifics of teaching STEM subjects at school, STEM-focused courses at supplementary education institutions, STEM teachers’ PD needs and prospects for integrated STEM approach implementation in Russia;

The project team has developed online questionnaires related to the target groups and survey’s goals. The following are online questionnaires’ links:

1. questionnaire for middle and high school students: <https://forms.gle/wpN5wjNMW4jSZn2E8>
2. questionnaire for secondary school teachers of STEM-disciplines: <https://forms.gle/gQU3gYK96DugmFjm6>
3. questionnaire for STEM-teachers at supplementary education institutions: <https://forms.gle/LxPT1a6GxksUGyAT6>

The analysis of the survey’s results was conducted by the project coordinator in Southern federal University M. Bondarev.

**Survey of middle and high school students’ attitudes towards STEM in Russia**

**(based on the questionnaire for middle and high school students)**

**The goal of the survey** isto identify the interest and attitudes towards STEM-disciplines (Chemistry, Physics, Biology, Geography, Technology, Mathematics, Informatics/Computer Science) of students in Russian schools. 952 Russian respondents (mainly 7th-10th grade students) from Rostov-on-Don and Volgodonsk (cities and towns of Rostov Oblast), Belgorod (cities and towns of Belgorod Oblast) and Kaliningrad (cities and towns of Kaliningrad Oblast) participated in the survey.

**Outputs of the survey:**

1. According to the results of the survey the most part of respondents (72 %) are satisfied with teaching STEM subjects, whilst only 62 % find their STEM subjects interesting (43% find them somewhat interesting and only 19 % - very interesting). As far as the use of ICT, educational/professional software and Internet resources during STEM subjects is concerned, approximately 66 % of respondents confirm the level of the use to be enough (but only 35% note the equipment and software are used regularly). 28 % of respondents claim that teachers rarely or never use ICT and specific software in the classroom. 26 % admit that there is not enough state-of-the art ICT / lab equipment and STEM tools and kits in their school. The great majority of students (696 out of 952) point out that usual STEM classroom activities in their school involve doing “exercises in the textbook” and only 38 % do laboratory work on a regular basis. Less than 20% carry out individual or group projects and conduct (mini-) research. Only 10% of the respondents state they study real-world cases and take part in interdisciplinary projects. Judging from this data, it’s possible to draw the followings conclusions: STEM teaching in Russian schools is fundamentally relevant to satisfy the majority of students. However, STEM teacher training programs to be developed should consider techniques and practices of motivating students as well as using ICT/lab equipment and STEM tools while promoting laboratory work, interdisciplinary projects and studying real-world cases.
2. The participation in STEM-focused extracurricular activities is shown mainly in the following disciplines: Mathematics – 450 resp., Biology – 175 resp., Chemistry – 172 resp., Physics – 171 resp., Informatics – 143 resp. While such areas as Geography, Ecology, 3D-modeling and prototyping, Technology, Robotics and Engineering are not so popular (less than 100 resp.). These data define the need for extracurricular training programs promotion in the subject areas mentioned above as well as development of PD programs and courses for future STEM evangelists/ambassadors. It’s also worth mentioning that 276 resp. (about 30 %) don’t participate in STEM-focused extracurricular activities, so the project team considers overcoming this tendency by designing and implementing educational marketing courses into the M.Ed. curriculum and PD programs to be developed.
3. The analysis of the students’ future career preferences shows that the choice of career paths is mainly related to Math, Informatics, Biology and Physics, while Chemistry and Technology are not considered important which definitely doesn’t meet the current needs of the National Technology Initiative and Russian S&T Development Strategy. Such attitudes point on the necessity of paying attention to these subject areas in the aims of completing the whole STEM approach consistency. New concepts of Technology and Chemistry as well as new methods of teaching Robotics, Engineering, Ecology etc. should be promoted.
4. Paying attention to the attitude towards STEM-focused supplementary education courses/activities (delivered in programming schools, FabLabs, science parks, Quantorium technology parks, coworking and leisure centers), approximately 50% of respondents do not attend them at all (466 resp.). A similar ratio represents those not participating in STEM competitions, contests, summer schools and camps (352 resp.). This negative tendency is to be overcome by implementing regular STEM-days, STEM-weeks and festivals, STEM ambassador programs and keeping events at STEM learning resource centers.
5. 51 % or respondents admit they were not influenced by anyone but themselves while planning their STEM-related career. Only 10 % of respondents were influenced by teachers. This tendency should also be overcome by developing and implementing into practice a course/training program in STEM-career guidance for teachers, so that the latter could motivate more students to continue into higher education and work in STEM-related areas.

**Survey of specifics of teaching STEM subjects in school, STEM teachers’ PD needs and prospects for integrated STEM approach implementation in Russia**

**(based on the questionnaire for secondary school teachers of STEM-disciplines)**

**The goal of the survey** isto study specifics of teaching STEM subjects in school, to identify STEM teachers’ PD needs and prospects for integrated STEM approach implementation in Russia. 166 respondents from Rostov-on-Don (cities and towns of Rostov Oblast), Belgorod (cities and towns of Belgorod Oblast) and Kaliningrad (cities and towns of Kaliningrad Oblast) participated in the survey. The profile of the respondents: 83 % female; age: less than 30 – 14 %, 30-35 – 16 %, 36-45 – 23 %, 46-55 – 33 %, more than 55 – 14 %; education grade levels: master’s degree – 60 %; approximately a half of respondents have more than 20 years of pedagogical experience.

**Outputs of the survey:**

1. According to the results of the survey STEM-teachers of comprehensive educational organizations show a significant interest in STEM PD programs as well as regional STEM resource and learning center activities. 69% of respondents claim to use teaching strategies, methods and techniques of the integrated STEM approach within classes and extracurricular activities whereas about 30% do not do it or are even not familiar with such an approach. Therefore, we believe it necessary to develop and implement STEM promoting activities and in-depth training programs/courses for teachers to adapt a new conceptual model of integrated STEM-education.
2. According to the respondents the main factors that negatively affect students’ motivation and quality of teaching STEM-disciplines are the lack of ICT (74 resp.)/laboratory equipment (55 resp.) and modern T&L materials (64 resp.) as well as lack of popularity of STEM careers (44 resp.). The respondents also note the lack of effective professional engagement and collaboration between educational organizations, businesses and industrial partners (31 resp.) in the implementation of STEM-disciplines, as well as lack of teachers motivation (28 resp.) and shortcomings in the methodology of STEM-teacher training (modern PD training courses, integrated STEM programs etc.). In this context, the importance of setting up a regional STEM learning resource center intended to provide teachers with T&L materials, PD training/M.Ed. courses and relevant equipment is favorably clear. It is also critical to promote interinstitutional interaction and collaboration between schools and STEM centers (71 reps.), educational centers for gifted and talented children (57 reps.), supplementary education institutions (Quantorium technology parks) and FabLabs (39 reps.), national and regional businesses/industries to ensure higher level of student motivation and quality learning experiences within STEM classes and STEM-focused extracurricular activities.
3. M.Ed. curriculum and PD training courses to be developed within the project should focus on the following pedagogical approaches, teaching methods and techniques indicated by the respondents as providing high students’ motivation and good learning outcomes within the STEM subjects: PBL, IBL, differentiated learning, research and laboratory studies. The following are the areas in which the respondents would like to enhance their professional knowledge and skills: the use of educational/professional software and online tools (73 resp.), the subject matter of STEM subjects they teach (58), psychological and pedagogical support for students (52), the use of ICT and laboratory equipment in the classroom (47).
4. In this context, the respondents also consider vital to pay attention to extracurricular activities, such as those preparing students for state exams, STEM labs and clubs, excursions, out-of-class events and conferences, science fairs and festivals.
5. Another negative trend for the project team to overcome by implementing PD training/M.Ed. courses/STEM ambassador programs and keeping STEM events is connected with a low teacher involvement in activities related to the implementation of the integrated approach to STEM education in educational institutions: 79% of respondents do not participate in such initiatives/activities.

**Survey of specifics of teaching STEM-focused courses at supplementary education institutions, STEM PD needs and prospects for integrated STEM approach implementation in Russia (based on the questionnaire for STEM-teachers at supplementary education institutions)**

**The goal of the survey** isto study specifics of teaching STEM-focused courses at supplementary education institutions, STEM PD needs, and prospects for integrated STEM approach implementation in Russia. 128 respondents from Rostov-on-Don (cities and towns of Rostov Oblast), Belgorod (cities and towns of Belgorod Oblast) and Kaliningrad (cities and towns of Kaliningrad Oblast), Kazan (cities and towns of The Republic of Tatarstan) participated in the survey. The profile of the respondents: 65% female; age: less than 30 – 16 %, 30-35 – 14 %, 36-45 – 28 %, 46-55 – 26 %, more than 55 – 16 %; education grade levels: master’s degree – 49 %; 34% of respondents have more than 20 years of pedagogical experience. 66 respondents work at municipal and regional supplementary education institutions; Mathematics, Robotics, Biology, Design, Physics, Engineering & Construction and Programming represent the framework of the STEM courses and supplementary education programs they especially focus on.

**Outputs of the survey:**

1. The results of the survey show the need to expand the STEM-teachers training in two main areas: *theoretical training* as the majority of the respondents recognize they do not use STEM teaching strategies on a regular basis/at all, 24% are not familiar with the conceptual model of integrated STEM-education; *practical development and implementation of integrated STEM modules* on the basis of research and laboratory studies (52 resp.), Project-based learning (48 resp.), case study (38 resp.), PBL/IBL (37 resp.) as the most efficient to provide high students’ motivation and good learning outcomes within the STEM courses and SEP they teach. It is to be noted that STEM-teachers at supplementary education institutions claim to use traditional learning strategies not so often as comprehensive school teachers.
2. According to the representatives of this focus group the main factors that negatively affect the motivation and quality of training of students in STEM-activities are also the lack of ICT equipment (53 resp.), educational/laboratory equipment (36 resp.) and modern T&L materials (42 resp.). It seems certain that in this case regional STEM learning resource center intended to provide teachers with T&L materials, PD training/M.Ed. courses and relevant equipment should become the core element of the regional STEM ecosystem. The following are the areas of professional development in which the majority of teachers are planning to enhance their professional knowledge and skills: the use of educational and professional software and online tools (43 resp.), the use of ICT and laboratory equipment (37 resp.).
3. More than 30% of the teachers at supplementary education institutions do not participate in any initiatives or activities related to the implementation of the integrated approach to STEM education in educational institutions. The ones who do attend conferences/seminars (less then 30%), organize STEM project activities (15%) and conduct research in STEM education (14%). This trend also should be taken into consideration while developing and implementing PD training/M.Ed. courses/STEM ambassador programs and keeping STEM events within the project.
4. The main education institutions the respondents collaborate with are represented by comprehensive schools (73 resp.) and municipal/regional supplementary education institutions (41 resp.). So as to ensure higher level of student motivation and quality learning experiences when running STEM courses and SEP the respondents deem appropriate to collaborate with STEM learning centers and innovative supplementary education organizations (“Quantorium” technology parks for children and youth, “NTI Circle Movement” project groups) (27%), regional centers for gifted children (23%), national and regional businesses and industries (21%). These issues should be addressed while developing and implementing PD training courses as well as M.Ed. teaching internship and school placement.
5. According to the survey results the respondents of this focus group are particularly interested in the following deliverables of the project “Integrated approach to STEM teachers training”: STEM PD training courses for teachers, best practices in STEM education and STEM ambassador programs.

The project team of M. Auezov South Kazakhstan State University together with S. Amanzholov East Kazakhstan State University and L.N. Gumilyov Eurasian National University has conducted a survey of three target groups in Kazakhstan intended to identify middle and high school (6-11th) students’ attitudes towards STEM, specifics of teaching STEM subjects at school, STEM-focused courses at supplementary education institutions, STEM teachers’ PD needs and prospects for integrated STEM approach implementation in Kazakhstan.

The project team has developed online questionnaires related to the target groups and survey’s goals. The following are online questionnaires’ links:

1. questionnaire for middle and high school students: <https://docs.google.com/forms/d/1ZjZo6kg2lmKg7wOefs41z0OmMAT9LwmnOo-pmKeIw6s/edit>
2. questionnaire for secondary school teachers of STEM-disciplines: <https://docs.google.com/forms/d/1jdxlAQshBobrt-WWJbTMScrvHpjXi3m-DG9rJ_raheY/edit>
3. questionnaire for STEM-teachers at supplementary education institutions: <https://docs.google.com/forms/d/1D2qFppTF_v09jImy8c5DfbmWNsgOFNS3JJrOJTi6bMc/edit>

Responsible executors of the project from M. Auezov South Kazakhstan State University translated the questionnaires into Kazakh. Questionnaires and Google forms were discussed at the meeting of the Working group (protocol № 2 dated 15.04.2019). The links to online questionairies were sent to the project coordinators at S. Amanzholov East Kazakhstan State University and L.N. Gumilyov Eurasian National University.

The distribution of these links to 90 e-mail addresses of educational organizations (departments of education, secondary schools, colleges and organizations implementing additional General education programs and courses in the field of STEM-education) was carried out by the responsible executors of the project from M. Auezov SKSU, Republic of Kazakhstan. ENU L.N. Gumilev, S. Amanzholov EKSU. The analysis of the survey results was carried out by the responsible executors of the project from M. Auezov SKSU., the results were evaluated by an expert sociologist, doctor of sociological Sciences E.S. Satymbekova.

**Survey of middle and high school students’ attitudes towards STEM in Kazakhstan**

**(based on the questionnaire for middle and high school students)**

**The goal of the survey** isto identify the interest of students in STEM-disciplines (Chemistry, Physics, Biology, Geography, Technology, Mathematics, Computer Science) in Kazakhstan schools. 201 Kazakhstani schoolchildren from 20 settlements participated in the survey, including the cities of Nur-Sultan, Shymkent, Ust-Kamenogorsk, Pavlodar, Uralsk, etc.: 11th grade students – 30,8%, 10th grade students – 28,4%, 9th grade students – 23,4%, 8th grade students – 17,4%.

**Outputs of the survey:**

1. The results of the survey show that Kazakh schools have just started to implement the basic STEM algorithms in secondary education, so the "new thinking" in this module should primarily relate to teachers retraining within M.Ed. program and PD training courses in the field of STEM education methodology and psychology.
2. The greatest interest of respondents to additional occupations and leisure centers are shown mainly in the following disciplines: Mathematics – 26,9%, Physics – 22,6%, Technology – 22,1%, Biology, Robotics, Design and 3D-modeling – 19,2% on each, Technical creativity (engineering) defines the importance of development of practical training programs for students in the above disciplines.
3. The analysis of the answers shows that the choice of disciplines by students is mainly related to the so-called «traditional» STEM-subjects (Math, Physics etc.), but not to the innovative STEM-subjects such as Robotics, Design and 3D modeling. This fact points on the absence of motivation by students in teaching innovative STEM-subjects, so the solution of this problem may be introduced in promotion of STEM-focused events like STEM-days, STEM-weeks or STEM-festivals aimed to increase to motivation in teaching innovative STEM subjects and to highlight their importance.
4. Judging from questionnaire’ analysis, universities should create STEM-focused curricula (master’s degree program) «Integrated approach to STEM teacher training» taking into account the current needs of the National Technology Initiative and Russian S&T Development Strategy. The curricula should be aimed to reach the main goals of the STEM-approach implementation, to increase the motivation of students in teaching STEM-related subjects and to provide educational organizations with competent and skilled HR in the STEM-field.

**Survey of specifics of teaching STEM subjects in school, STEM teachers’ PD needs and prospects for integrated STEM approach implementation in Kazakhstan (based on the questionnaire for secondary school teachers of STEM-disciplines)**

**The goal of the survey** isto study the specifics of teaching STEM-disciplines (Chemistry, Physics, Biology, Geography, Technology, Mathematics, Computer Science) in schools, to identify the PD needs as well as STEM prospects in Kazakhstan. 306 teachers from 20 settlements, including the cities of Nur-Sultan, Shymkent, Ust-Kamenogorsk, Pavlodar, Uralsk, etc. participated in the survey. The Highest percentage of participation falls on the city of Shymkent – 52.3%.

**Outputs of the survey:**

1. Respondents of the survey note that the main factors that negatively affect the motivation and quality of students’ training in STEM-disciplines are the lack of modern educational and methodological support and modern educational equipment, special educational/laboratory equipment as well as low speed Internet connection in educational organizations. Apart from the shortcomings in teaching methodology, respondents point to a weak level of professional competence in the subject matter, psychological, pedagogical and technological training of STEM teachers, the lack of effective interaction between teachers, educational organizations, industrial partners in the implementation of STEM-disciplines, as well as low teacher motivation.
2. In general, teachers show a significant interest in STEM education, and therefore, it is necessary to develop and implement more in-depth training courses and programs for in-service teachers to adapt to a new model of STEM-education within the integrated approach.
3. M.Ed. curriculum and PD training courses to be developed within the project should focus on the following pedagogical approaches, teaching methods and techniques indicated by the respondents as providing high students’ motivation and good learning outcomes within the STEM subjects: PBL, IBL, differentiated learning, research and laboratory studies.

**Survey of specifics of teaching STEM-focused courses at supplementary education institutions, STEM PD needs and prospects for integrated STEM approach implementation in Kazakhstan (based on the questionnaire for STEM-teachers at supplementary education institutions)**

**The goal of the survey:** to identify opportunities in joint activities in the field of STEM-education with universities and schools, study of the features of the implementation of additional General education programs and courses in the field of STEM-education (technical creativity, programming, design and 3D-modeling, robotics, etc.) in organizations of additional education of children and youth in Kazakhstan. 152 teachers implementing additional General education programs and courses in the field of STEM-education participated in the survey.

**Outputs of the survey:**

1. The results of the survey show the need to expand the training program of STEM-education in 3 main areas: *theoretical training, psychological adaptation of teachers to new interdisciplinary modules,* *practical development and implementation of integrated STEM modules*. It seems certain that regional STEM learning resource center intended to provide teachers with T&L materials, PD training/M.Ed. courses and relevant equipment should become the core element of the regional STEM ecosystem.
2. According to the survey results the respondents of this focus group are particularly interested in the following deliverables of the project “Integrated approach to STEM teachers training”: STEM PD training courses for teachers, best practices in STEM education and STEM ambassador programs.

**Conclusions**

To sum up, the project team considers that:

1) the interest and attitudes towards STEM-disciplines by students in Russia and Kazakhstan could be expressed with the following statements: STEM teaching in schools is fundamentally relevant to satisfy the majority of students. However, STEM teacher training programs to be developed should consider techniques and practices of motivating students as well as using ICT/lab equipment and STEM tools while promoting laboratory work, interdisciplinary projects and studying real-world cases within the framework of students’ career preferences.

2) specifics of teaching STEM subjects in school and STEM-focused courses at supplementary education institutions in Russia and Kazakhstan is shown in such a way: teachers show a significant interest in STEM education, and therefore, it is necessary to develop and implement more in-depth training courses and programs for in-service teachers to adapt to a new model of STEM-education within the integrated approach.

3) STEM teachers’ PD needs and prospects for integrated STEM approach implementation in Russia and Kazakhstan are as follows: M.Ed. curriculum and PD training courses to be developed within the project should focus on the following pedagogical approaches, teaching methods and techniques indicated by the respondents as providing high students’ motivation and good learning outcomes within the STEM subjects: PBL, IBL, differentiated learning, research and laboratory studies.

At the same time it is necessary to develop STEM ambassador courses and carry out STEM events like STEM days & weeks, STEM festivals in terms to overcome the negative trends of participation’ absence in STEM-focused activities and to increase the role of integrated STEM-approach in the whole educational area.