DATA OF THE STATE OF THE ART REVIEW

SMART MATHEMATICS TEACHER

No. 2018-1-LT01-KA201-046956

Summarized by Kaunas Region Education Centre

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CONTENTS

I. Introduction of the project "Smart Mathematics teacher"

The project SMART-MT contributes to the achieving of Europe 2020 benchmarks: to decrease the number of the low achievers in reading, science and math up to 15% and implement the priority "Smart growth: developing an economy based on knowledge and innovation". OECD's PISA data (2015) show that among the three domains, the share of low achievers is the highest in math (EU average - 22,2%), although the competence in math has been identified at EU level as one of the key competences for personal fulfillment, active citizenship, social inclusion and employability in the 21st century. Except PL (only 17,2%), other project partner countries have low attainments of pupils in math (LT-25,4%, LV-26%, RO-39,9%, GR-35,8%). Also, the data of this survey uncovered the unevenness between disadvantaged and advantaged pupils; highlighting that the lowest achievements are of pupils from lower social-economic or migrant backgrounds, living in remote areas. The analysis of the mentioned EU reports showed that these problems are closely related with the lack of math teachers' competencies, especially digital, and ability to use attractive teaching methods based on informational technologies which enable to promote attractive learning of math. In order to address these issues and the challenges the following aim and objectives are foreseen in the project:

The aim - to develop Mathematical Teachers' Digital Educational Culture to Enhance to Enhance Pupils' Engagement and Achievement.

The objectives:
1) to enhance Math teachers' professional development by improving their digital competencies to use Mobile Apps in the teaching process;
2) to support Math teachers to adopt innovative digital practices based on Mobile Apps in order to improve pupils' mathematical skills and address their underachievement in Math;
3) to strengthen the capacity of Math teachers to develop pupils' critical thinking and creativity through integration of innovative Mobile Apps based exercises into teaching process;
4) to support Math teachers in dealing with diversity in the classroom through exchange of work based best teaching practices, presented as Open Educational Resources.

To meet the above mentioned needs and implement the objectives, the partnership will develop 4 intellectual outputs:

IO1 Training course for Math teachers *"Teaching Maths in digital era"*

The main aim of the O1 is to develop a Training Course for Math teachers, working with the pupils from 11 to 12 years old, in order to extend and develop their Digital Educational Culture and competences needed for effective, innovative and attractive teaching of math to underachieving pupils in diverse classes (pupils having special learning needs, low motivation, living in remote areas, coming from diverse backgrounds e. g. migrants, socially disadvantaged).

IO2 E-Toolbox for Math teaching

The main aim of the O2 is to develop an e-Toolbox with a set of mobile apps, oriented for development of the math skills of underachieving in math pupils. These innovative digital era mobile applications will be used as practical exercises within the teaching process, thus, the O2 will serve for both target groups: math teachers and the pupils

IO3 E-Toolbox for developing critical thinking and creativity teaching

The aim of output O3 is to develop an e-Toolbox with a set of mobile apps, oriented for development of critical thinking and creativity of pupils by combining the knowledge of math and other STEAM subjects.
STEAM learning stimulates innovation, creativity, critical thinking, and problem-solving skills, resulting in a well-rounded, multi-faceted student. It encourages pupils to think about what they're
learning in a more connected, holistic way. Through STEAM, pupils develop the skills and attributes to navigate the world around them.

IO4 A Set of Best Practices Dealing with Diversity in the Math Classroom

The main aim of the O4 is to develop a set of best practices from partner countries, how math teachers deal with diverse groups of pupils in the classroom using modern technology and digital tools to reach better results in learning math.

These intellectual outputs will support improvement of Math teachers' digital competences to use Mobile Apps and Open Educational Resources in the teaching process in order to enhance pupils' mathematical skills, creativity, critical thinking and problem solving. The developed intellectual outputs will have the possibility to be transferred and applied by teachers of STEAM subjects.

Project's target groups:

- Math and STEAM teachers working in basic schools
- Low-achievers from 5-6 grade (school year), aged 11-12 from disadvantaged backgrounds (facing educational, social-economical, geographical, cultural obstacles) and having special learning needs.

The general methodology of the project is based on the blended learning approach, using the reversed/flipped training methods, micro learning, gamification and Open Educational Resources as well as best practices of peer teachers in partner countries. The two intellectual outputs (O2, O3) are based on the specific methodology - open and innovative digital era Mobile applications approach using problem-oriented experiential and self-directed e-learning.

The main impact on the pupils is decreasing underachievement in Math by providing them with attractive digital tools for learning. The partnership expects that at least 50% of pupils from the target group will start using the newly developed Mobile Apps and will change their attitude towards Math as an interesting an useful subject.
The Math's teachers will improve their didactic, social and digital competences to use new up-to-date modern tools in the teaching process and which will boost pupils' motivation, contribute to their engagement in Math and influence better results.

II. The aims and methodology of the State of the Art review

As the project partnership results and outcomes are closely related with the pupils mathematical achievements, students' individual progress at classroom, the development of mathematical teachers' professional qualification, by starting to create of the IOs' it is very important to know any peculiarities of formal general education: didactic and social methodology in Math lessons; teaching and learning curriculum of Math and other STEAM subjects', the most important cognitive abilities necessary to improve the performance of low achievers in math; knowledge about pupils' (aged 10-13) needs, interests, attitudes.

The aims of this State of Art review are:

1. to find out the situation in partner countries related to the development of mathematics teachers' digital, social and didactic competences, necessary to work with low-achieving pupils with fewer opportunities and from disadvantaged backgrounds in order to engage them in learning math and improve their learning results;
2. to select the most essential abilities/skills of aged 5-6 grade pupils, aged 10-13 which are necessary to improve their math's achievements and develop mobile apps;
3. to indicate what real life situations or areas are the most interesting ones to pupils aged 10-13 which are necessary to improve their math's achievements and develop mobile apps;
4. to discuss what could be available scenario(s) from pupils' real-life situations.

The summarized data of this analysis from partner countries is a basis for development of the Curriculum and 3 Modules (IO1): "The Use of Apps to improve pupil's Math skills", "The use of Apps to promote pupil's critical thinking and creativity", "Dealing with diversity in the classroom" and the preparation of intellectual outputs: "Creating e-Directory of existing mobile apps to improve pupils' math skills"(IO2), „Creating e-Directory of existing mobile apps to enhance pupils' critical thinking and creativity"(IO3), "Development scenarios for "The Math-App"(IO2), "Development scenarios for "The Eureka App"(IO3) and "A Set of Best Practices Dealing with Diversity in the Math Classroom"(IO4).

The methodology of the State of Art review was based on *focus group** in each partner country with the members of the Local action (teachers of Math and other STEAM subjects, staff of teacher training centers, stakeholders, associated partners, etc.) according to the prepared in partnership common questionnaire.

***Method**: **focus group** is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs, and attitudes towards a product, service, concept, advertisement, idea. Questions are asked in an interactive group setting where participants are free to talk with other group members. A focus group is an interview, conducted by a trained moderator among a small group of respondents. The interview is conducted in an informal and natural way where respondents are free to give views from any aspect.*

Some recommendations for moderation of the Focus group have been recommended:

- to remind to participants, that there are no right or wrong answers, only different points of view; free expressions and opinions are welcome;
- to record the minds, opinions of the discussion with the permission from the participants;
- to involve at least two people for organising the Focus group discussion- one taking note, the other talking with the members of the focus group.

Beside the group discussion focus group participants were asked to select the most important and important the cognitive skills/abilities of the low-achieving pupils (5-6 grade) which should be improved and exercised with the use of mobile apps in order to support better achievements in math.

The Focus group meetings at national levels have been organised in according to the Agenda (see Annex 1).

III. Information on the Focus Groups' meetings in the partnership countries

The project SMART focus groups (in each partner country) consisted of 10-12 members of Local Action Group (LAG), teachers of Math and other STEAM subjects, staff of teacher training centers, stakeholders, associated partners, etc. The total number of participant 55 expressed their opinion on the topic. The focus groups by the partners were organized according to the Focus Group Meeting Agenda (see Annex 1) elaborated by the leading partner, KRSC, and they took place November-December 2018. All partners used a common questionnaire (Annex 2) and prepared national reports accordingly. The leading partner, KRSC, summarized the national reports and developed the transnational report. The report is available in the English language and is also uploaded on the project's website https://smart.erasmus.site/

Kaunas Region Education Centre *Date of the focus group meeting:* 29 November 2018 *Place of the focus group meeting:Kaunas, Lithuania* *Number of participants:* 17	

Danmar Computers *Date of the focus group meeting: 20 December 2018* *Place of the focus group meeting: Danmar's office, Hoffmanowej 19, Rzeszów, Poland* *Number of participants: 10*	
Eurotraining Educational Organization *Date of the focus group meeting:12 December 2018* *Place of the focus group meeting: Veranzerou 1, Athens, Greece* *Number of participants:11*	
Tukums 2nd Elementary School *Date of the focus group meeting: 16 November, 2018* *Place of the focus group meeting:Tukums, Raina st. 3a,* *Latvia* *Number of participants:8*	
School George Emil Palad *Date of the focus group meeting: 23 November, 2018* *Place of the focus group meeting: School George Emil Palade, Aleea Godeanu 4 Ploiest, Romania* *Number of participants:* 9	

IV. Summary report from the Focus Group Meetings in Latvia, Lithuania, Poland, Greece and Romania

PART 1. Information about the situation in partner countries related to the development of mathematics teachers' digital, social and didactic competences

1.	**Do teachers use ICT to aid teaching/learning mathematics in the classroom?**
GR	Almost all participants, except for one, responded that they use ICT, mentioning the following: – Geogebra – Videos from YouTube – MathDesktop – WolframAlpha – Gamification – Digital Storytelling – Simulations – Adaptive Learning – Artificial intelligence – Robotics – PCs, mobile devices For not using ICT, the reason is that there is no available equipment at school. Additional questions: Positive experiences: – Motivation to learn, interaction between students – Combination of knowledge, visual material helps in comprehension – Increased interest and participation of students – Visualization of abstract mathematical concepts, opportunity to experiment and explore – Developing skills and motivation to learn – Better understanding of mathematics notions, enhancing creativity – Better organization of the course, actual interaction with students – Practical comprehension of abstract terms, that engage students Disappointments/negative experiences: – Students getting distracted – Some noise and fuss – Difficulties in finding targeted material – Criticism from colleagues and parents Source of influence: – Lack of motivation to learn from "traditional" ways of teaching – Training

	– The variety of activities and applications offered – Involvement with technology in teaching – Personal motivation – The development of visual options can produce great results – Personal improvement as a teacher, progress and improvement of students Identifying students' need to see something familiar in the classroom
LT	Math teachers do not often use ICT in the classroom due to lack of equipment (smart boards, tablets, etc.). Those teachers, who replied in the positive, use the available software programs, create programs themselves and share them with their colleagues. Among the most usual programs are the following: EMA class, EMA teacher's book, EMA quick revision tests; Kahoot, Youtube, etc. Biology teachers use interactive educational software: SMART Notebook 3D Biology Classroom Management Mozaik 3D emokykla.lt (grades 5-6 and 7-8) padlet.com Tablets and mobile phones are rarely used in the classroom because math teachers are unaware of the existing Mobile Apps. Younger teachers are more open-minded, creative innovative than senior teachers who prefer the traditional methods of delivery – the chalk and board method. Teachers reflected that using mobile telephones in the classroom makes learning more attractive, engages pupils into the learning process.
LV	The reasons of ICT usage: • To make math's lessons more interesting; • Students can practice their knowledge with new methods; • It is easier to get reflection at the end of the lesson or topic; • Students feel more personally connected to lesson if they can use their mobile phones in a learning process; • Students remember things better if they have also seen it not only heard.
PL	During the discussion the teachers responded and agreed that, of course, there are such representatives of their profession who use ICT to aid teaching/learning mathematics in the classroom but these are exceptions and not a significant trend. The main forms of using ICT in the classroom so far are: - sending homework by using an email; - using multimedia boards; - communication with students by groups on FB; - use of the online version of Sudoku. At the same time the main reasons why there is no wider use ICT to aid teaching/learning

	mathematics in the classroom are: - limited knowledge and courage of teachers, - belief in the effectiveness of traditional methods of teaching, - fear of embarrassment in the eyes of students (better knowledge of ICT among students).
RO	Two math teachers replied positively to this question and their examples included: **office packet**, some **power point presentations** for presenting geometry shapes, Youtube educational resources – video demo lessons, experiments for chemistry) Most Math teachers answered negatively, due to busy syllabus, lack of equipped lab and lack of personal ICT competences, on the one hand. At the same time, they explained that it is too time consuming to prepare lessons and carry out class activities in this way, while this learning method is not exam friendly, due to the fact that the most important exams in the Romanian education system are pen-written. From the same point of view, it's easier for science subjects, because there are labs equipped with all the necessary devices. Regarding the additional enquiry, one math teacher expressed disappointment with such tools, as she took an ICT course in the past, during which the application GeoGebra was modelled, but it was difficult for her to put it too much into practice mainly because of the lack of ICT skills of the respective teacher and also because of her reluctance to try it. Besides, classes have no interactive whiteboards, which makes it almost impossible to use the application in class.
	Conclusion **Having summed up the answers, it turned out that the use of ICT is not very popular and is seldom used in the classroom to teach mathematics.** <u>The main reasons for not using ICT in the math classroom are:</u> • limited availability or equipment (multimedia boards, tablets, laptops) or software; • poor digital competence of teachers to use ICT tools and equipment; • few digital programs to teach Math in the classroom; • traditional forms of teaching are a priority; • fear of embarrassment in the eyes of the students, because of their better knowledge of computer technologies; • The use of ICT for teaching is time consuming, not exam-friendly; • There are software programs available for other subjects (biology, physics, chemistry) other than mathematics. <u>The teachers who choose to use ICT in the classroom, stated that:</u> • ICT makes math lessons more interesting; • Students can practice their knowledge with new methods; • It is easier to get reflection at the end of the lesson or topic; • Students feel more personally connected to lesson if they can use their mobile phones in a learning process; • Students remember things better if they have also seen it not only heard
2.	**If "Yes", what are the aim(s) of such teaching/learning using ICT? The aims are listed according to Bloom's taxonomy, *choose 2-3 most appropriate answers*.**

	a. Provide knowledge b. Comprehend knowledge c. Apply knowledge in new or familiar situations d. Sort materials or concepts, facts into components or/and to systematize them e. Judge, relate, evaluate the phenomena f. Create: design, formulate, build, invent, compose
GR	Taking into consideration the target group of low achieving pupils in math, aged 10-13, teachers stated that the following aims are the most urgent: a) Provide knowledge b) Comprehend knowledge c) Apply knowledge in new or familiar situations
LT	Teachers have chosen the following: A) Provide knowledge C) Apply knowledge in new or familiar situations
LV	Teachers mostly chose: a) Provide knowledge; b) Apply knowledge in new or familiar situations.
PL	Teachers indicated the following aims: a. Provide knowledge c. Apply knowledge in new or familiar situations d. Sort materials or concepts, facts into components or/and to systematize them
RO	a) Provide knowledge b) Comprehend knowledge c) Sort materials or concepts, facts into components or/and to systematize them
	Conclusion Of all the listed aims according to the Bloom's Taxonomy, the most frequently mentioned were taking into consideration the target group of low achieving pupils in math, aged 10-13 and the requirements of the national curriculum for teaching math: a. Provide knowledge b. Comprehend knowledge c. Apply knowledge in new or familiar situations
3.	**How could ICT and Mobile Apps in the Math classroom help:** ● differentiate and personalize learning ● promote pupils' critical thinking and creativity ● enhance pupil's engagement and motivation
GR	Mobile apps and ICT differentiate and personalize learning when: – Overcoming learning difficulties – Aid learning depending on the student's level – Aid teaching working with diverse groups of students, both for native and for non-native ICT can contribute to promoting critical thinking and creativity: – Motivate students to create something that is described in the app – Resolve a problem/exercise using their own methodology ICT and mobile apps can enhance students' engagement and motivation – By using mobile phones for learning – By creating some kind of game that gives rewards or credits

	– By addressing everyday problems – By using a familiar tool – a mobile telephone
LT	ICT tools aid differentiation and personalization of learning: teachers can select tasks according to the pupils' learning level and abilities; they also pay attention to the complexity of tasks. EMA practice books contain problem solving tasks which do not promote creativity, however, enhance pupils' critical thinking. Creativity is exercised through integration of STEAM school subjects. ICT is beneficial in many ways: it helps to engage pupils in learning and promote their motivation to learn.
LV	The teachers decided that usage of ICT and Mobile Apps in the Math classroom can help to: • differentiate and personalize learning; • enhance pupil's engagement and motivation.
PL	The most frequently repeated answer was: -enhance pupil's engagement and motivation
RO	The teachers consider that the main advantages of ICT and Mobile Apps in the Math classroom would be to: -differentiate and personalize learning -enhance pupil's engagement and motivation
	Conclusion Most of the partner reports declare that ICT can help differentiate and personalize learning and enhance pupil's engagement and motivation, but don't explain HOW. Teachers stated that mobile apps and ICT help differentiate and personalize learning when assigning different learning tasks depending on the student's level and abilities and working with diverse groups of students. What concerns promoting critical thinking and creativity, teachers hold that creativity is exercised through integration of STEAM school subjects whereas critical thinking is exercised applying the acquired knowledge in real-life situations. All teachers agreed that ICT and mobile apps can enhance students' engagement and motivation because mobile phones are attractive tools at hand; besides, Mobile apps have the gamification elements that give rewards or credits.
4.	**Do Math/STEAM teachers use Mobile Apps in formal and/or non - formal education?** If "Yes", specify what (provide names and/or links and specify the context) If "No", indicate reasons why (1-3)
GR	Geogebra, Walphram Alpha Reasons why they don't use apps: – Available material on apps is not compatible to the curriculum – Lack of opportunities – Lack of knowledge on available apps
LT	Hardly ever do teachers use apps both in formal and in non-formal education mainly due to the following reasons: • Lack of availability of such apps • Teachers are either unaware of such apps or do not know where to find them.
LV	Those teachers who answered "yes", said that in their lessons they use apps like "Simply fractions", "Uzdevumi.lv", "Fraction bingo", "Math training", "GEOgebra". One teacher who answered "no", said that she doesn't have resources to do those activities, other teacher told that she actually doesn't know how to use them.
PL	Among the mentioned applications appeared:

	- "Matematyka dla dzieci - Labmat w klasach 1,2,3,4,5" [Mathematics for children - Labmat in classes 1,2,3,4,5] An app that teaches math through play. Correct task resolution leads to the release of small Labmaks who have been imprisoned by an evil wizard! Each correctly solved task brings the savior closer to unlocking the next character. Free all Labmaki and learn maths by the way! - Thinking Blocks Multiplication „*Use number blocks to solve multiplication word problems, a strategy supported by Common Core standards. This app introduces kids to six problem solving models, which helps them organize information and visualize number relationships*". Teachers who do not use Mobile apps, indicated the following reasons: - limited knowledge and courage of teachers, - belief in the effectiveness of traditional methods of teaching, - fear of embarrassment in the eyes of students (better knowledge of ICT among students).
RO	One physics teacher used **Kahoot** for revision lessons and extracurricular activities One ICT teacher used **Scratch** for algorithm introduction/explanation and initiation in programming. She also used the platform **CODE.org** for programming. One chemistry teacher used various **Youtube** educational resources, such as video demo lessons or chemistry experiments and step by step demonstrations. The reasons for "no" answer in case of the other teachers (mostly Math teachers) were the lack of time and lack of teachers' digital competences, the discrepancies between the types of examination in the Romanian educational system and this way of working with students.
	Conclusion The use of Mobile Apps in formal and non-formal education, both math and STEAM subjects is limited. Teachers indicated the following reasons for not using Mobile Apps in the classroom: • Lack of knowledge on available apps (in English and national languages) • Lack of Mobile apps for learning and games • Lack of digital competences on how to use apps in the classroom • Lack of time (both for search of apps and for using them in the classroom) The interactive tools vary in all partner countries, however, some (Youtube, Kahoot, Geogebra, Scratch) are known internationally.
5.	**In case Math/ STEAM teachers use free of charge Mobile Apps in the classroom, which Apps do they prefer:** g. In English h. In the national language
GR	In English and in the national language (Greek) Why: – Mainly in Greek, except for videos that might be in English – In Greek: easier to follow for students – In English: they are more updated, there is no relevant material in Greek
LT	Teachers would rather use mobile apps in their national language due to the teachers' poor English language skills. There are no descriptions of the existing Mobile apps in Lithuanian.
LV	Teachers prefer to use apps in native language, the main reason is the lack of English

	language knowledge.
PL	Applications in the national language, due to lack of foreign language competences mostly
RO	a. They prefer applications in the national language, due to local patriotism/preservation of national identity as well as lack of foreign language competences.
	Conclusion Teachers prefer apps in national languages because: • They are easier to follow for students • Lack of knowledge of the English language • There are no translation of descriptions of mobile apps and directions on how to use them in national languages In case teachers choose apps in EN there are no relevant material in their national languages and because they are more updated.
6.	**The partnership is planning to create two e-directories (collections/sets of existing Mobile Apps in English and national languages, available ICT based learning tools online) to enhance pupils' engagement in learning math and exercise their critical thinking, problem solving and creativity.** **Do you think such e-directories would be useful to STEAM teachers? Which of the directories would you choose and why?**
GR	All participants responded that both e-directories would be useful for them. Both of them would address the needs of teachers and students, and assist them to improve their skills. They would, also, be useful in engaging students to express their creativity and critical thinking. The two e-directories could be used in combination.
LT	Teachers believe that both e-directories would be useful to aid teaching in the classroom, however, they would take priority of the second e-directory because it exercises pupils'critical thinking, problem solving and creativity. Also, because of integration of STEAM subjects. Classifying the apps according to the topics would be beneficial.
LV	Teachers answered that they would like to use both directories: Students want to try new ways of learning math. The most important skills in Latvia's new educational program "SKOLA 2030" are creativity, critical thinking and problem solving.
PL	Definitely Yes, especially the second one, this will increase the students' involvement and their level of motivation.
RO	Yes, especially the second one, due to its attractiveness, due to future requirements of thinking in a Tran disciplinary manner and due to the possibility it offers to better adapt to real life situations/ labor market.
	Conclusion Having summed up the answers, it turned out that both e-directories would be of great use to teachers. Such e-directories would save teachers' time and give a wider view of the available apps. The majority of teachers would choose the second e-directory as a priority. They believe that apps, integrating STEAM subjects would serve the purpose of exercising pupils' creativity, critical thinking and problem solving and would increase pupils' engagement and motivation. Besides, interdisciplinary manner is highlighted in the national educational

	programs.
7.	**Do you have any experience of integrating Math into other STEAM (Science, Technology, Engineering, Arts, Math) subjects?** **a. Yes, specify what** **b. No, explain the reasons**
GR	Teachers integrate math in Robotics and Physics club
LT	Yes, teachers have experience of integrating the following subjects: Math and Arts Math and Chemistry Math and Biology (most often) Math and Physics
LV	In physics (sound, motion), chemistry (consistency, capacity), ICT, technology (measurement units transformation, graphs, diagrams, charts, volume).
PL	Math is integrated with the following school subjects: - physics, - information technology, - chemistry, - music.
RO	Math is integrated with the following school subjects: chemistry, physics, ICT, technology (proportion, the rule of three, measurement units transformation, graphs, diagrams, charts, percent, area, volume, perimeter, concentration)
	Conclusion The participants claimed to have had experience of integrating math with other STEAM subjects, also with history and languages.
8.	**If "Yes", please specify the topics of integrated lessons (3-5)**
GR	– Robotics and Physics club – Physics – Engineering
LT	Math is integrated with: **Biology** (truss and blossom, foliage, symmetry of plants, leaves; healthy eating; **Geography** (estimating of travel costs and routes); mapping; pyramids, sundial, roman numbers **Technology** (organizing parties and festivals; jewelry making; gift wrapping; classroom repair; safe traffic (geometrical figures), **Art**: national ornaments, symbols, elements (geometrical figures, central symmetry), **Economics**: shopping (calculating quantities, percentage, discounts); creating of small enterprises; **Chemistry** materials and mixtures
LV	None
PL	a. physics – "The use of mathematical formulas in the understanding of Newton's law" b. information technology – "Mathematical basics of programming" c. chemistry – "Percent proportions of chemical mixtures" d. music – "Rhythm as a mathematical sound record"
RO	a. percent concentration of liquid/solid substances (chemistry)

	b. algorithm for calculating the area (ICT) c. energetic value of food, applying fractions to growing plants (technology) d. inclined plane e. graphs, Pitagora's theorem, the composition of the vectors
	Conclusion The topics are varied according to the integrated subjects: **Biology** (truss and blossom, foliage, symmetry of plants, leaves; healthy eating, energetic value of food, applying fractions to growing plants); **Geography** (estimating of travel costs and routes); mapping; pyramids, sundial, roman numbers **Technology** (organizing parties and festivals; jewelry making; gift wrapping; classroom repair; safe traffic (geometrical figures), **Art**: national ornaments, symbols, elements (geometrical figures, central symmetry); "Rhythm as a mathematical sound record" **Economics**: shopping (calculating quantities, percentage, discounts); creating of small enterprises; **Chemistry** materials and mixtures, percent concentration of liquid/solid substances, The topics will be useful when creating mobile apps.
9.	**What professional training programs/ courses (either on-line or face-to-face) on the topic of using Mobile Apps in the classroom have you attended or heard of in your country (at institutional, regional, national level)?**
GR	The participants responded having taken part in the following courses: – Second level training in Mathematics – MathDesktop – kalstem.weebly.com – Trainings by the Hellenic Union for ICT in Education
LT	Some teachers remembered having taken part in the seminars on how to use Mobile apps in the classroom. However, they were few and teachers do not feel comfortable with their competences. All of the participants mentioned that they feel a shortage of seminars on how to use apps for teaching and agreed that such professional development programs would be of great help.
LV	Teachers mostly answered that they haven't attended courses about those topics. One teacher attended a course entitled "Use of IT in lessons" and two teachers attended a course entitled "Use of *GEOgebra* in maths'lessons", „Basics in arts programming setting *Scratch*. "
PL	Teachers have heard about courses on how to use ICTs and ICT devices, but they did not participate in them
RO	Three teachers attended a course entitled "Multimedia tools in school" in which Kahoot and GeoGebra were mentioned Mostly no, due to lack of offer, financial issues – very few courses are financially accessible
	Conclusion Teachers mentioned a few courses on the use of ICT tools. However, the majority stated facing the shortage of professional training programs/courses on the topic of using Mobile apps in the classroom. They would like to participate in special courses on how to use Mobile

	apps for teaching and learning.
10.	**What knowledge and skills would you like to improve to make the mathematics learning process appealing to pupils using Mobile Apps and other ICT tools? Please select 3 the most important ones:** • Selecting • Creating and modifying • Managing, protecting and sharing • Using ICT tools to differentiate and personalize learning • Using ICT to actively engage learners • Facilitating learners' digital competences
GR	– Facilitating learners' digital competences – Creating and modifying – Using ICT tools to differentiate and personalize learning – Using ICT to actively engage learners
LT	Teachers would like to improve the following skills: • Teachers chose creating and modifying • Managing, protecting and sharing • Using ICT tools to differentiate and personalize learning
LV	The teachers said they would like to improve the following skills: • Using ICT tools to differentiate and personalize learning; • Using ICT to actively engage learners; • Creating and modifying.
PL	The teachers said they would like to improve the following skills: 1. Facilitating learners' digital competences 2. Using ICT tools to differentiate and personalize learning 3. Using ICT to actively engage learners
RO	The teachers said they would like to improve the following skills: • Using ICT tools to differentiate and personalize learning • Using ICT to actively engage learners • Facilitating learners' digital competences
	Conclusion Among the various answers, the following were the most frequent ones: • Using ICT tools to differentiate and personalize learning • Using ICT to actively engage learners • Facilitating learners' digital competences
11.	**Do you have any experience of working with diverse groups of pupils? Have you faced any issues/ challenges? What knowledge and skills would you like to gain/improve to deal with diverse groups of pupils in the classroom?**
GR	Teachers have experience working with diverse groups of pupils. However they face the following challenges: – Challenges in teaching students of different ages and languages, as well as students with learning difficulties – Teaching classrooms with students of very high and very low performance, and students with different paces of learning – Different spoken languages (migrant students)

	The participants would like to improve these skills: – Working together through diversity – Teaching through video storytelling – Using videos to overcome the language barrier
LT	Teachers have little experience to work with diverse groups of pupils. They lack knowledge on how to differentiate and personalize learning with such groups. Also, there is a shortage of tools and means (including modified textbooks and exercises, interactive tools) to work with disadvantaged pupils.
LV	The respondents answered having little experience of working with diverse groups of pupils. The main problem in the classroom with diverse students is lack of time because it is really hard at the same time to work properly with students who understand everything and work fast and with students who needs assistance. The teachers would like to improve their knowledge of selecting the most appropriate exercises for low achievers.
PL	The only differentiation that we encounter during our work (teachers said) is the division between children from the city and the countryside. This division causes some behavioral problems but does not affect real learning results.
RO	The participants answered in the positive. The teachers consider that in time, such differences grow/ accentuate, generating even more difficulties, including psychological problems in case of the low achieving students. In their opinion, such differences generate difficulties in working in groups (lots of time to prepare and explain the task, lack of engagement and motivation in case of students with low achievements, too many children in the class). These teachers would like to improve time management skills, methodological and digital competences in order to increase attractiveness of lessons, competences to transfer knowledge from one domain/subject to another, to help students to understand the usefulness of knowledge.
	Conclusion The respondents answered that to achieve better learning results in math and other STEAM subjects, also, creating a positive and appropriate learning environments, especially working with diverse groups of pupils, teachers would like to improve social, didactic competences, learn from best practices in partner countries. The topics of interest would be: differentiation and personalization of the learning content, time management, the use of ICT and Mobile apps to increase attractiveness of lessons, dealing with multiculturalism.
12.	**Within partnership 24 success stories will be created. Please choose 3-5 topics which would be the most relevant for you to develop your professional skills as a teacher** • Teaching math using Mobile Apps • Teaching math through integration with other STEAM subjects • Teaching math using other ICT tools and methods • Dealing with diverse groups (low achievers, facing social and other obstacles) of pupils in the math classroom • Individualization and differentiation in the math classroom • Engagement and motivational tools and methods in the math classroom, both in formal and non-formal education

	• Development of pupils' critical thinking • Development of pupils' creativity • Other
GR	– Teaching math through integration with other STEAM subjects – Engagement and motivational tools and methods in the math classroom, both in formal and non-formal education – Development of pupils' critical thinking – Development of pupils' creativity
LT	Teachers chose the following topics as being the most urgent ones: • Teaching math through integration with other STEAM subjects • Teaching math using other ICT tools and methods • Dealing with diverse groups (low achievers, facing social and other obstacles) of pupils in the math classroom • Individualization and differentiation in the math classroom • Engagement and motivational tools and methods in the math classroom, both in formal and non-formal education
LV	• Teaching math through integration with other STEAM subjects • Dealing with diverse groups (low achievers, facing social and other obstacles) of pupils in the math classroom • Development of pupils' critical thinking • Development of pupils' creativity
PL	1. Development of pupils' critical thinking 2. Teaching math using other ICT tools and methods 3. Engagement and motivational tools and methods in the math classroom, both in formal and non-formal education
RO	• Teaching math through integration with other STEAM subjects • Dealing with diverse groups (low achievers, facing social and other obstacles) of pupils in the math classroom • Development of pupils' critical thinking • Development of pupils' creativity
	Conclusion The most popular topics for success stories are as follows: • Teaching math through integration with other STEAM subjects • Dealing with diverse groups (low achievers, facing social and other obstacles) of pupils in the math classroom • Engagement and motivational tools and methods in the math classroom, both in formal and non-formal education • Development of pupils' critical thinking • Development of pupils' creativity

PART 2. The main mathematical skills (abilities which are important for low-

achieving pupils (5-6 grade)

13.	**What are the underlying reasons for student low achievement in math in your country and their reluctance to learn the subject (specify 2-3 reasons)?**
GR	– The subject is not directly linked to everyday life – Students always try to find the easy way to solve a problem – Lack of interest and motivation – Boring subject – Abstract terms and concepts
LT	Teachers who lack creativity, usually do not use attractive teaching methods. They are not able to demonstrate how math skills could be applied in real life situations. Limited integration of STEAM subjects prevent form solidifying pupils‘ knowledge. What is more, little attention is paid to differentiation and personalization of learning tasks, especially working with diverse groups of pupils, including low-achievers and pupils with special learning needs.
LV	• Lack of basic skills in math. • Poor economic/social background • Lack of student’s motivation; • Students are not able to link math’ exercises with real life situations.
PL	1. unfinished and unreliable educational system as a whole 2. no systemic incentives for better learning 3. universal treatment of mathematics as a necessary evil and not as an opportunity for a good job
RO	1. lack of maths basic skills (from primary level) 2. poor economic/social background 3.Teaching Math is too abstract and not entirely compatible with the theory of multiple intelligences
	Conclusion Having summed up, the following reasons have been highlighted as being the most important ones for pupils’ low achievement in math: • The subject is not directly linked to everyday life • Boring subject, teachers lack creativity, usually do not use attractive teaching methods. • Lack of basic skills in maths.
14.	**What of the below listed cognitive skills/abilities of the low-achieving pupils (5-6 grade) should be exercised with the use of mobile apps in order to support better achievements in math?**
	Conclusion Having summed the data collected by partners, it turned out that the highlighted cognitive abilities are the most important and important. Teachers suggest developing mobile apps to exercise the highlighted cognitive skills/ abilities in order to achieve better learning results in mathematics.

1.	**Cognitive abilities – knowledge and perception:**	Most important	Important	Total
1.1	to be able to memorize and reproduce basic mathematical concepts (*area, fraction*, etc.), symbols (≤, +), definitions, structure (*units, tens, hundreds*, etc.) and features of numbers	9	11	**20**
1.2	to be able to recognize mathematical objects (*figures: rectangle, square*, etc.), numbers, fractions (*simple and decimal*), literal and numeral expressions (*e.g., 3a + a; a + 6 = 18; 0,5 · 6 + 1,3; etc.*)	12	9	**21**
1.3	to be able to recognize equivalent mathematical objects (*e.g., equivalent simple and decimal fractions, geometrical figures angled in different ways*)	6	14	**20**
1.4	to be able to choose the right answer from the given options	10	9	19
1.5	to be able to compare (>, <, ≥, =) and round numbers	6	12	18
1.6	to be able to perform common algebraic procedures (*to calculate meanings of numeral expressions, perform addition, subtraction, multiplication, etc.*)	14	6	**20**
1.7	to be able to write a natural number in words, Arabic or Roman numerals (*e.g., twenty one – 21 – XXI*)	4	8	12
1.8	to be able to write a simple or decimal fraction in words or numerals (*e.g., two thirds – 2/3; two fifths – 0,4*)	5	12	17
1.9	to be able to find and select information from diagrams, charts and other sources of information	15	5	**20**
1.10	to be able to evaluate a partition of a scale in measurements of mass, time and length	9	12	**21**
1.11	to be able to use means of measurement	16	3	19
1.12	to be able to choose and apply units of measurement (*length, mass, length, area, volume, etc.*) properly	13	5	18
2.	**Cognitive abilities – application**			
2.1	to be able to choose a valid operation, method, strategy for solving ordinary tasks of a known algorithm (*e.g., 36·48+64·48= 48·(36+64)=...*)	14	7	**21**
2.2	to be able to present, depict mathematical data in diagrams, charts, schemes	9	11	**20**
2.3	to be able to depict mathematical data in one way presented in another way (*e.g., depict the given data in a column diagram*)	6	14	**20**

Points	*20*	*21*	*22*	*23*	*24*	*25*
No. of	*5*	*5*	*4*	*2*	*4*	*3*

	participants			
2.4	to be able to create an appropriate model for solving a common task (*e.g., find 20% of number 160… possible variants: 160 : 5; 160 · 1/5; 160 : 100 · 20; etc.*)	7	12	19
2.5	to be able to depict a graph or scheme according to the task setting (*e.g., a student is able to depict a probability tree*)	5	9	14
2.6	to be able to draw a proper geometrical figure (*e.g, to draw a right-angle triangle with legs of 3 cm and 4 cm*)	12	8	**20**
2.7	to be able to apply data from schemes, charts, graphs, diagrams for solving a task	12	8	**20**
2.8	to be able to minimize/maximize units of measure (*1 cm = 10 mm; 1 cm = 0,01 m; etc.)*	10	7	17
2.9	to be able to write, present, explain the task solution	16	4	**20**
2.10	to be able to make conclusions or answer the given questions.	10	9	19

PART 3. The real life situations or areas which are the most interesting ones to pupils aged 10-13.

15.	**What problem-oriented real life situations are the most interesting ones to pupils aged 10-13 (5-6 grade)? Please, provide examples (e.g. managing one's own pocket money, cooking a birthday cake, etc….)**
GR	– Organization of a school visit – Managing your money – Installing useful equipment – School grades – School trip – Dividing the day – Buying a personal item, for example a bicycle
LT	Pupil's one's own self and all that surrounds him Game/film heroes/ avatars Sports Travelling (calculating the distance, duration, budget, comparing and choosing the most cost-effective means of transportation (by car, train, plane, bus) My room (decorating, furnishing, designing) Shopping on-line or in the supermarket Taking care of the pet (calculating the monthly expenses) Taking care of one's own body (calculating the heart rate before and after workout) Cartography (drawing maps) Creating travel routes for the class field trip Managing one's own pocket money
LV	Organizing their leisure time, cooking, use of discounts, taking care of pets, buying new mobile phone, classroom repair, planning of the class trip.
PL	- managing one's own pocket money

	- running your own business - mechanical examples for boys and economic / kitchen for girls
RO	Managing and organizing their personal time, preparing recipes for healthy lifestyle, taking care of pets, managing one's own pocket money
	Conclusion The most popular topics (real life situations) would be: Travelling (calculating the distance, duration, budget, comparing and choosing the most cost-effective means of transportation (by car, train, plane, bus) Creating travel routes for the class field trip Managing one's own pocket money Taking care of the pet (calculating the monthly expenses) Shopping on-line or in the supermarket, counting discounts Cooking
16.	**To create a mobile app it is necessary to convert the real life situation into a Math task (exercise) which could develop the above mentioned cognitive abilities and skills of pupils. Please provide a short scenario(s) for 1-2 of the above mentioned real-life situations.**
GR	1. Organize a school visit, e.g. to a museum: Calculate the different costs, subtract relevant discounts, and divide to find the cost per student 2. We ask from students to visit different shops and calculate the discounts/sales of different products 3. A new projector will be installed to the classroom. Students will have to use geometry, simple equations, measuring, etc., to decide the best position of the projector 4. Students will have to calculate the minimum grade that they have to achieve in order to pass their exams 5. The 2/3 of the classroom's students will be coming to the trip to the mountain. If the classroom has in total 21 students, how many of them are coming to the trip? 6. An app that will express the duration (hours) of different activities in different ways, e.g. sleep: 1/3 of the day (8h in 24h), studying: 20 % of (day – sleep), playing basketball: 2/5 of studying 7. Identifying different alternatives, calculating discounts and shipping costs, comparing the results, choosing the best solution (students should take into consideration the quality standards of the products, too → combined thinking)
LT	John and Peter were to chop grandfather's firewood. If the brothers worked separately, John would do the task in 30 min., while Peter would do the task in 1 hour. How much time it would take if the brothers worked together?
LV	- At the daytime the student's sleep and awakes time ratio is 3:5. The awake time is 6 hours longer. How many hours does a student sleep? What else can you calculate? - Anna wanted to buy new skates. The price for skates now is 45 euros, Anna knew that next week those skates will have a discount. How much money she will need to buy the skates next week? - Anna and her brother Emils want to make oatmeal cookies for the Martin's day market. They found mother's recipe and decided to make those cookies using only 1/3 part of the necessary products. Recalculate the recipe for them: 200 g butter; 4 glasses oatmeal, ½ glass sugar, 3 eggs, 3 spoons potato flour, ½ spoon sodium carbonate.
PL	*Running your own business*

	You are the manager of a large enterprise. Your income last year was 10,000 Euro, your expenses amounted to 7,500 Euro. This year your income amounted to 12,000 Euro and your expenses amounted to 11,000 Euro. What profit percentage has changed this year compared to the previous one?
RO	*Organizing Christmas school show.* In order to organize the Christmas school show, the school has been sponsored with 120 oranges, 80 packets of biscuits, 200 waffles, which children must divide into packets with the same content. Which is the maximum number of packets and what does each packet contain?
	Conclusion All of the described situations will be beneficial for creating mobile apps.
17.	**Of all the things we discussed, what would you remarks and suggestions be?**
LV	Teachers hope that those intellectual outputs will really help in math lessons. Those teachers who are not good in ICT, they will search for a possibility to learn how to do it so they can actively use the result of this project in their lessons. They believe and hope that this project will improve their students' skills and abilities in math lessons.
PL	All teachers expressed a great interest in the future results of the project and confirm readiness to participate in the next phases of the project.
RO	The round table talk was very beneficial, making our staff reflect on the quality of their teaching and the expected performances of the students' target group. Our suggestion is that the difficulty level for most Mobile Apps should be simple, gradual, accessible and attractive.
	Conclusion The participants of the focus groups in partner countries have expressed their interest in the SMART project and its future results as they think the intellectual outputs will be useful to use in the classroom. The e-directories of existing mobile apps will aid teachers, both of Math and other STEAM subjects to reach better pupils' achievements and enhance their motivation to learn. All teachers look forward to the new Math and Eureka App which will be available in EN and national languages.

General conclusions

1. The State of the Art Review served the purpose to find out the real situation in partner countries related to the development of mathematics teachers' digital, social and didactic competences, necessary to work with low-achieving pupils with fewer opportunities and from disadvantaged backgrounds in order to engage them in learning math and improve their learning results. The results of the collected data disclosed that the majority of math teachers prefer traditional methods of teaching in the classroom, because: they have limited availability or equipment (multimedia boards, tablets, laptops) or software; poor digital competence to use ICT tools and equipment; few digital programs to teach Math in the classroom; fear of embarrassment in the eyes of the students, because of their better knowledge of computer technologies. Whereas teachers of other STEAM subjects (biology, physics or chemistry) are more likely to use ICT tools, because there are more software programs available and their classrooms and labs are better equipped. Math teachers agree that integration of ICT tools into formal and non-formal education makes math lessons more interesting. However, math teachers lack digital competences due to the shortage of professional development programs/ courses on the subject.
2. Teachers stated that mobile apps and ICT help differentiate and personalize learning when assigning different learning tasks depending on the student's level and abilities and working with diverse groups of students. What concerns promoting critical thinking and creativity, teachers hold that creativity is exercised through integration of STEAM school subjects whereas critical thinking is exercised applying the acquired knowledge in real-life situations.
3. The participants of the Focus groups agree that creating of two e-directories would be of great use. Such e-directories would save teachers' preparation time and make the lessons more attractive to pupils. They believe that mobile apps, integrating STEAM subjects would serve the purpose of exercising pupils' creativity, critical thinking and problem solving and would increase pupils' engagement and motivation.
4. The respondents answered that in order to achieve better learning results in math and other STEAM subjects, also, create a positive and appropriate learning environment, especially working with diverse groups of pupils, it is important to improve social, didactic competences, and learn from best practices in partner countries. They believe that success stories from their pair teacher in other countries would serve a good example on how to differentiate and personalize of the learning content, manage classroom time, and use ICT and Mobile apps to increase attractiveness of lessons, dealing with multiculturalism.
5. The conclusion was made that taking into account the abilities of the target group (low achievers in math, aged 10-13), the exercises for the mobile apps should be oriented into the first 3 aims of the Bloom's Taxonomy: provide knowledge, comprehend knowledge, and apply knowledge in new or familiar situations. The summed results of cognitive skills and abilities (knowledge/perception and application) revealed what skills for the 5-6 grade pupils are the most important to improve in order to achieve better learning results in math. (See question 14).
6. All respondents agreed that developing mobile apps, it is crucial to pay attention to real life situations or areas that are the most interesting ones to pupils aged 10-13. They suggested the possible real-life situations: travelling, creating travel routes for the class field trip, managing one's own pocket money, taking care of the pet (calculating the monthly expenses), shopping on-line or in the supermarket, counting discounts, cooking.

Annex 1

AGENDA

Focus group meeting with target groups

Date:
Time:
Place:
Organized by partner:

List of participants:
(name, surname, institution, occupation)

Time	Content
	Welcome and Agenda.
	Introduction of the participants of focus group
	Presentation of the project "**SMART Mathematics Teacher".** Aim of the State of Art Review
	Round table discussion in Focus group
	Concluding of the meeting, invitation for the further participation in the further training

Annex 2

PART 1. Information about the situation in partner countries related to the development of mathematics teachers' digital, social and didactic competences

2. Do teachers use ICT to aid teaching/learning mathematics in the classroom?

If "Yes", please specify what …….

If "No", indicate the reason(s) (explain why)

……

Additional questions for discussion:

- Tell about the positive experiences you've had using XXXXX (ICT)
- Tell about the disappointments you've had with XXXX (ICT)
- Who or what influenced your decision to use the ICT/Mobile App?

3. **If "Yes", what are the aim(s) of such teaching/learning using ICT? The aims are listed according to Bloom's taxonomy, *choose 2-3 most appropriate answers*.**
   a. Provide knowledge
   b. Comprehend knowledge
   c. Apply knowledge in new or familiar situations
   d. Sort materials or concepts, facts into components or/and to systematize them
   e. Judge, relate, evaluate the phenomena
   f. Create: design, formulate, build, invent, compose

4. **How could ICT and Mobile Apps in the Math classroom help:**
   - differentiate and personalize learning
   - promote pupils' critical thinking and creativity
   - enhance pupil's engagement and motivation

5. Do Math/STEAM teachers use Mobile Apps in formal and/or non - formal education?

If "Yes", specify what (provide names and/or links and specify the context)

……

……..

……..

If "No", indicate reasons why (1-3)

……..……

……..

……..

6. In case Math/ STEAM teachers use free of charge Mobile Apps in the classroom, which Apps do they prefer? Explain, why?:
   a. In English
   b. In the national language

7. **The partnership is planning to create two e-directories (collections/sets of existing Mobile Apps in English and national languages, available ICT based learning tools online) to enhance pupils' engagement in learning math and exercise their critical thinking, problem solving and creativity.**

   - The aim of the e-Directory O2/A1 is to provide **Math** teachers and 5-6th grade learners with the opportunity to select the most appropriate mobile apps to aid teaching and learning of **Math** both in formal and non-formal education.
   - The aim of the e-Directory O3/A1 is to provide **Math/STEAM** teachers and 5-6th grade learners with the opportunity to select the most appropriate mobile apps to exercise pupils' **creativity, critical thinking and problem solving** both in formal and non-formal education.

Do you think such e-directories would be useful to STEAM teachers? Which of the directories would you choose and why?

8. **Do you have any experience of integrating Math into other STEAM (Science, Technology, Engineering, Arts, Math) subjects?**
   a. Yes, specify what
   b. No, explain the reasons

9. **If "Yes", please specify the topics of integrated lessons (3-5)**
   a.
   b.
   c.
   d.
   e.

10. **What professional training programs/ courses (either on-line or face-to-face) on the topic of using Mobile Apps in the classroom have you attended or heard of in your country (at institutional, regional, national level)?**
    a. Yes (please specify.....)
    b. No

11. **What knowledge and skills would you like to improve to make the mathematics learning process appealing to pupils using Mobile Apps and other ICT tools? Please select 3 the most important ones:**

    - Selecting
    - Creating and modifying
    - Managing, protecting and sharing
    - Using ICT tools to differentiate and personalize learning
    - Using ICT to actively engage learners
    - Facilitating learners' digital competences

12. Do you have any experience of working with diverse groups of pupils? Have you faced any issues/ challenges? What knowledge and skills would you like to gain/improve to deal with diverse groups of pupils in the classroom?

……
……

13. Within partnership 24 success stories will be created. Please choose 3-5 topics which would be the most relevant for you to develop your professional skills as a teacher

- Teaching math using Mobile Apps
- Teaching math through integration with other STEAM subjects
- Teaching math using other ICT tools and methods
- Dealing with diverse groups (low achievers, facing social and other obstacles) of pupils in the math classroom
- Individualization and differentiation in the math classroom
- Engagement and motivational tools and methods in the math classroom, both in formal and non-formal education
- Development of pupils' critical thinking
- Development of pupils' creativity
- Other (please specify)……

PART 2. The main mathematical skills (abilities) which are important for low-achieving pupils (5-6 grade)

13. What are the underlying reasons for student low achievement in math in your country and their reluctance to learn the subject (specify 2-3 reasons)?

1…….
2…….
3…….

14. **What of the below listed cognitive skills/abilities of the low-achieving pupils (5-6 grade) should be exercised with the use of mobile apps in order to support better achievements in math?**

1.	**Cognitive abilities – knowledge and perception:**	Most important	Important	Least important
1.1	to be able to memorize and reproduce basic mathematical concepts (*area, fraction*, etc.), symbols (≤, +), definitions, structure (*units, tens, hundreds*, etc.) and features of numbers			
1.2	to be able to recognize mathematical objects (*figures: rectangle, square*, etc.), numbers, fractions (*simple and decimal*), literal and numeral expressions (*e.g., 3a + a; a + 6 = 18; 0,5 · 6 + 1,3; etc.*)			
1.3	to be able to recognize equivalent mathematical objects (*e.g., equivalent simple and decimal fractions, geometrical figures angled in different ways*)			
1.4	to be able to choose the right answer from the given options			
1.5	to be able to compare (>, <, ≥, =) and round numbers			
1.6	to be able to perform common algebraic procedures (*to calculate meanings of numeral expressions, perform addition, subtraction, multiplication, etc.*)			

1.7	to be able to write a natural number in words, Arabic or Roman numerals (*e.g., twenty one – 21 – XXI*)			
1.8	to be able to write a simple or decimal fraction in words or numerals (*e.g., two thirds – 2/3; two fifths – 0,4*)			
1.9	to be able to find and select information from diagrams, charts and other sources of information			
1.10	to be able to evaluate a partition of a scale in measurements of mass, time and length			
1.11	to be able to use means of measurement			
1.12	to be able to choose and apply units of measurement (*length, mass, length, area, volume, etc.*) properly			
2.	**Cognitive abilities – application**			
2.1	to be able to choose a valid operation, method, strategy for solving ordinary tasks of a known algorithm (*e.g., 36·48+64·48= 48·(36+64)=...*)			
2.2	to be able to present, depict mathematical data in diagrams, charts, schemes			
2.3	to be able to depict mathematical data in one way presented in another way (*e.g., depict the given data* <table><tr><td>*Points*</td><td>*20*</td><td>*21*</td><td>*22*</td><td>*23*</td><td>*24*</td><td>*25*</td></tr><tr><td>*No. of participants*</td><td>*5*</td><td>*5*</td><td>*4*</td><td>*2*</td><td>*4*</td><td>*3*</td></tr></table> *in a column diagram*)			
2.4	to be able to create an appropriate model for solving a common task (*e.g., find 20% of number 160… possible variants: 160 : 5; 160 · 1/5; 160 : 100 · 20; etc.*)			
2.5	to be able to depict a graph or scheme according to the task setting (*e.g., a student is able to depict a probability tree*)			
2.6	to be able to draw a proper geometrical figure (*e.g, to draw a right-angle triangle with legs of 3 cm and 4 cm*)			
2.7	to be able to apply data from schemes, charts, graphs, diagrams for solving a task			
2.8	to be able to minimize/maximize units of measure (*1 cm = 10 mm; 1 cm = 0,01 m; etc.)*			
2.9	to be able to write, present, explain the task solution			
2.10	to be able to make conclusions or answer the given questions.			

PART 3. The real life situations or areas are the most interesting ones to pupils aged 10-13

15. **What problem-oriented real life situations are the most interesting ones to pupils aged 10-13 (5-6 grade)? Please, provide examples (e.g. managing one's own pocket money, cooking a birthday cake, etc….)**

…….

16. **To create a mobile app it is necessary to convert the real life situation into a Math task (exercise) which could develop the above mentioned cognitive abilities and skills of pupils. Please provide a short scenario(s) for 1-2 of the above mentioned real-life situations.**

e. g. Management of one's own pocket money.

John and Peter were to chop grandfather's firewood. If the brothers worked separately, John would do the task in 30 min., while Peter would do the task in 1 hour. How much time it would take if the brothers worked together?

17. **Of all the things we discussed, what would you remarks and suggestions be?**