Project Significant Maths for Adults: Enabling Access across Europe/ Sigmath

Review on Blended Learning in Adult Education

Kaunas 2013

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1 Purpose of the document

This document summarizes the desk-research on the current practice of blended learning approach in adult education. It identifies good practice in the use of blended learning in Lithuania & will provide recommendations for the design of the *SigMath* resources.

The main section of the review is structured into six parts:

- Blended learning theories, definitions & concepts by different authors
- Characteristics for adult learners: their learning aspirations, needs for studies, challenges in learning with informational communicational technologies (*ICT*)
- Role of technology in developing adult learners skills, including *ICT* & institution integration, *ICT* features in continuous learning
- Approaches to blended learning: models, uses cases & scenarios
- Series of online tutorials for Math adult learners
- Recommendations for developing a blended learning model in SigMath project, including Web 2.0 [1] tools, virtual learning environment etc.

Additional part of the review (*AnnexA* & AnnexB) covers Web 2.0 tools, virtual learning environment Moodle [2] & abilities to apply them in SigMath project in more detail:

- Social networks (Facebook, Elgg, etc.)
- Blogging tools
- E-portfolio tools
- Podcasts
- Moodle usage examples in developing online Math courses.

All of above listed key points are consistently described (with illustrations where needed) in the next chapters of this document.

2 Theories on Blended Learning

Blended learning is difficult to conceptualize as one idea, because there are many pedagogical theories about the term & different approaches how to use blended learning method. The term it selves is referring to diverse aspects of learning and teaching.

Another feature accompanying the phenomenon is that the term *blended learning* has no clear translations in other languages. The question could then be if other cases investigating and researching similar questions, not defined as blended learning, are still dealing with blended learning? It is possible to give a positive answer to this question if the research fits the definitions of what blended learning is.

This chapter defines blended learning concepts derived by *Karsten Gynther* [4], *Josh Bersin* [5], *Kaye Thorne*, introduced by *Oliver & Trigwell*. Though the idea of blended learning is around in the mid 90's, these authors are claimed to be the classical & most important initiators of blended learning theories established in 2003, 2004, 2005 years.

Furthermore blended learning theory was redefined & improved by Innosight Institute [3], which was the foundation of classifying blended learning models (Chapter 5).

2.1 Blended learning by Karsten Gynther

Gynther states that the gap previously existing in traditional versus web-based, distant or virtual learning is disappearing. Teaching is supported more & more by digital or net based flexible solutions in educational organisations. A virtual dimension is on its way into all sorts of education, whether experimenting or already implementing it. The term blended learning is of American origin. It grasps the blend of traditional teaching and technology based teaching using a wide variety of pedagogical methods and different forms for technology. Gynther points that the term blended learning puts four different didactical questions in focus:

1. What kind of knowledge should the students get and what kind of pedagogical form will be necessary to organize the teaching from?
2. How do you need to organize the learning room?
3. How do you need to organize the learning milieu?
4. What kind of learning resources can build up under your choices?

Gynther finds that the term blended learning does not only regards the blend between technological and traditional classroom teaching but also regards the matter of what to learn and what pedagogical method and what kind of technology that promotes learning and different forms of knowledge are used in teaching. It is important to find technological solutions that support the different didactical choices. Face to face communication is, today, just one of several ways to organize the teaching and learning. The author describes how the future educational market puts the different educational institutions under new types of pressure due to new types of education, subjects and a new type of students. New type of students demands a flexible educational design where new user profiles are in focus. This has consequences also for the learning design.

The result is that blended learning is not *one* learning paradigm by it-selves but rather a delivery mode to be used within other pedagogical models. In this regard it would probably be sounder to introduce blended learning rather as a mode within pedagogy.

2.2 Blended learning by Josh Bersin's

Bersin claims that blended learning is the combination of different training "media" (technologies, activities, and types of events) to create an optimum training program for a specific audience. Bersin uses the term blended learning as traditional instructor-led training being supplemented with other electronic formats where blended learning programs uses many different forms of e-learning, perhaps complemented with instructor-led training and other live formats.

Bersin (2004) offers two concrete approaches and finds that the goal of blended learning is to synthesize the face-to-face and technology-based teaching into an integrated mix. In this way one can tailor the teaching basing on actual needs. First of all - the technology can complement traditional instructor-led program and second it can complement technology-based training where the socialization process is lacking and where the students lack motivation and excitement from an instructor. From this thought Bersin finds two general approaches to blended learning:

1. The "program flow" model: a step-by-step curriculum that integrates several media into a chronological program or syllabus. The chapters are building on each other. It ends in an exercise or assessment to measure total learning. This model is comparable to a college or high-school course.
2. The "core-and-spoke" model: One fundamental training approach (onsite classroom training or web-based courseware) with other materials, interactivities, resources and assessments as "supporting materials, optional or mandatory materials that surround and complement the primary approach.

The first approach creates both a deep level of commitment and a high completion rate. Because of this students will feel more engaged and can plan their training over time. Bersin claims that this approach also lets the students find time to fit training into their existing schedules and at the same time it forces them to continue until the conclusion. The approach enables the teachers to track the progress and therefore also find any potential problems. Bersin finds that this approach fits well into the classroom teaching. This fits into most instructional design paradigms (learn/try/assess). It serves well for a certification program and it is easy to modify and maintain.

The second approach Bersin presents is designed with a single course using a single media (electronic or live) employing other media or learning activities as optional or supplemental material. The students decide for themselves which supplemental material to use and they do not need to complete the course at the same time. This approach assumes the students to be motivated self-study learners. This model speeds up the development process because the training organization can build the surrounding materials over time.

2.3 Blended learning by Kaye Thorne

Blended learning is:

- an *elegant solution* to the challenges of tailoring learning and development to the needs of individuals
- term represents an opportunity to integrate the innovative and technological advances offered by online learning with the interaction and participation offered in the best of traditional learning

In Thornes book *Blended learning: how to integrate online & traditional learning* blended learning is defined as the mix of traditional forms of classroom training and one-to-one coaching with:

- Multimedia technology
- CD ROM video streaming
- Virtual classrooms
- Voicemail, email and conference calls
- Online text animation and video-streaming

As mentioned many of the books within the field of blended learning have a “how-to-do” approach with (private) companies as their main audience and question of how these companies can make training more efficient, less cost and time demanding as their subject matter. These books address the reader in a very informal non-academic language with phrases like “how can it help? Is it right for your organization? How can you implement it?” It advertises blended learning as *the* training method in an organization. It is hype, it is new and it solves nearly all training problems.

2.4 Blended learning theories introduced by *Oliver & Trigwell*

Oliver & Trigwell represented blended learning ideas of many authors (Whitelock & Jelfs, Driscoll, Hofmann, Valiathan).

Whitelock & Jelfs (2003) opened a journal special issue on blended learning where they introduced three definitions of the term:

1. the integrated combination of traditional learning with web-based online approaches
2. the combination of media and tools employed in an e-learning environment;
3. combination of a number of pedagogical approaches, irrespective of learning technology use.

Oliver and Trigwell mention all of these articles but also draws in Driscoll’s summary of her book (2002) where she identifies four different ‘concepts’ denoted by this term:

1. combining or mixing web-based technology to accomplish an educational goal
2. combining pedagogical approaches (‘e.g. constructivism, behaviourism, cognitivism’) to produce an optimal learning outcome with or without instructional technology
3. combining any form of instructional technology with face-to-face instructor-led training; and
4. combining instructional technology with actual job tasks.

Driscoll summarizes that blended learning means different things to different people, which illustrates its widely untapped potential.

Valiathan states that blended learning is:

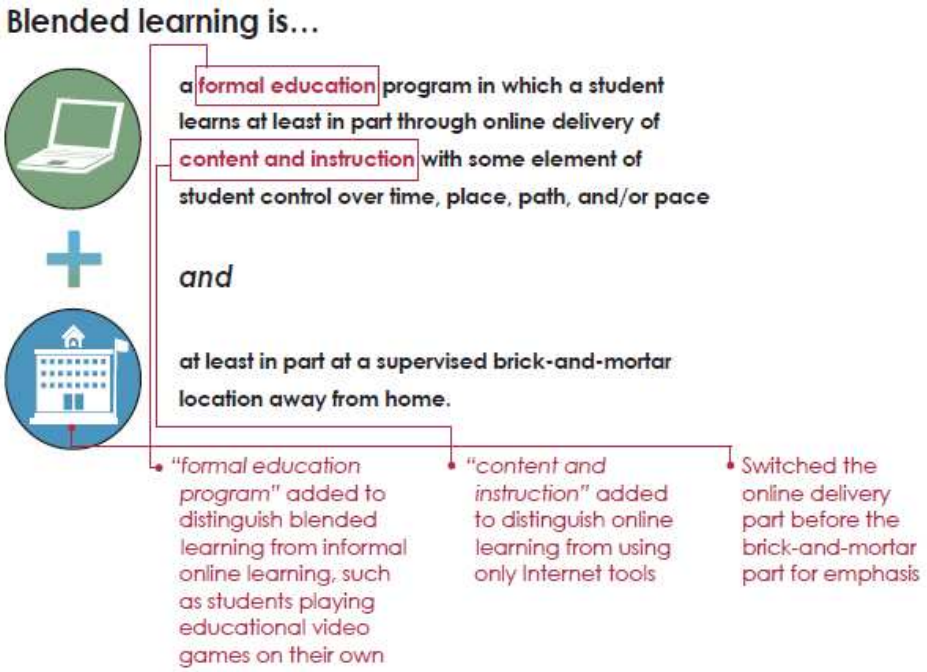
1. skill-driven learning, which combines self-paced learning with instructor or facilitator support to develop specific knowledge and skills
2. attitude-driven learning, which mixes various events and delivery media to develop specific behaviour
3. competency-driven learning, which blends performance support tools with knowledge management

Oliver and Trigwell are critical to the use of the term *blended learning* in all contexts because they find that the feature all of these examples and definitions share is that they are all described from the perspective of the teacher, the instructor or the course designer.

The result is that blended learning is not *one* learning paradigm by it-selves but rather a delivery mode to be used within other pedagogical models. In this regard it would probably be sounder to introduce blended learning rather as a mode within pedagogy.

2.5 Blended learning by Innosight Institute

The main idea of blended learning by Innosight institute is illustrated in picture 1:



Picture1. Blended learning definition

The first component of the definition—online delivery of content and instruction with some element of student control over time, place, path, and/or pace—incorporates language from Evergreen Education Group's and iNACOL's definitions of online learning. They define online learning as education where content and instruction are delivered primarily over the Internet. The term online learning is used interchangeably with virtual learning, cyber learning, and e-learning. The phrase "with some element of student control over time, place, path, and/or pace" was included to distinguish blended learning from technology-rich instruction.

The second component of the definition specifies that the learning must be "supervised" and take place "away from home." This is to distinguish it from students learning full-time online at a brick-and-mortar location such as a coffee shop, public library, or home. Someone associated with the brick-and-mortar setting provides the supervision, rather than a parent or other adult who is associated primarily with the student.

So having defined different blending learning theories, next chapter identifies the characteristics & needs of adults learners and provides some teaching recommendations.

3 Characteristics and needs of adult learners

Adult learners are different from youth (pupils, students) because most of them have already had some learning experience in the past. Also adult learners think from other perspective and usually are more motivated, prefer active dedicated studies.

It is important to emphasize the learning aspirations of adults because this forms the foundation of teaching principles. Key points are listed below:

- Manage to accomplish work faster & better
- Gain knowledge about concerned topics, subjects
- Gain mandatory basic knowledge that is required for daily work tasks
- Get a qualification certificate
- Assurance of not losing a job
- Employer requirements to take the learning course
- More possibilities to find a new & better job, change profession
- Meet new people
- Start own business

Table 1 illustrates basics characteristics of adult learners [6]. It also compares the needs of adult learners and youth in the study process. Furthermore, teaching recommendations are provided for the tutor in order to know the necessary guidelines for learners better.

Table1. Adult learner characteristics & teaching recommendations

Characteristic	Teaching Recommendations
Adults want to take more control over learning than youth: as adults are self-directed in their lives, they transfer this need for independence to the learning situation	• Ask for their preferences • Allow them to choose among different activities • Implement peer & self- assessment
Adults draw upon their experience as a resource for learning	• Use their experience as a resource for learning • Connect their previous knowledge with their new knowledge
Adults tend to be more motivated than youth**.** They are goal oriented: have clear objectives for attending a course	• Show them the objectives of the course • Invite them to share their objectives & make them part of the annual plan • Maintain their motivation through varied and relevant activities
Adults are pragmatic: they want to put what they learnt immediately into practice	• Don't spend too much time on theory • Try to put the learners needs first • Make them use what you've taught immediately

The learner role is secondary for adults and they must fit their learning into life's margins (being a learner is not usually their main priority)	• Establish a peer relationship with them (respect should be shown) • Give all learners the same opportunities • Anticipate (extend) deadlines
Many adults lack confidence in their learning because of negative past experience "rusty" study skills	• Use confidence building activities • Teach study skills • Use group work to reduce anxiety
Adult are more resistant to changes. They have seen that some changes in life were not for the best	• Explain the reasons underlying the changes • Link new ideas with previous ones • Introduce changes slowly (one by one)
Adult groups are more diverse in terms of age & experience	• Establish a collaborative atmosphere in the classroom • Present materials in different ways
Adults must compensate for aging in learning. Though adults may have problems related with age such as sight, they learn slowly but more deeply	• Check the learning environment • Check learning pace. Give learners time to process the information

In addition, there are some general needs for studies that adult learners participate in. Basic aspects are:

- Active Learning. Despite the fact that adult learners are busy individuals they want to be engaged in active learning. Lessons should be interesting, practical and applicable
- Effective presentations. Adult learners have limited time in class and they want to get the most out of the class time. Furthermore adult learners are more experienced and expect quality presentations
- Time Management. Working adults are pressed for time, they are time conscious and therefore value punctuality and well-paced classes
- Communicating expectations. Adult learners want their instructors to communicate clearly their expectations for the course and specific assignments
- Sharing Timely and Relevant Resources
    - Upload lecture materials at least three days before class
    - summarize what was discussed during learning activities/online discussions so that there is a closure
    - let the materials be available throughout the entire period of the course etc.
- Constructive feedback. Provide relevant feedback, ensure timely & detailed feedback summarize comments to give an overview of what to improve on
- Approachability & encouragement. Adult learners want their instructors to understand their challenges and appreciated instructors who were approachable and patient

So in order to adapt mentioned adult learners needs and characteristics to a blended learning model, the role of technology in the teaching process is described in the next chapter. Moreover ICT importance & challenges for adult learners are identified.

4 Role of technology in developing adult learners Math/numeracy knowledge & skills

A lot of different aspects that apply to various studies (math, information technologies etc.) need to be analyzed when exploring relationships between adult learners and information communication technologies. Firstly, there are many challenges for adult learning in learning with ICT technologies. Main themes:

- Most adults were taught in a traditional and passive classroom, so ICT is probably a new way of managing the learning process
- Nowadays ICT changes so rapidly that even though adult learners have some knowledge about ICT it could be outdated and not suitable for the offered studies. As a result additional learning is required
- As memory decreases with age, it gets more difficult to assimilate the required learning material. In addition, if understanding how various ICT tools work is required then the workload gets much bigger
- Some adults could be afraid of using ICT & consider extra work & money involved in studies

Not only adult learners, but instructors/tutors also face challenges in conducting a more robust and modern learning course. Basic key points are:

- Instructors should adapt and change as they learn how to use new medium
- Instructors, instructional designers and other professionals working in the design of online environments for adults must understand adult learning theory, especially in terms of its relationship to distance or online learning
- In addition to the learning material itself, instructors should have a good understanding of the online environment (*Moodle* etc.) that is being used in the learning process

Other part of this chapter covers the importance of ICT in developing learning knowledge, aspects of encouraging adult to use technologies and how they can facilitate adult learning process.

4.1 The importance of ICT in developing learners knowledge and skills

Nowadays, in the fast moving and changing world informational communicational technologies play a significant role in education, industry and business. Adult learners are no exception: they need to adapt to a more modern working environment, improve their ICT skills. General points are:

- ICT becomes essential as contemporary education system is focused on preparing learners for daily life & problem solving
- Education should be adapted to volatile circumstances in a fast moving world: follow the changes of new and upcoming ICT
- Modern economy encourages global competition & education should not be limited to a traditional school environment
- The popularity of ICT change the way how people communicate, find information & gain knowledge (computers, internet, radio, TV in various forms)

- Appropriate & competent usage of ICT improves education system. Nowadays this process is almost inevitable

More specific points about the importance of ICT in the learning process (studies) are:

- Learning can be interactive & based on communication if ICT are used. This way a wider & more motivated learning environment in an education institution & beyond could be created. Learners solve problems communicating or working together
- ICT usage allows learning to be applied according to individual needs, learning content (*what do we learn?*) & methods (*where & how do we learn?*)
- Learning can be done anywhere, using a computer, mobile phone etc. In this situation it is important to make individual tasks for learners with special needs (blind, deaf or very talented ones)
- There is no need to teach all learners at once as ICT can control the process. This is very convenient for adult learners who have a job or look after their children

In addition, there is a subset of educational institutions in the world that have not applied (or just starting) ICT in classes. To tackle this problem, topic about ICT & institution integration should be discussed. Especially: teaching about information communication technologies, using information communication technologies in various lessons or lectures, applying newest technological solutions into the management of educational institution, creating a virtual learning environment.

Another important thing about ICT is that it has a lot of useful features related to continuous learning:

- Flexibility in respect of time & place (learning at home, using a virtual learning environment or distance learning)
- Flexibility in respect of learning material (courses are prepared for example according to organization needs)
- Easy access to information & other people
- Convenient communication with other people using online resources
- New approach to organizing learning (individualization of the process, better preparation & control of the learning material).

Despite many advantages of informational communicational technologies in adult learning, it is necessary to encourage adults to use ICT and show how they can facilitate the learning process.

4.2 How to encourage adults to learn with technologies

Technologies are infiltrating all aspects of life and eventually even the most unsociable individuals will need to learn the basics. All the while, adults face two distinct disadvantages: they tend to have fear and little experience with technologies, and even the healthiest among them show declines in cognitive and motor function that can interfere with their ability to use technologies [8].

Also lack of confidence is a major factor in older adults' ability to become experienced with computer technologies. Learning new things definitely takes more time as you get older. Also some evidence to suggest that adults require specific procedural training to learn to use computer technologies [11]. Psychology and motivation are often overlooked factors, who suggest that older people weigh benefits heavily when deciding whether to adopt new technologies.

Primarily adults should not be afraid of learning by using technologies. Teachers should encourage and reassure learners. Technologies can be used easily and do not need to be afraid. There are many

technologies adapted and simplify specially for adults. But need to realize that every single thing that we want to learn requires effort, as well as technologies. Need to understand that technologies can facilitate the learning process. It is important encourage adults learning by using technologies:

- not to be afraid to use technologies for learning
- realize that technologies can facilitate learning
- are simplified technologies for older adults
- technologies can be useful not only for learning

4.3 How technologies can facilitate adults learning?

Advances in technology have always transformed the way people are educated. From the abacus that made teaching math easier millennia ago, to the word processor that changed the way research papers are written and presented, humanity's technological progress has impacted education.

Though technological change has shaped education from the beginning, the digital revolution has certainly increased the speed at which education is transformed. In the past twenty years or so, there have been changes that few people ever dreamed of [7].

Just consider the following ways that information technology, the Internet and other developments have reshaped the way education is attained, measured and delivered. The way people learn is changing. Recent research reveals that 42% of adults surveyed said they are much more likely to use the internet for learning than they were a year ago and this is likely to become more common through the use of smartphones and other mobile devices.

Advances in technology have made this easier. Adults can access learning at any time and almost anywhere, using audio, video and text content from broadcasters, education providers or their own peers on social media. The tools they've used to do this have changed too, with around one third of web users now accessing the web through a mobile device, such a tablet or smartphone.

Learning experience that aims to adults is directly related to changes in life, which leads to the desire or need to learn. Adults basically want to get involved in learning before, after, or even change the course of their lives. Once they realize that change is inevitable, adults engage in any learning activity that promises "to help them cope with the changes" [10]. Adults are motivated to learn due primarily to the fact that they have to use what knowledge or skills which are sought. Learning is a means to an end, not an end in itself. Technologies can be a tool to learn a variety of things more easily [9]. The training process is inconceivable without modern technologies which not only speeds up the training process, but also improves the absorption of the subject taught, helps to structure better absorb the information.

Older, working adults are now able to go back to school while maintaining a career and a family. Online classrooms also tend to be a much more economical option for adults who want to go back to school. It's also true that most online classrooms provide the same opportunities to learn as a seated class would.

- technologies can facilitate adults learning
- technologies can help to absorb learning material for adults
- technologies can help to provide a more structured learning material

Technologies do not teach to think - it helps thinking people.

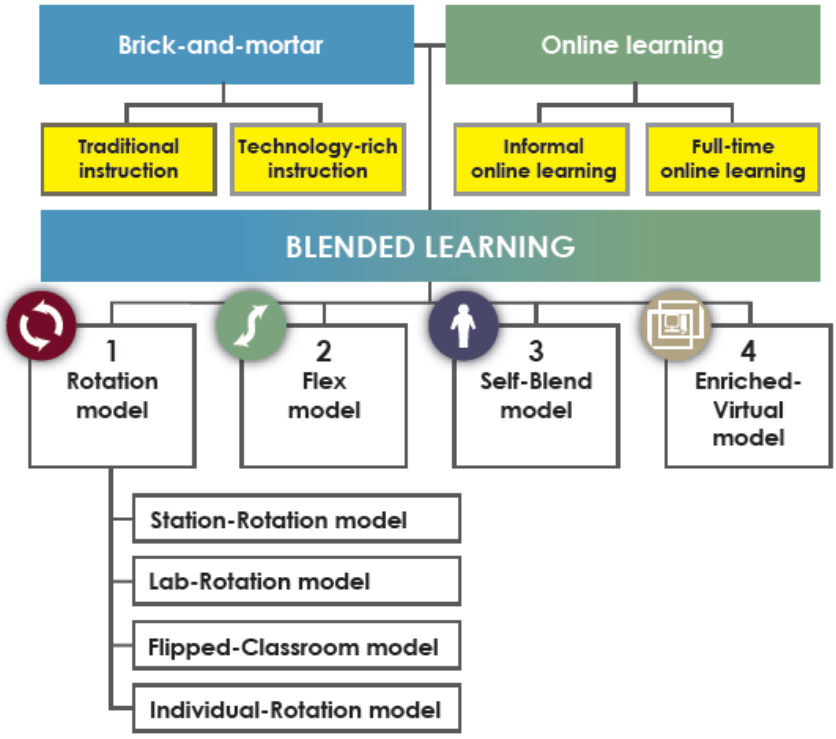
5 Approach to blended learning. Models & use cases

Previous sections (2, 3 & 4) of this document covered theoretical aspects of blended learning, adult characteristics and importance of ICT. This chapter focuses on applying blended learning models in practice, analyzing blended learning use cases in education. Blending learning models are described on basis of the Innosight Institute K-12 classification [3]. It includes identification of basic model structure (rotation, flex, self-blended, enriched-virtual) and usage scenario examples.

One critical part of blended learning models is that they involve "some element of learner control of time, place, path & pace"**:**

- Time: Learning is no longer restricted to the education institution day or year
- Place: Learning is no longer restricted to the walls of the classroom
- Path: Learning is no longer restricted to the pedagogy used by the teacher
- Pace: Learning is no longer restricted to the pace of an entire classroom of learners.

Picture 2 shows blended learning model structure. Generally, there are three main parts: "Brick-and-mortar", "Online learning" and "Blended learning". Brick-and-mortar learning refers to a traditional institution that might involve technologies ("Technology-rich institution"). Online learning includes informal and full-time learning whereas blended learning component – rotation, flex, self-blended and enriched-virtual models.



Picture2. Blended learning model structure

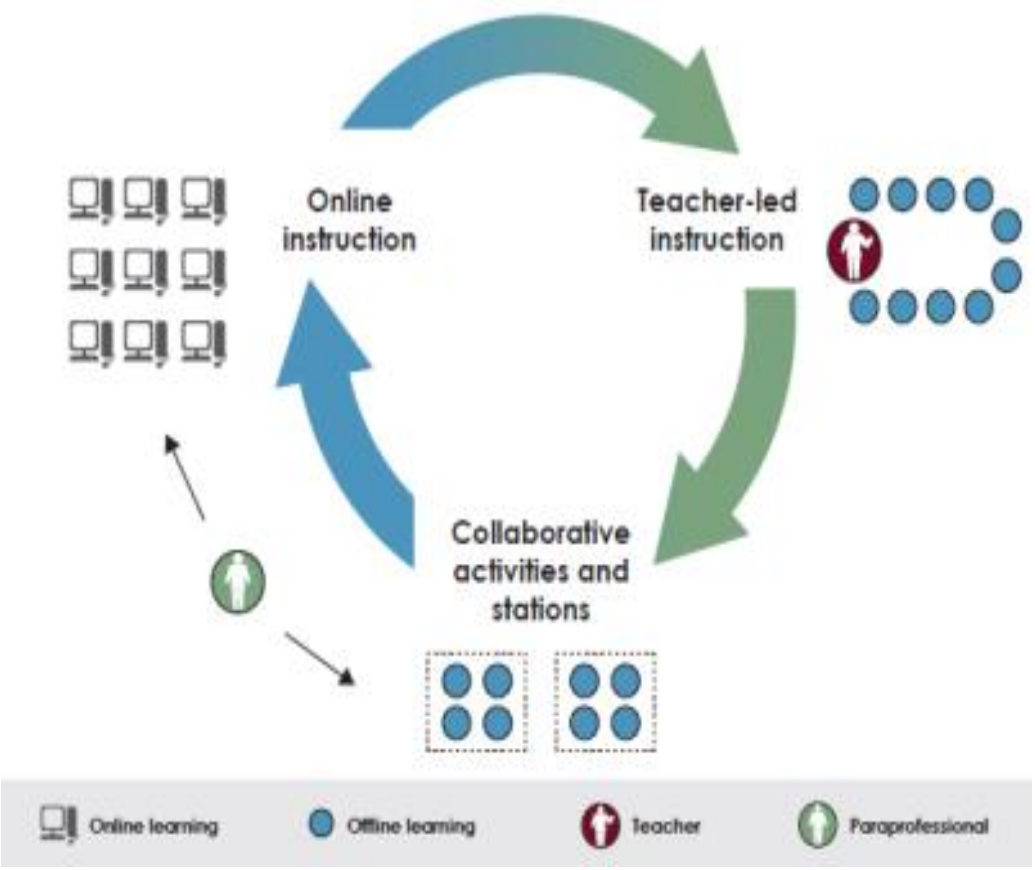
Each of blended learning models (with sub-models) is described in detail in 51.-5.4 chapters. Use cases are analyzed as well.

5.1 Rotation Model

Rotation model is divided into four sub-models which have some similarities and differences. The key similarity of models is that all include some part of learning online with a computer and another part – in a traditional way.

Station rotation model: learners rotate on a fixed schedule or at the teacher's discretion. Rotation includes at least one station for online learning. Other stations might include activities such as small-group or full-class instruction, group projects, individual tutoring, and pencil-and-paper assignments (picture 3).

Example: throughout the day the teacher rotates learners among online learning, small-group instruction, and individual assignments.

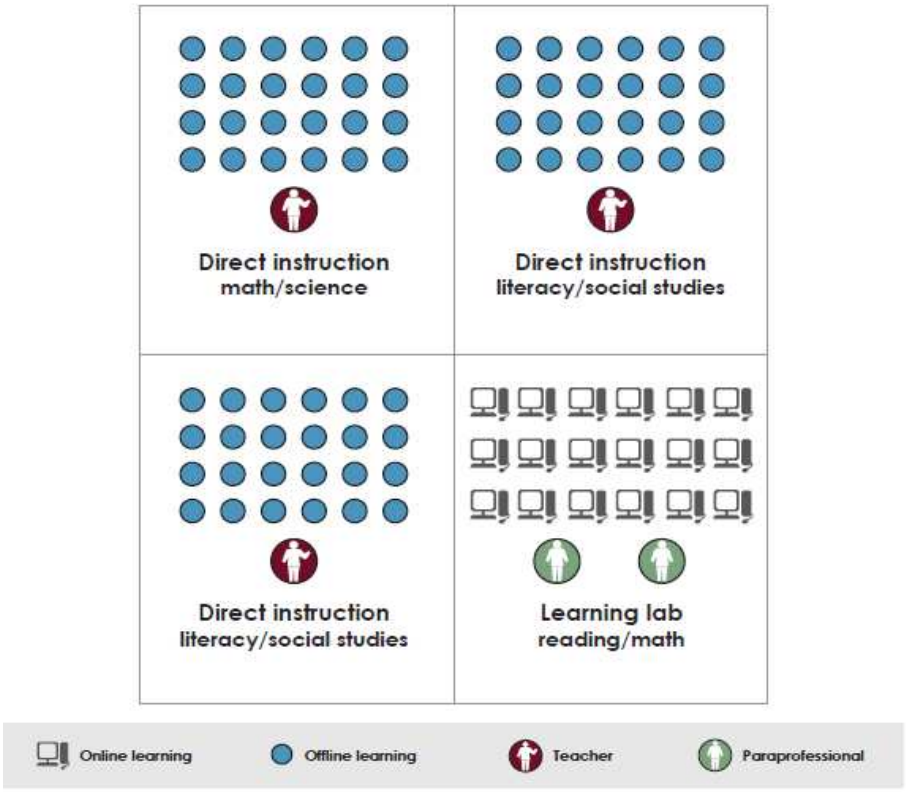


Picture3. Station rotation model

Lab rotation model:

- Learners rotate among locations on the brick-and-mortar campus
- At least one of these spaces is a learning lab for online learning, while the additional classroom(s) house other learning modalities
- Different from the Station-Rotation model because students rotate among locations on the campus instead of staying in one classroom for the blended course or subject (picture 4).

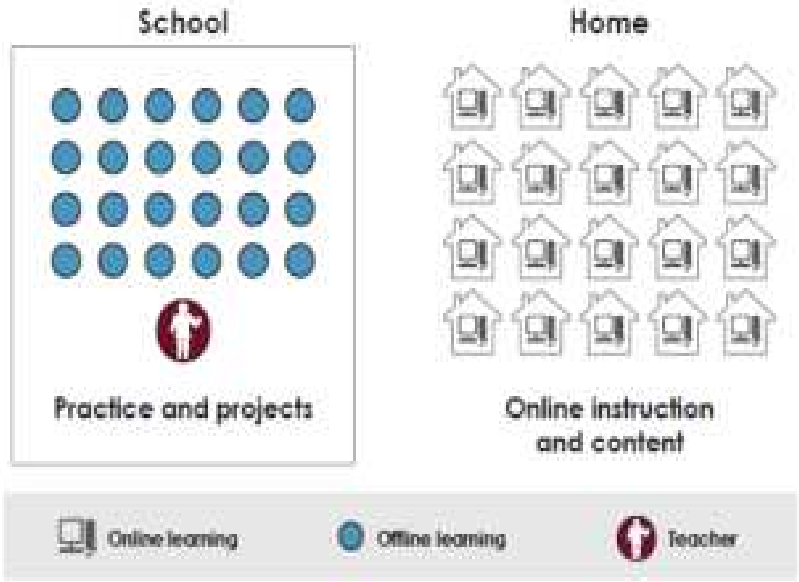
Example: Learners rotate out of their classrooms to a learning lab for two hours each day to further their instruction in math and reading through online learning.



Picture4. Lab rotation model

Flipped-classroom model: Learners rotate on a fixed schedule between face-to-face teacher-guided practice (or projects) on campus during the standard school day and online delivery of content and instruction of the same subject from a remote location (often home) after school.

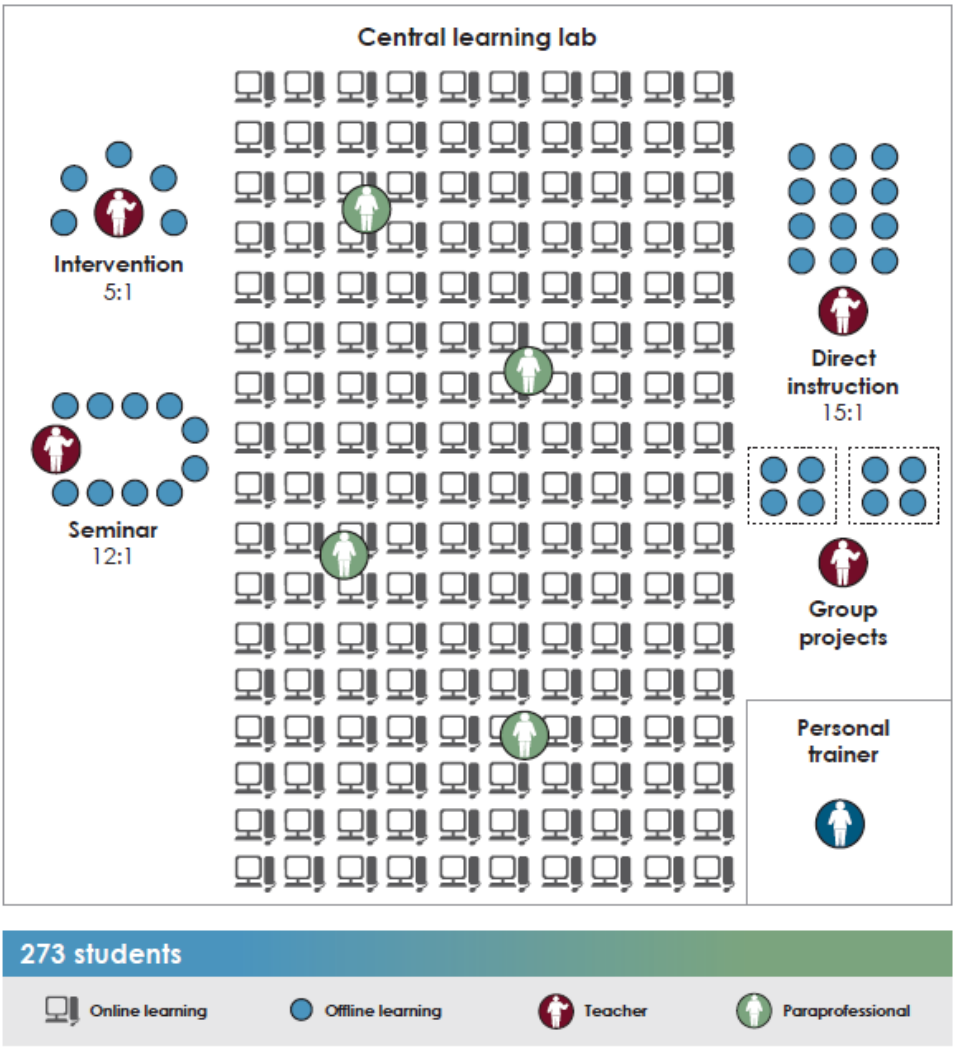
Example: Learners use Internet-connected devices after school at the location of their choice to watch 10 to 15 minute asynchronous instruction videos and complete comprehension questions on Moodle. At education institution they practice and apply their learning with a face-to-face teacher.



Picture5. Flipped-classroom model

Individual-Rotation model: Students rotate on an *individually customized, fixed schedule* among learning modalities, at least one of which is online learning. An algorithm or teacher(s) sets individual student schedules (picture 6).

Example: Assigns each student a specific schedule that rotates them between online learning in the learning center and offline learning. Each rotation lasts 35 minutes.



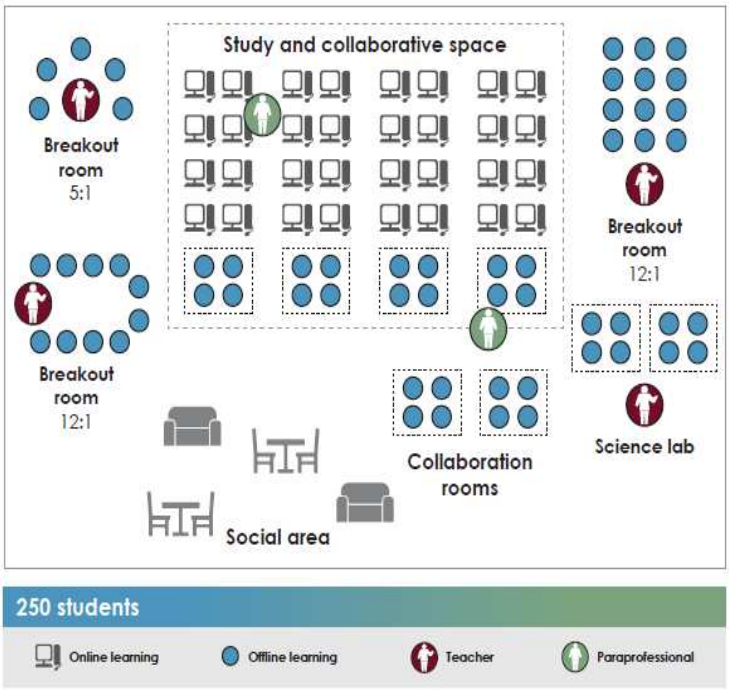
Picture6. Individual Rotation model

5.2 Flex Model

Flex Model:

- content and instruction are delivered primarily by the Internet, students move on an individually customized, fluid schedule among learning modalities and the teacher is on-site
- The teacher or other adults provide face-to-face support on a flexible and adaptive as-needed basis through activities such as small-group instruction, group projects, and individual tutoring
- Some implementations have substantial face-to-face support, while others have minimal

Example: face-to-face teachers use a data dashboard to offer targeted interventions and supplementation throughout the day for core courses (variations with elected online courses)



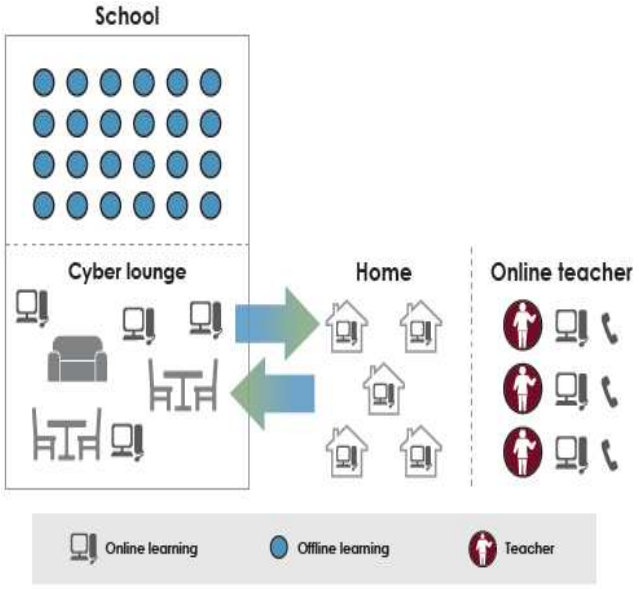
Picture7. Flex model

5.3 Self-Blend Model

Self-Blend Model: students choose to take one or more courses entirely online to supplement their traditional courses and the teacher-of-record is the online teacher

Example:

- Learners has the option of taking one or more online courses
- All learners complete a cyber-orientation course prior to enrollment
- Courses are asynchronous and learners can work on them any time during the day
- Learners can work on their online courses at school, but they are also free to complete the courses remotely if they prefer.

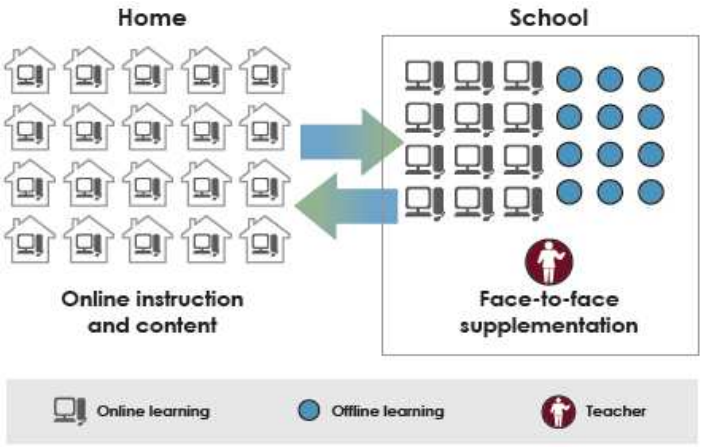


Picture8. Self-Blend Model

5.4 Enriched-Virtual Model

Enriched-Virtual Model: Whole-school experience in which within each course (e.g. math), learners divide their time between attending a brick-and-mortar campus and learning remotely using online delivery of content and instruction.

Example: Learners meet face-to-face with teachers for their first course meeting at a brick-and mortar location. They can complete the rest of their coursework remotely, if they prefer, as long as they maintain some specified point average in the program.



Picture9. Enriched-Virtual Model

5.5 Blended learning use cases

In addition to giving examples of blended learning models (5.1 - 5.4 chapters) this section analyzes other use cases of blended learning. Despite of the fact that SigMath project focuses on adult learners with lower math competence & skills, the examples provided cover uses cases in higher education considering that most important ideas can be adapted according to the project requirements.

Table2. Blended learning use case for mathematical programming course

Name of the case: Mathematical programming
Target Groups: Students of Applied Mathematics. Also from informatics, economics
Pedagogical approach • Traditional teaching is combined with problem, project, discussion based learning • All the assignments are compulsory and can be found on the web: the schedule of the lessons and consultation time with the tutor are found there.
Use of technology • www page (for presenting illustrative materials, practical examples of problem solving) • Electronic dictionary with links to wider information • Discussion forums, email • Videoconferencing for online lessons, virtual learning environment.
Blending method • combining both - traditional lectures (face-to-face) (15 lessons, each of the lesson takes 2 hours) and seminars plus distant collaboration with the students (discussions' forums, online questionnaires, videoconference meetings online (6 lectures, each takes 1.5 hours), students can find all the material in the virtual environment

• (for individual work is given 52 hours and students have 15 lessons in the laboratory class, each of it takes 2 hours

Table3. Blended learning use case for data analysis course

Name of the case: Data Analysis
Target Groups: Undergraduate students
Pedagogical approach: Basic idea is to learn from other solutions & presentations, share the learning
Use of technology: Course website & an online learning environment. All course materials are available on the website, including students presentations & exercise files
Blending method • online learning environment is integrated into the course very closely: includes all material • Main teaching method is small group "lectures" which are based on questions & discussions • The web is usually used as part of f-t-f learning sessions as well, not only as an additional or separate tool • 33% is for web based learning, 33% f-t-f & 33% of individual work.

Table4. Blended learning use case for Information management & information systems course

Name of the case: Information management & information systems
Target Groups: Undergraduate students in Information Sciences
Pedagogical approach: Constructivist, combining both cognitive and social constructivism as well as problem-based learning
Use of technology: Internet search engines, word processors and a learning environment
Blending method • Optional problem-based seminar and support materials on the web, parallel to face-to-face lectures • 25% of web-based learning environment, 15% lecture time, individual study (60%)

Table5. Blended learning use case for learning theories course

Name of the case: Learning theories
Target Groups: Teachers, teacher training students, developers & tutors of e-learning
Pedagogical approach: local teaching & tutoring, net-based guidance, video transmission
Use of technology: course is organized for both on-campus & off-campus students. The study uses the Internet and a learning management system. Carried out tasks: • Distribution of material • Broadcast of live and on-demand video • Teacher-student and student-student interaction • Synchronous & asynchronous communication, guidance
Blending method • Classroom lecturing is a relatively small part of the course. This is broadcasted live and on demand videos • On campus students are given f-t-f guidance and off campus students are given guidance through email, learning management system, messengers, discussion forums

6 Series of examples on the use of blended learning in adult Math learning

This chapter covers various math online resources. Main source are websites & portals known by education community. Primary focus is on math online material related to adult learners. However some extra resources are analyzed as well to identify proper recommendations for the project needs better.

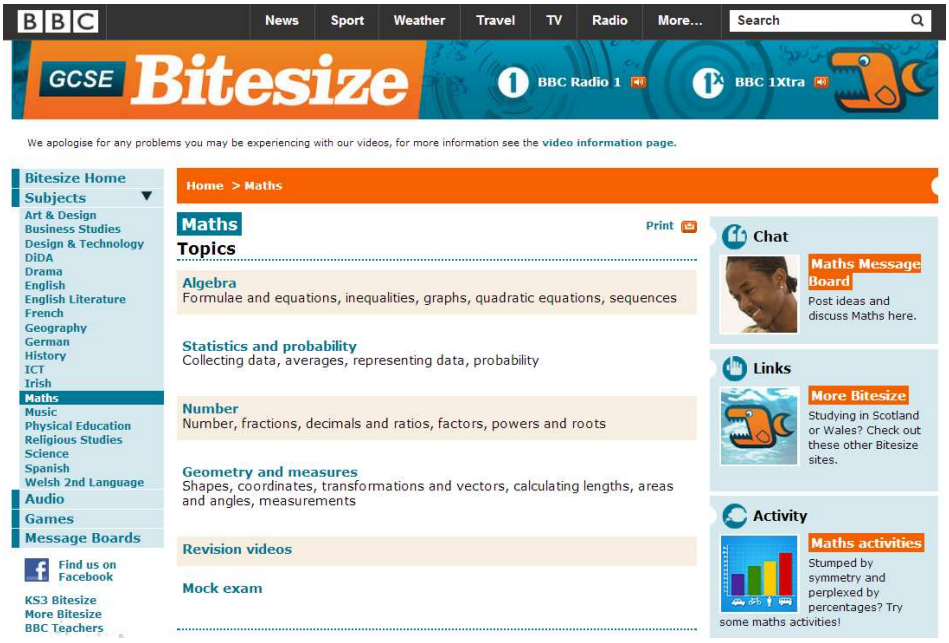
BBC (Bitesize, Skillswise), USA National Security Agency (NSA) and other resources are analyzed in detail in the next chapters.

6.1 Math online resources from BBC

BBC is a great online resource for learning math [12]. It includes interactive math games, tests, activities and revision exercises about algebra, data handling, numbers, shapes, space and measures, fractions, proportions, quizzes, games on timetables, functions, polynomials, statistics, trigonometry, etc. Homepage (picture 10) is a reference list to actual math resources.

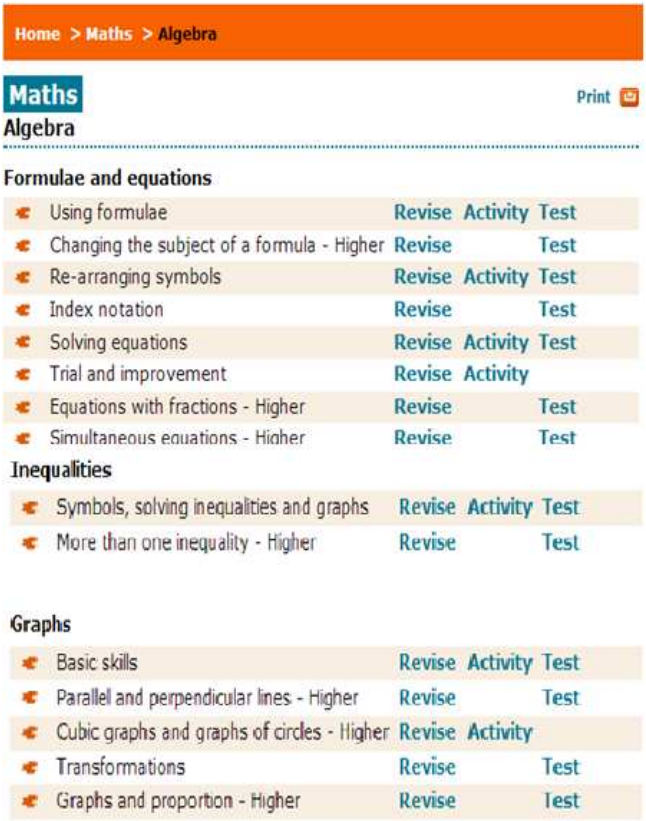
Picture10. BBC Math learning resources homepage

Bitesize: is an online resource training library [13]. Picture 11 illustrates structure of the homepage. Main elements are: navigation (on the left side in a blue background, breadcrumb, content area in the center, right side with chat, links & activity). Subjects include: art & design, business studies, design & technology, drama, English, math etc. There are also audio, games, message board zone.



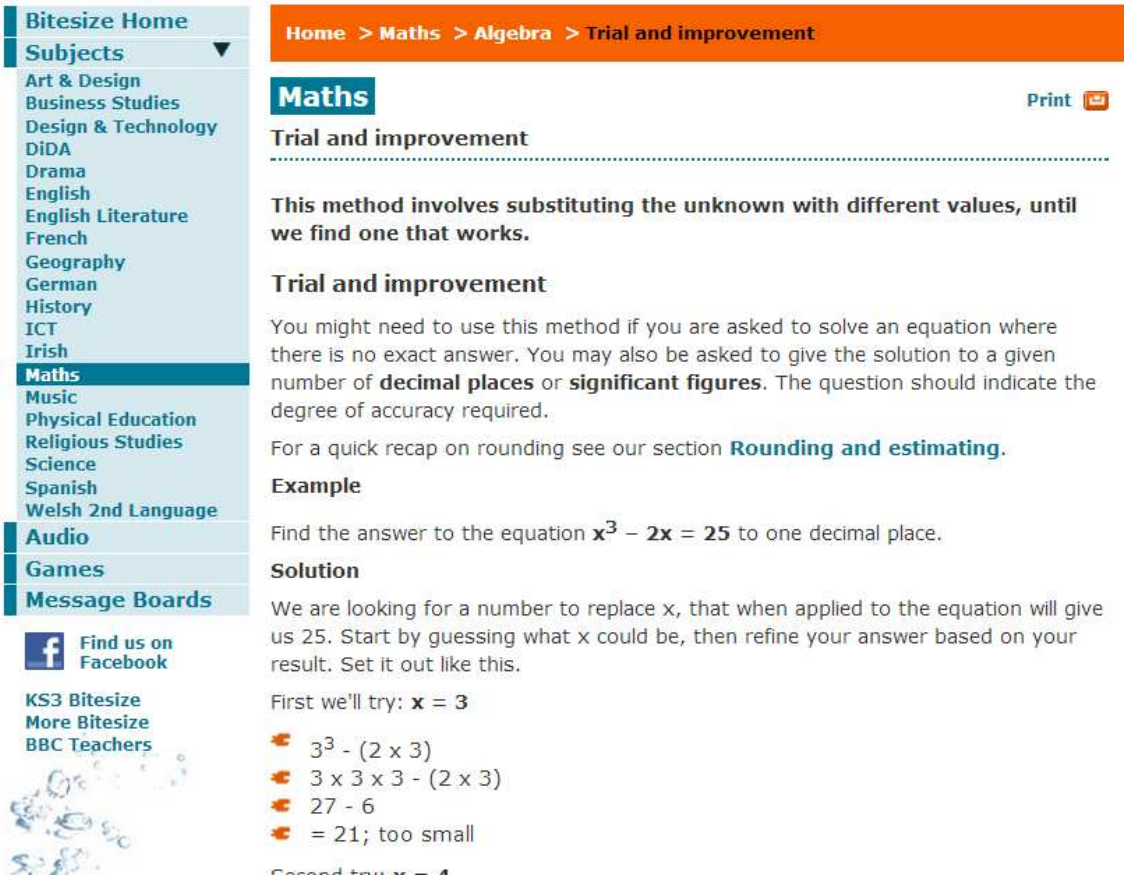
Picture11. Bitesize homepage

Picture 12 shows the material for math algebra. Topics: formulae and equations, inequalities, graphs. Each topic has a set of learning objects with *revise*, activity and *test* features.



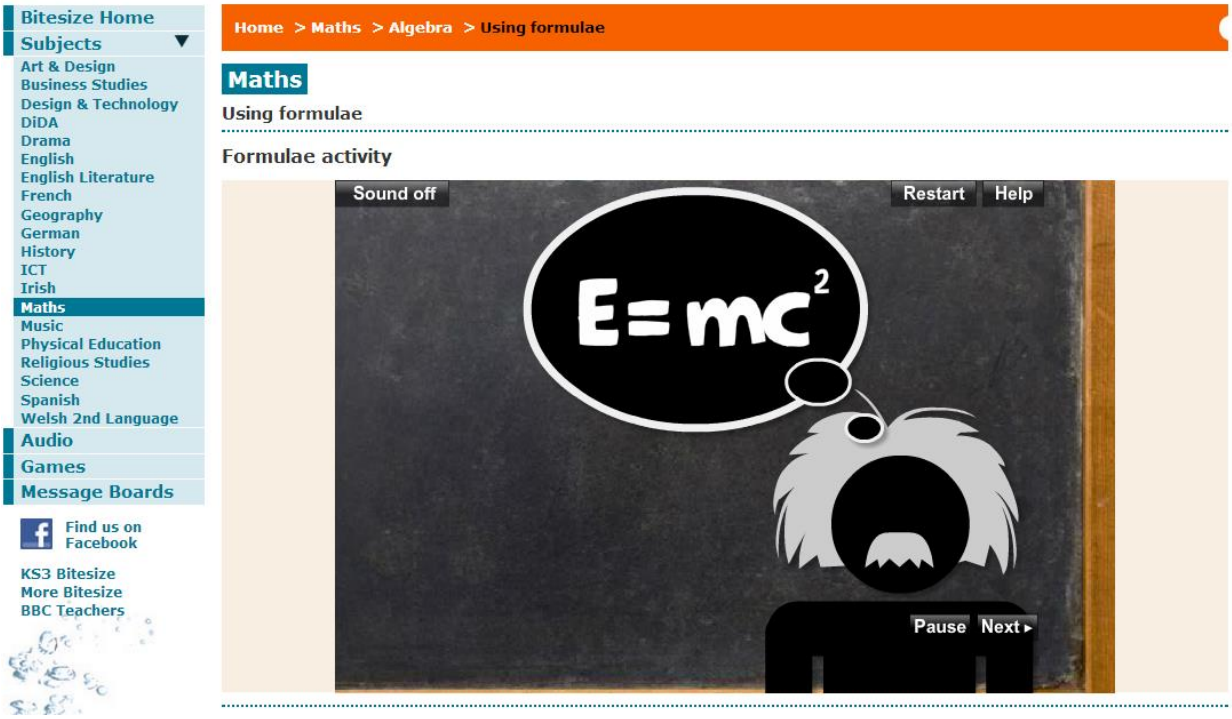
Picture12. Bitesize math algebra topic

Revise feature lets the user analyze desired material once more and fill the necessary gaps. This section of the website gives practical examples and solutions of particular problems (picture 13).



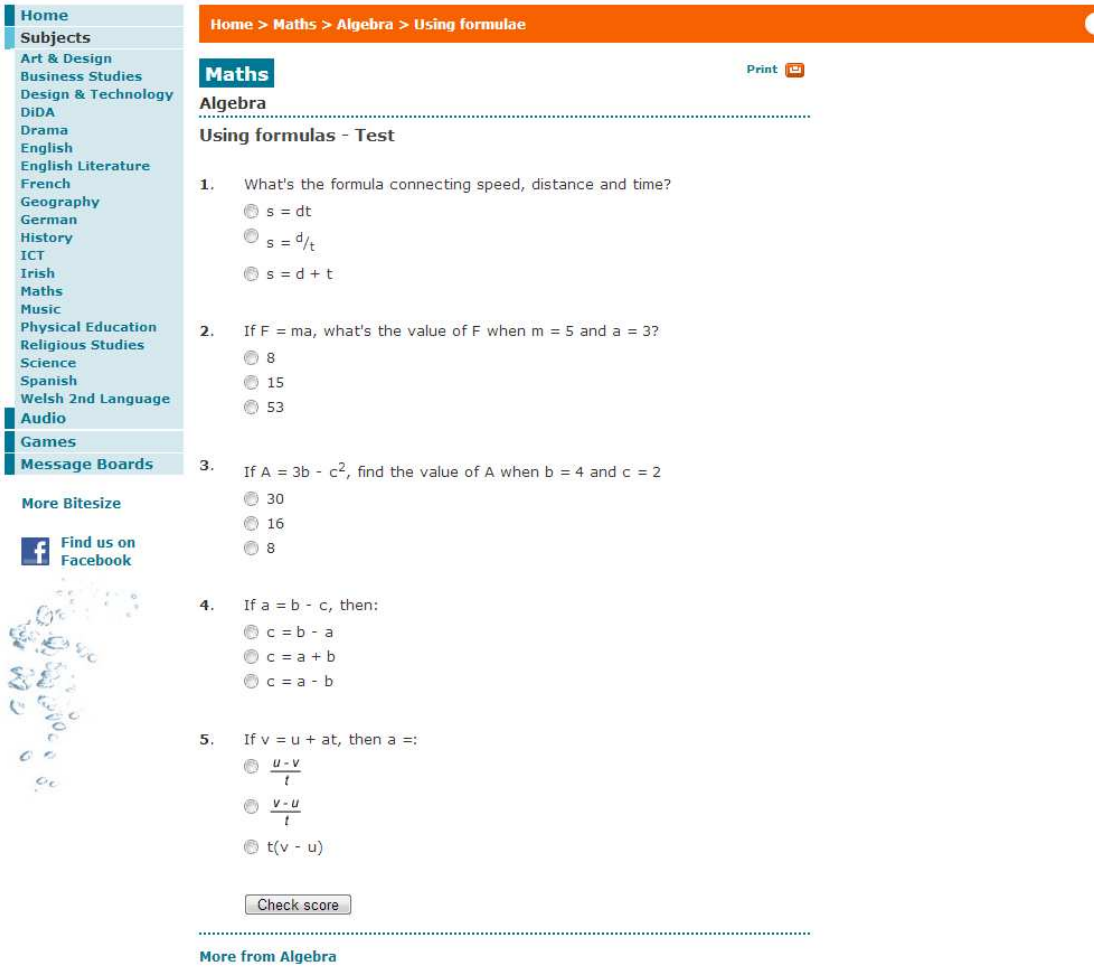
Picture13. Bitesize *Revise* feature

Revise feature provides interactive video and audio material about a topic. Picture 14 shows an example of formula usage.



Picture14. Bitesize *Activity* feature

Test feature is for those learners who want to check their math skills for a particular topic. Example (picture 15)



Picture15. Bitesize tests

Skillswise: is a BBC math resource for adults [14]. It includes math topic areas for numbers, calculation, percentage and fractions, measuring, shapes (picture 16)

Picture16. *Skillswise* math learning resource website

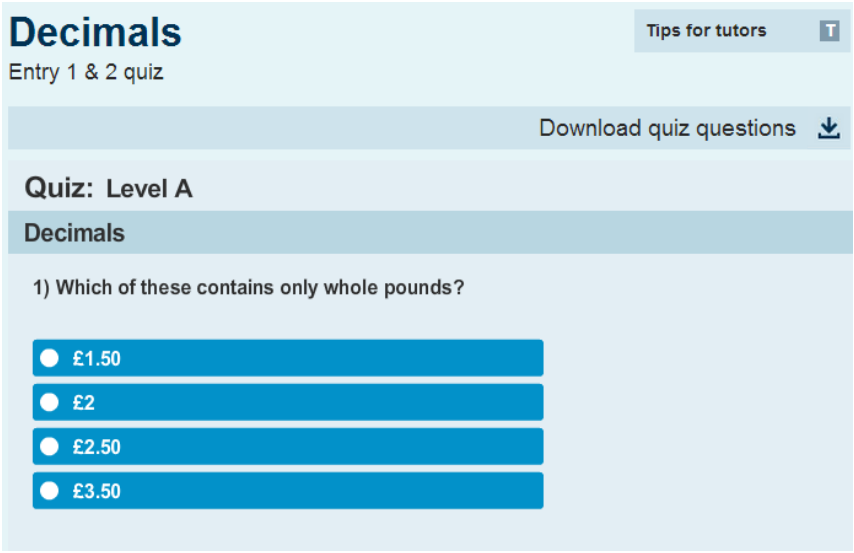
Skillswise calculation subtopics (picture 17): addition, subtraction multiplication, division, pen & paper methods, timetables, multiples and fraction, problem solving.

Picture17. Calculation theme subtopics

Each subtopic has an environment for the learners. Furthermore learning can be started by selecting one of the entry points and choosing which skills need to be improved. Also there is an introduction video, related to the topic, games and videos etc. (picture 18)

Picture18. *Skillswise* "Multiples and factors" tasks, learning entries

Skillswise tests are organized in a way that is shown in picture 19. A question is given with answer variants. Moreover, there are options for the use to download quiz questions and see possible tips for tutors.

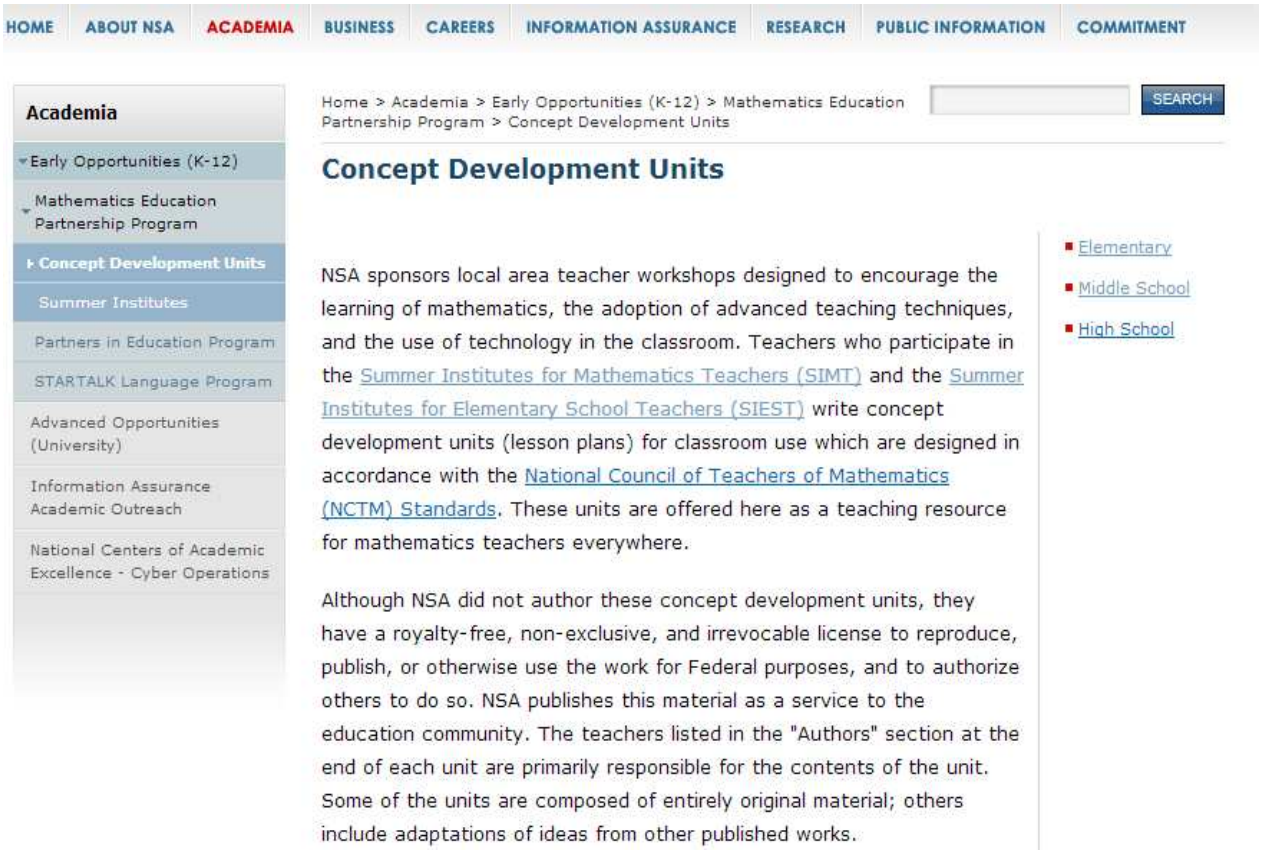


Picture19. *Skillswise* test example

For even more robust math examples the reader is advised to read [10] resource of this document.

6.2 USA National Security Agency (NSA) sponsors math material

USA National Security Agency is another content-rich online math resource [15] which is appropriate for adults. Material is structured according to levels (elementary, middle school, high school).



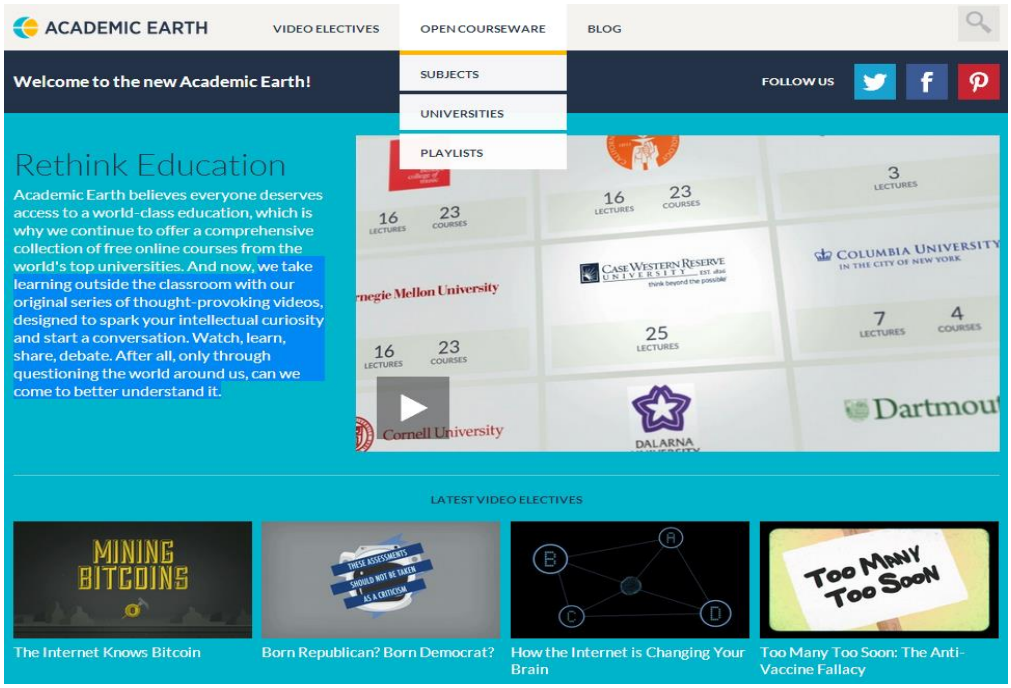
Picture20. USA National Security Agency math resources

List of elementary level topic list (arithmetic, data analysis/probability, fractions, geometry, measurements, patterns/Algebraic Thinking) is shown in picture 21. Each resource is a link to a *pdf* document that has many subtopics with overview and grade.

Picture21. USA National Security Agency math resources

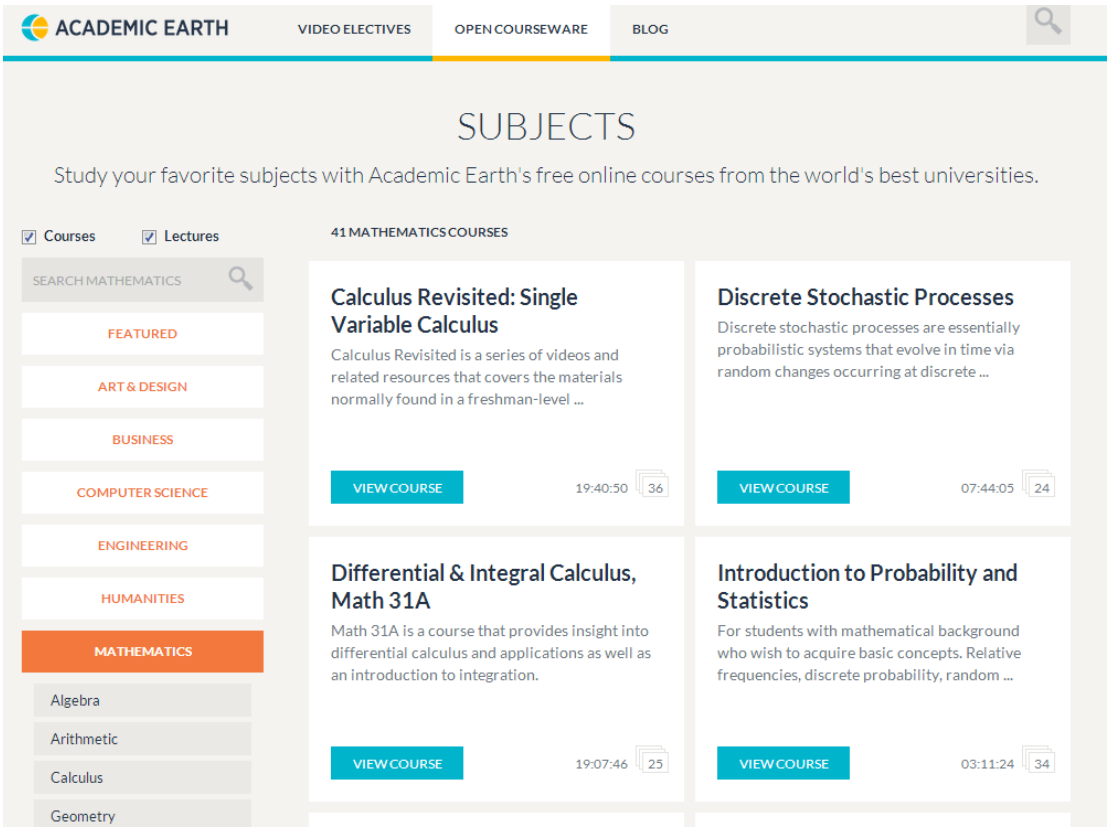
6.3 Learning Math on Academic Earth

Academic Earth offers a comprehensive collection of free online courses from the world's top universities (Stanford, Harvard, MIT etc.). It takes learning outside the classroom with original series of thought-provoking videos, designed to spark intellectual curiosity and start a conversation with the abilities to watch, learn, share, debate [19].

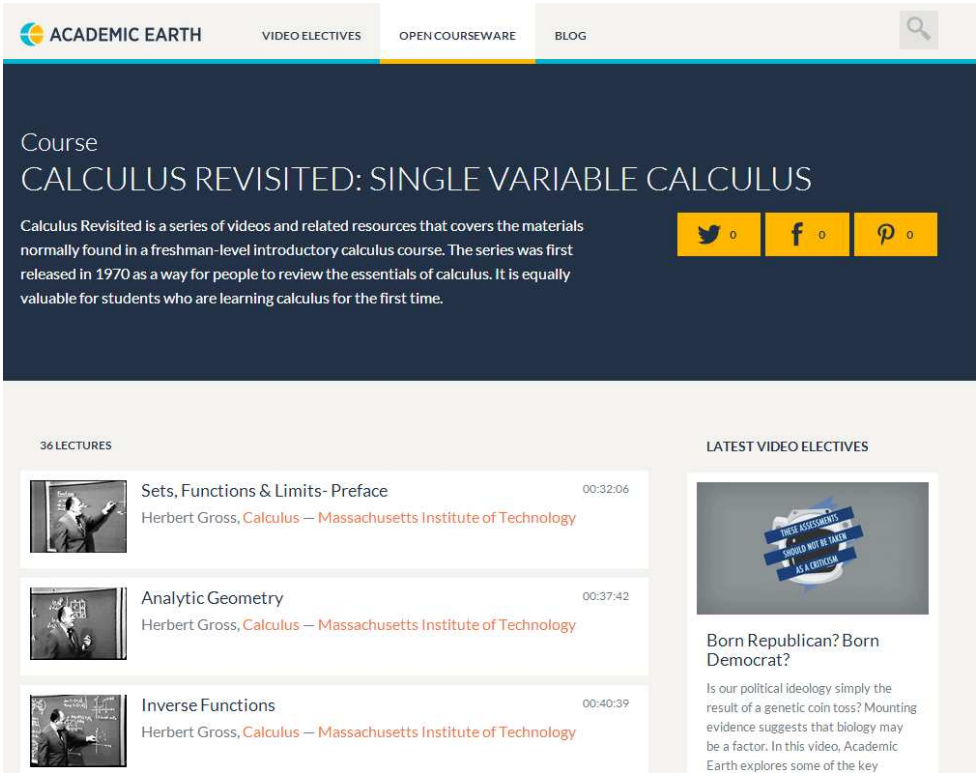


Picture22. Academic Earth homepage

Learners can choose Open Courseware to select and analyze material by subject, university or playlist. Picture 23 shows a page for math (total number of math courses & lectures, time length and description). Learners can click the “View Course” link (picture 24) and explore the course itself.



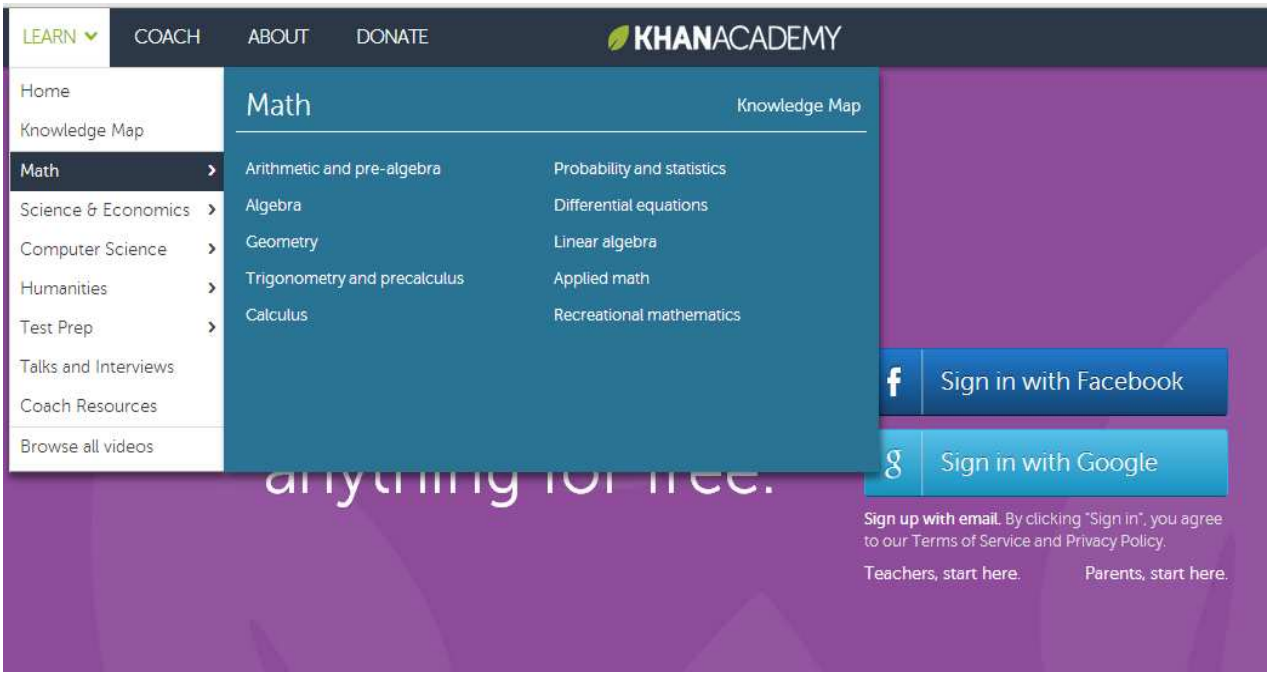
Picture23. Academic earth training subjects



Picture24. Academic earth single variable calculus course

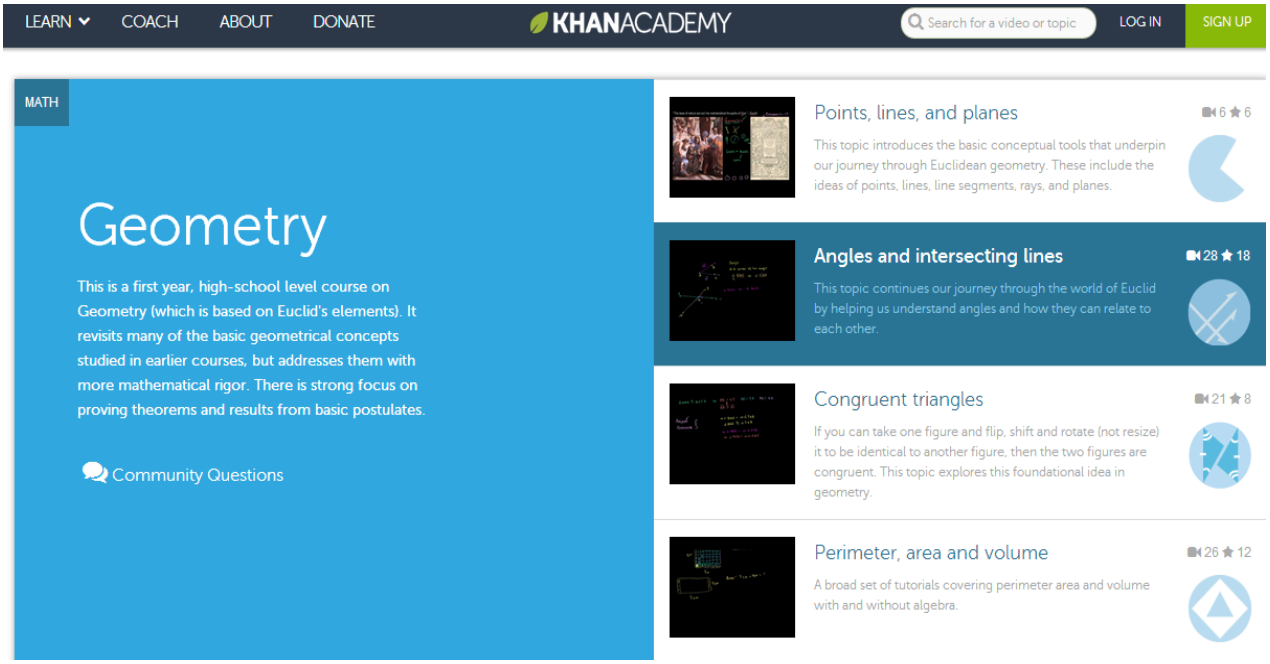
6.4 Khan Academy

Khan Academy [22] is a similar resource to Academic Earth. It provides video course material about math, computer science, economics and humanities subjects. Math topic is grouped into: arithmetic and pre-algebra, geometry, algebra, calculus, trigonometry and precalculus, probability and statistics, applied math, recreational mathematics, differential equations.



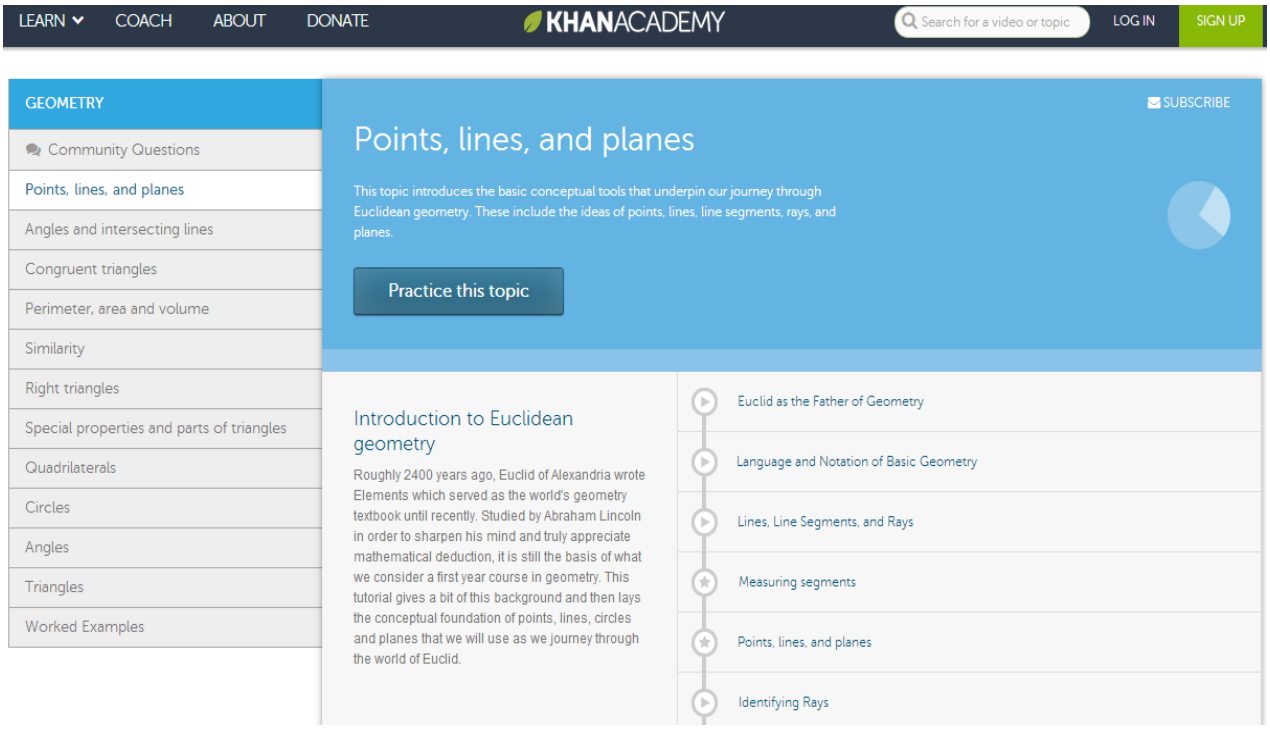
Picture25. KhanAcademy Math topics

When a topic is chosen, learners see a short description of the course and a series of related lectures (picture 26). Lectures have a photo shot of the item, description and ratio.



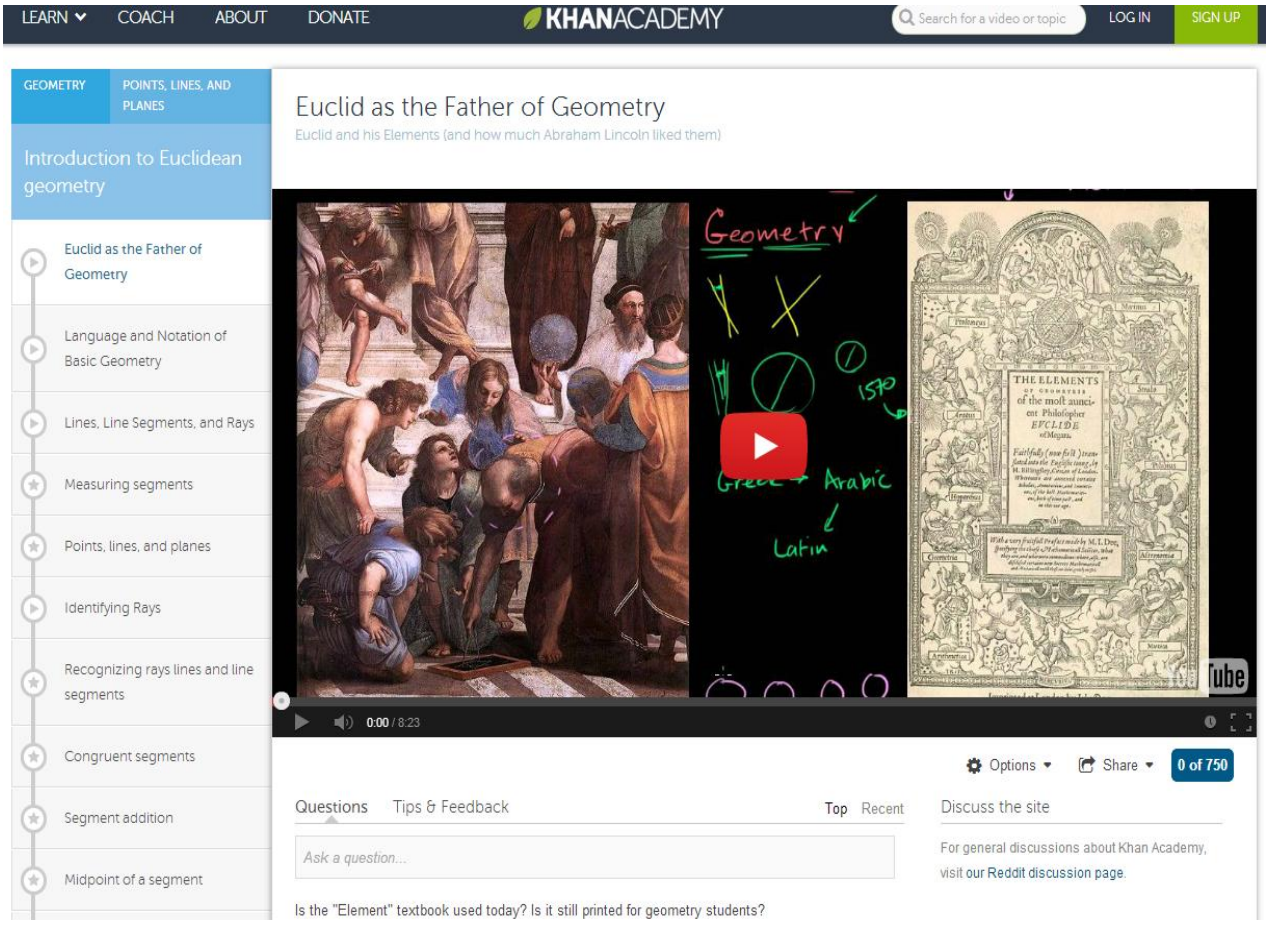
Picture26. KhanAcademy geometry course

Picture 27 shows “Points lines and planes” page sample. Learners can practice the subject, or explore content of an individual lesson.



Picture27. KhanAcademy geometry course lecture list

Most of the KhanAcademy individual lessons are presented in Youtube format (picture 28). Furthermore, there is a discussion are, sharing options, questions to be asked, addition feedback and resources.



Picture28. KhanAcademy single lecture

6.5 Hooda Math

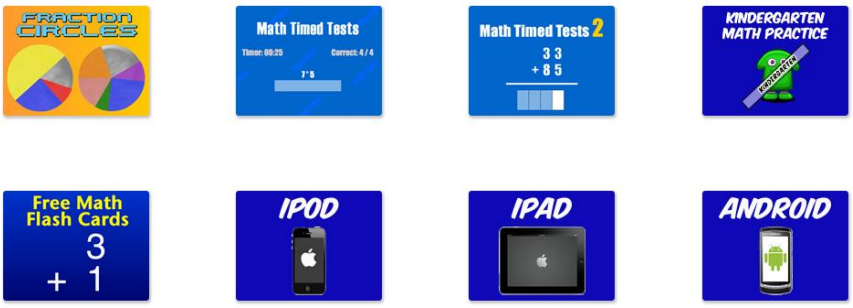
Hooda is a buddy system for learners to increase the level of effective understanding about mathematics. This process is implemented using game format as this makes math learning easier & entertaining. Hooda is designed to follow "Common Core State Standards for Mathematical Practice" which state that "learners should represent problems coherently, justify conclusions apply the mathematics to practical situations & use technology mindfully to work with the mathematics" [16].

Hooda Math includes:

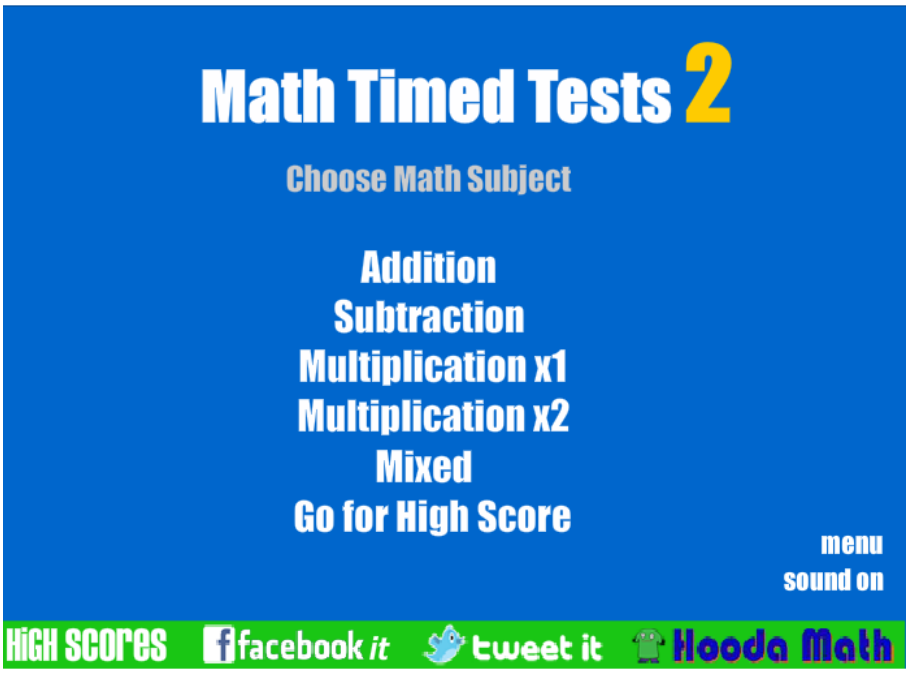
- Math Games: is a set of math games divided into groups (Geometry, Logic, Number, Racing, Puzzle, etc.). Some of the categories can have multiple games associated with it. Each game has a short description, instructions how to play, rating. *Picture29* illustrates two Hooda Math games "Math find" (on the left) & "Integer Tilt" (on the right). "Math Find" wants the user to circle arithmetic expression that matches answers on right side whereas "Integer Tilt" requires moving blocks in a way to keep the bar balanced. For more interactive math games user is advised to visit Hooda Math website.

Picture29. Hooda Math Games examples

- Math Apps: is a set of various math applications for different type of devices (smartphones, tablets etc.) that are adapted for *IPOD*, *IPAD*, *Android* (Picture 30) operating systems. Some of these apps are free, however others are charged with a specified price (in these cases users get redirected to a web store like Google Play etc.). Hooda Math itself offers applications that help user improve his math knowledge while taking *addition*, subtraction, multiplication, mixed tests (Picture 31) & many more.



Picture30. Hooda Math application categories



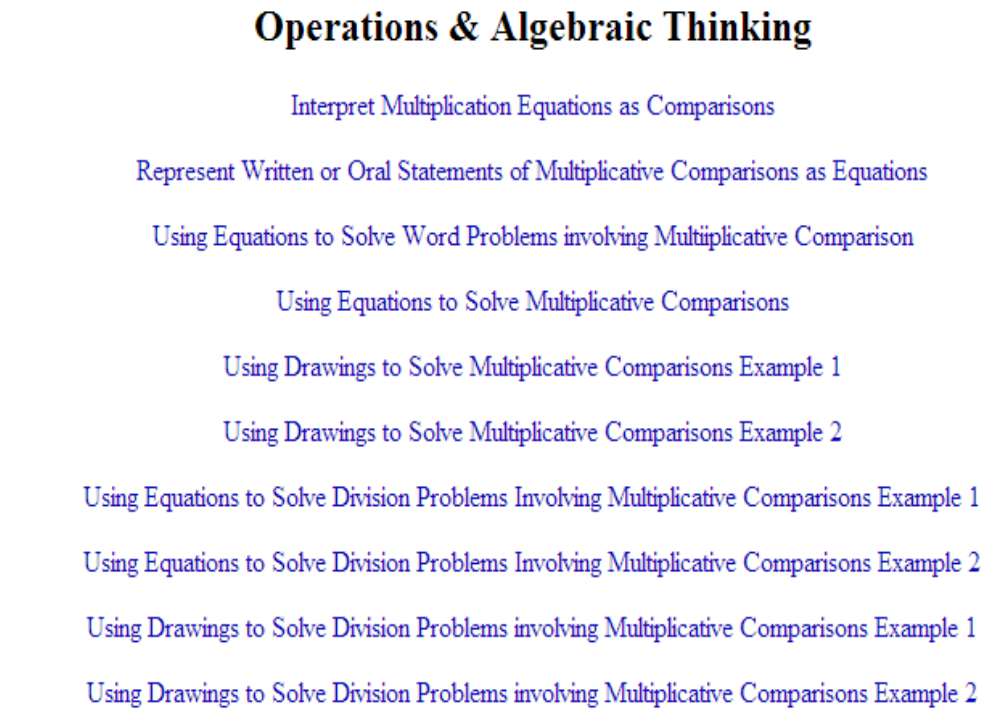
Picture31. Hooda Math subject application

- Math Movies: is a set of videos which are related to math subjects. For example *Picture32* shows a funny representation about area & perimeter calculation. More videos on Hooda Math include “quadratic equation”, “the π search”, “add up to ten” etc.

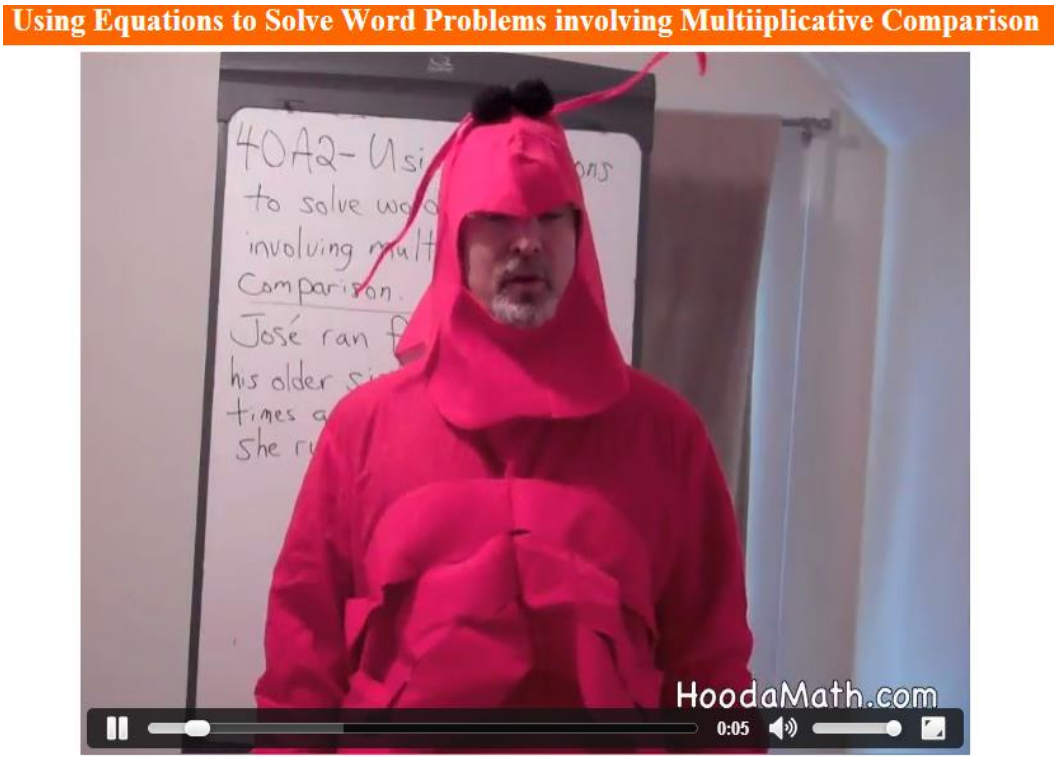
Picture32. Hooda Math subject application

- Math Tutorials: are divided into groups:
  - 3rd, 4th, 5th Grades. Topics include operations & algebraic thinking, *number & operations in Base Ten*, *Fractions*, *Measurement & Data*, *Geometry*
  - 6th, 7th, 8th Grades. Topics include *Ratios & Proportional Relationships*, *Number System Expressions & Equations Geometry Statistics & Probability Functions.*

An example of topics is shown in *picture 33*. When user clicks on a particular tutorial, he can see a funny character (*picture 34 illustrates a* teacher dressed as a chicken) visually explaining a subject on a white board or using similar measures. As the grade rise the tutors become less funny, but are more realistic and informative.



Picture33. Hooda Math tutorial “Operation & Algebraic Thinking” & topic list



Picture34. Explaining multiplicative comparison in a funny way for 4th grade learners

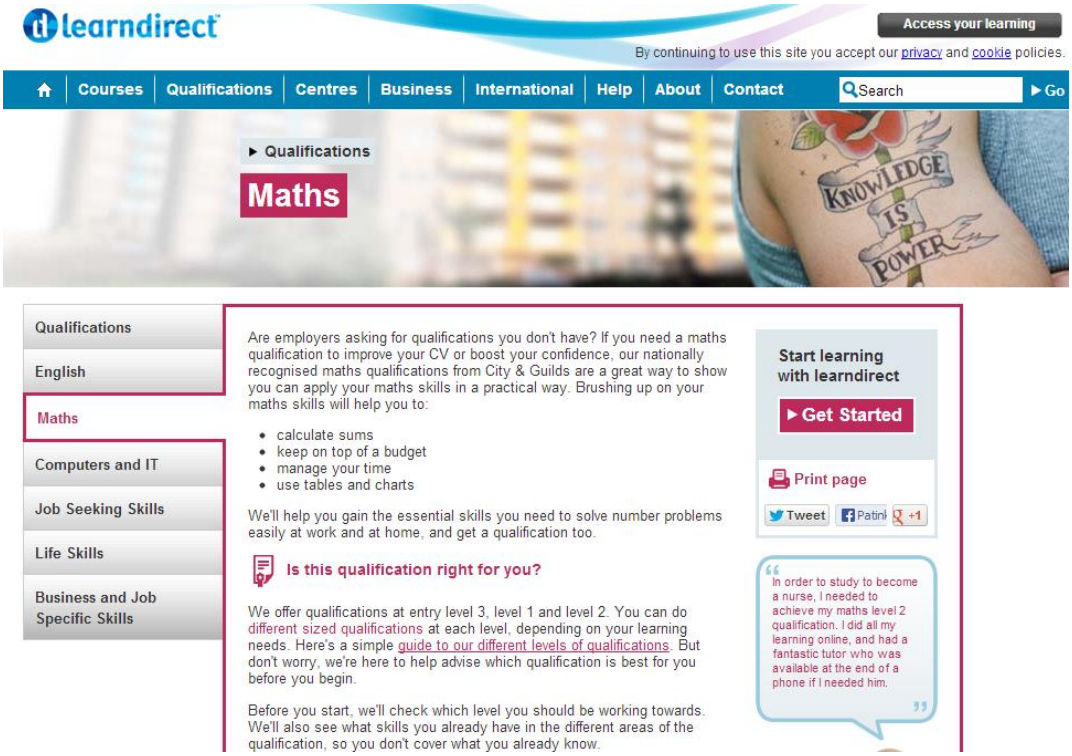
Moreover part of the Hooda Math tutorials is closely associated with *Adapted Mind* [17], so reader of the document can analyze the named resource on his own.

6.6 Other Math online resources

Previous chapters showed that there are many various math online training resources. Internet is so widely spread these days that basically no limits can be reached when looking math material.

In addition, math resources listed below are analyzed. However these resources are not covered as consistent as in 6.1 – 6.5 chapters. Only brief descriptions and links are given.

- Learn direct mathematics [20]: is a training resource to boost learners motivation and improve math various topics (math, English etc.) skills

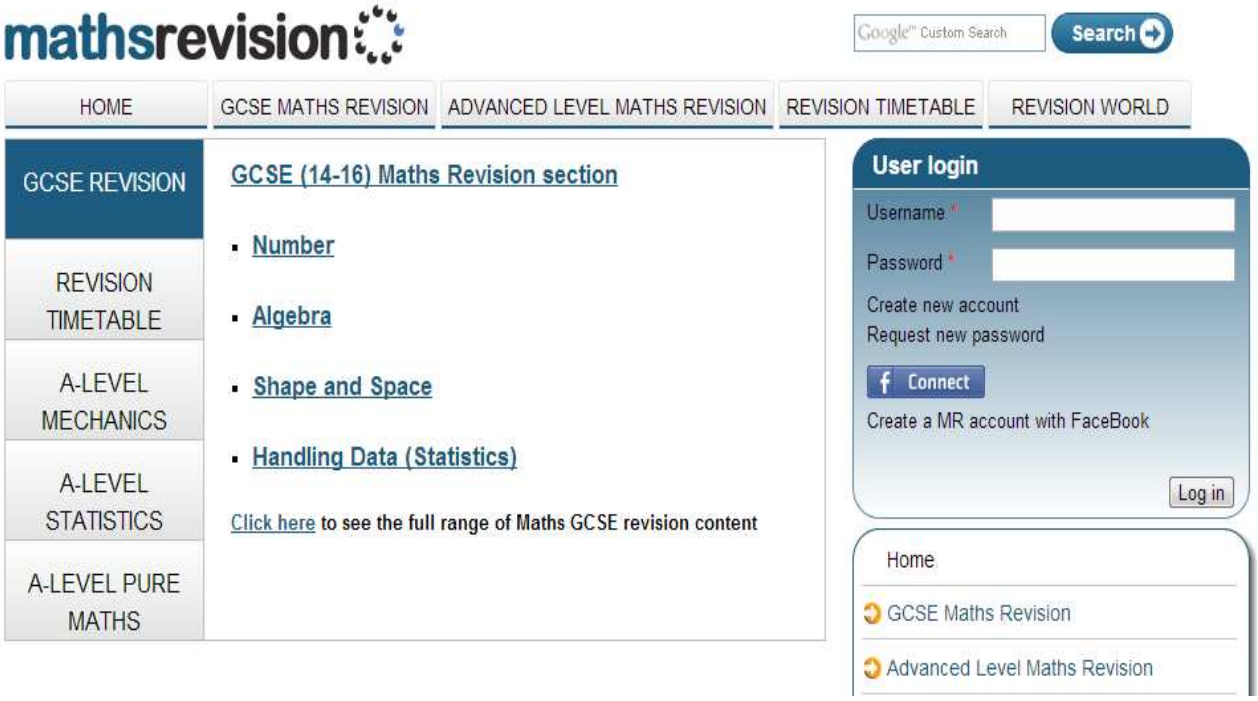


Picture35. Learn direct mathematics homepage

- Math tutor [21]: is a training resource to bridge the gap from school to university study

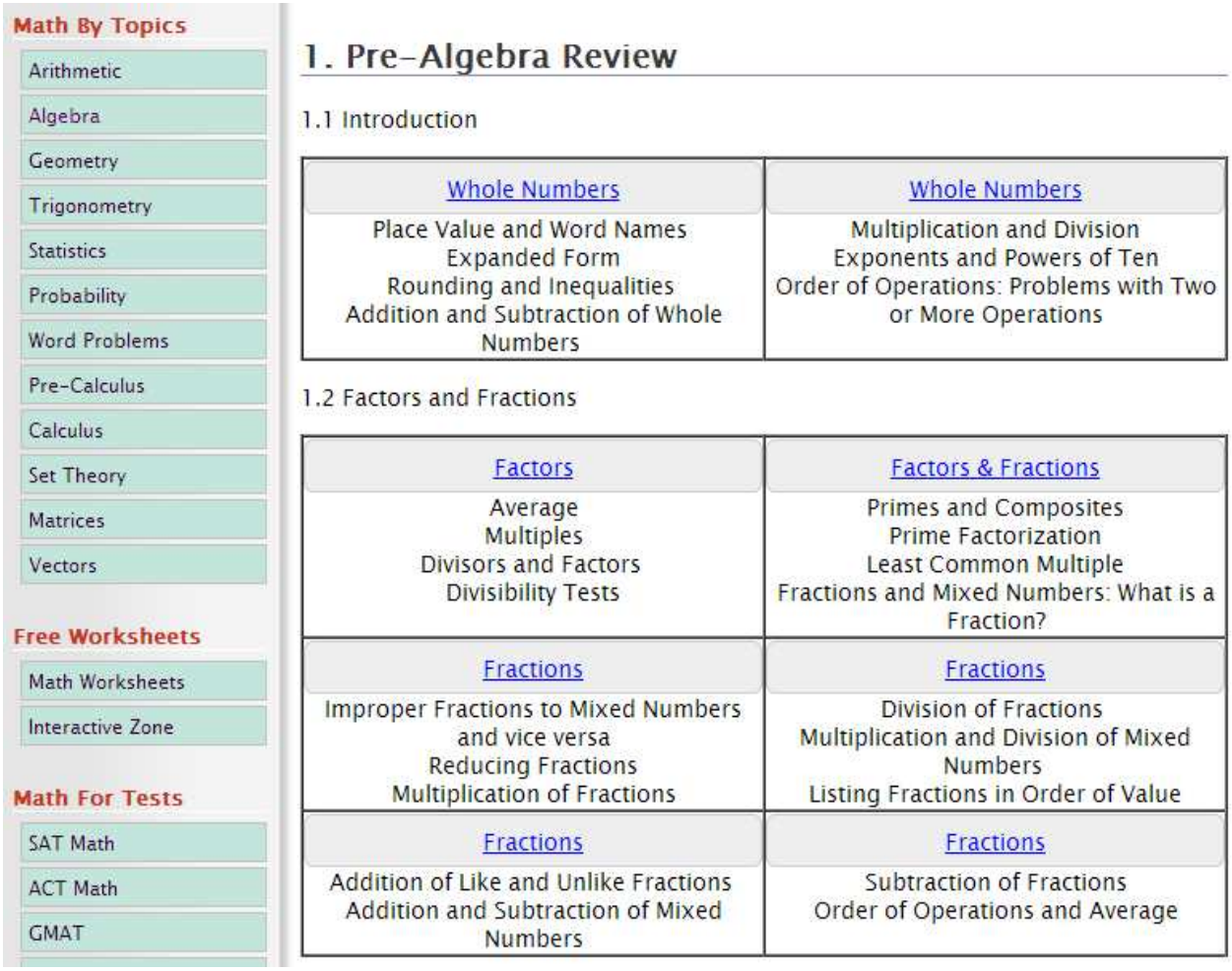
Picture36. Math tutor website

- Math revision [24]:



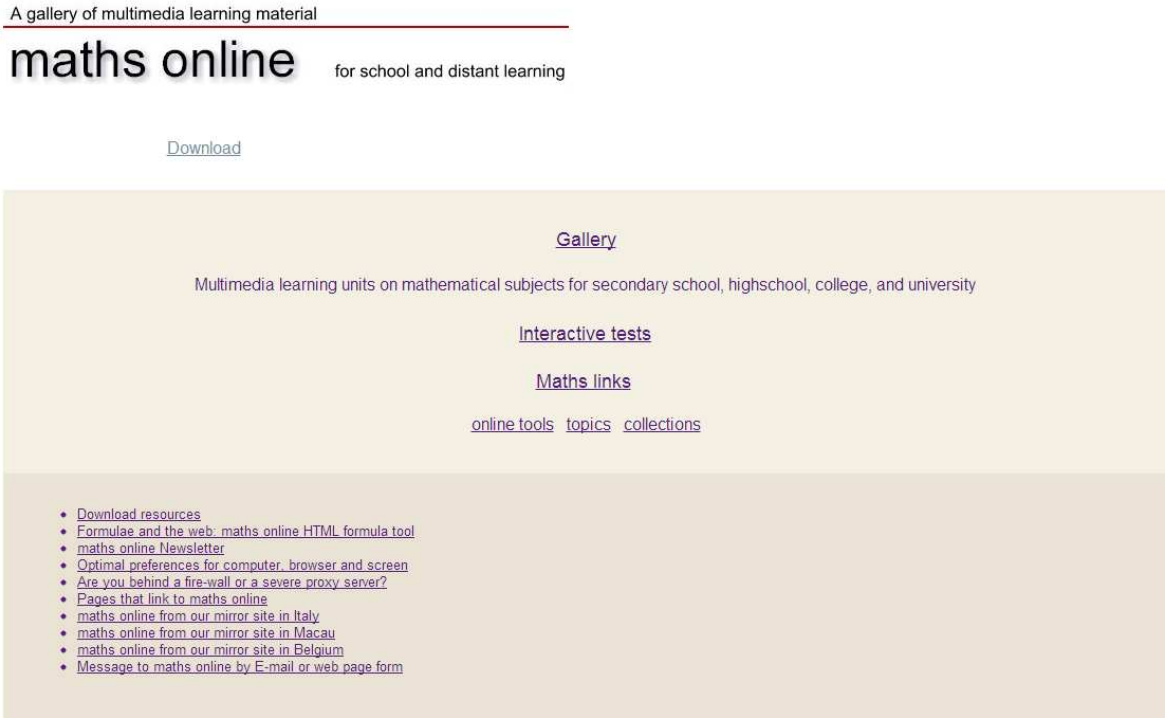
Picture36. Math revision resource

- Online Math learning [23]:



Picture37. Math online algebra learning resource

- Math online for school and distance learning [25]: is a gallery of multimedia learning material.



Picture38. Math online for school and distant learning

- Lithuanian video lessons website [18]: is a project orientated for teachers to share knowledge about subjects taught in Lithuanian secondary schools & gymnasiums. *Vaizdopamokos.lt* is a non-profit voluntary organization aiming to attract more tutors from the country. Project features:
  - Blog. Contains information about project activities, advertising, communication with other partners, useful links or organizing contests
  - Volunteer registration form for tutors who provide video tutorials for the project. Form includes teacher first & last name, telephone, teaching subject & stage (for example 6-7 grade), school
  - Tutorial creation guide. Includes tool descriptions needed for video & audio recording, slideshow presentation template
  - Project donation (Could be done via *Paypal* or other forms).

As for the learning material, it corresponds to those subjects that are taught in Lithuanian secondary schools by the given program.

Mathematics subject contains most of the tutorials compared with all other categories. Tutorials are divided according to grades:

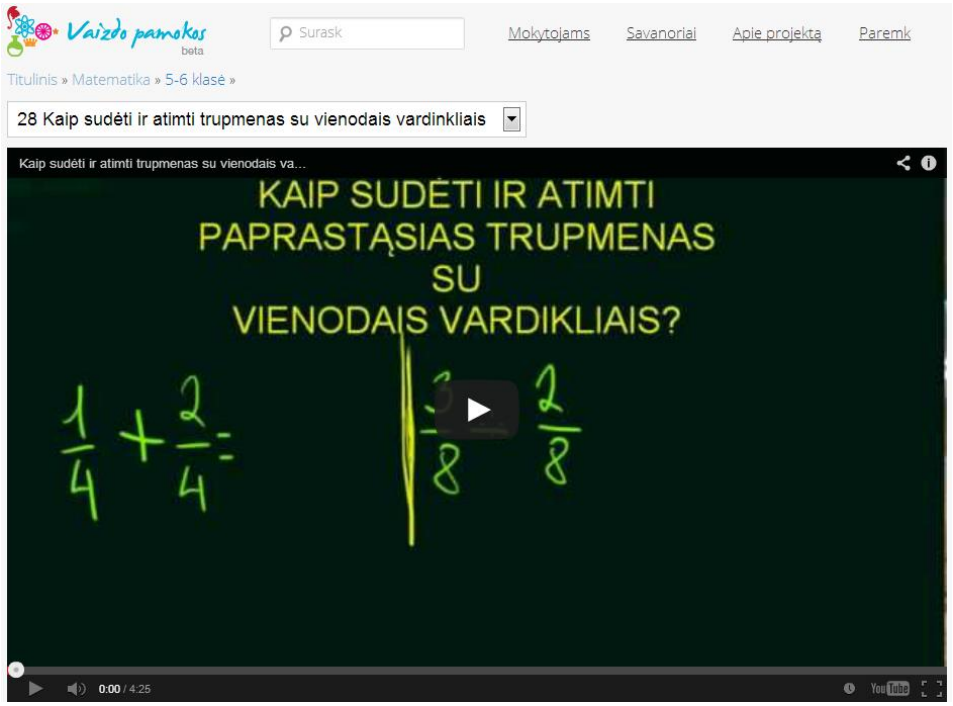
- 1^{st} - 2^{nd}. Topics include "*Addition till number 6*".
- 3^{rd} - 4^{th}. Topics: "*Addition*", "*Subtraction*", "*Perimeter*", "*Multiplication*"
- 5^{th} – 6^{th}. Topics include: fractions, scaling, equations etc.
- 7^{th} -8^{th}. Topics include: exponentials, proportions, percentages etc.
- 9^{th} -10^{th} .Topics: functions, triangles, vectors etc.
- 11^{th} -12^{th}. Topics: trigonometry, stereometry, logarithms etc.

Other learning categories included in the project:

- Physics. Photo metrics, electromagnetism, induction, gravitation etc.

- Lithuanian Language: salutations, predicate usage in sentences etc.
- English language: tenses (Present simple, present perfect, past simple etc.), passive voice, sentence construction, question words etc.
- French language: adjectives
- Arts: perspective, visual art genres etc.
- Non-formal education tutorials related with computer science): 3D modeling, Python, Java, Scratch programming, Google Sketch up.

An example of mathematics video tutorial on “How to add & subtract fractions with equal denominators” is given in *picture 39.*



Picture39. Math video tutorial about fraction addition and subtraction

So in addition to provided learning math material, reader of the document is advised to consider these resources:

- Microsoft Mathematics – provides graphing calculator that plots in 2D and 3D, step-by-step equation solving, and useful tools to help students with math and science studies [26]
- Math worksheet generator creates multiple math practice problems, from basic math to algebra, in seconds [27]
- Math in daily life resource [28] teach numeracy, calculations, algebra [28]. It also provides video lessons for grade K – 2, 3-5, 6-8, 9-12, College/Adult
- Math Daily [29] is a resource for learning math in game format & entertainment. Content is structured by categories (arithmetic, geometry etc.)

7 Recommendations for developing a blended learning model for adult tutors and their learners in SigMath project

This is a conclusion chapter of the document which presents recommendations to develop a blended learning model for adult tutors and their learners in SigMath project. The given list below is not final and could be extended further in a specific phase (e.g. platform development) of the project. Some additional information, necessary for the recommendations is provided in *Annex A*. and *Annex B.*

Recommendation list:

1. Virtual learning environment (*VLE*) usage in the platform (*Moodle* or any other appropriate). As SigMath ideology is based on blended learning *VLE* component is an essential part of the "whole project picture". *VLE* should be chosen, according to the key points:
    a. Fulfilling requirements which are imposed to SigMath project
    b. Invoking already used *VLE* good practices and extending with some more features
    c. Establishing necessary *VLE* activities (functions): pages, tests, quizzes, assignments, assessments, calendar, user roles & privileges etc.
    d. Proper integration opportunities with SigMath platform
2. In order for adults learners & tutors to get used to informational communicational technologies in the project more, a representing course about ICT in blended learning should be prepared
3. Consider applying Web 2.0 technologies (social networks, blogs, wiki, podcasts, etc.) in the project as they provide some good communication & interaction opportunities for the tutor and the learners. Many existing Web 2.0 usage examples are provided in Annex B. Important thing to note about this recommendation is to decide whether Web 2.0 tools should be used as standalone applications or as a part (integrated) of the SigMath platform
4. Choosing a blended learning model that best suits SigMath project needs. Models could be selected from the given examples (Rotation, Flex, Self-Blended, Enriched-Virtual) or alternatively a new custom one could be created. However the custom model should have features, appropriate for blended learning
5. Creating good quality rich math content. The material (various math topics) should be classified into categories: algebra, geometry, statistics etc. Furthermore the resources should expose to which qualification framework levels (*EQF Level 2* or similar) they belong. Extra semantics could be added by establishing associations between elementary information units (e.g. geometry coordinate system with quadratic $ax^2 + bx + c$ equations) and so on
6. Adapting resources from external sources. There is so much useful math content nowadays that some part of these resources could be added to SigMath project as well. In development stage this kind of resources could help decide the material which fits SigMath project requirements best
7. Describing the innovative, different methods and technologies that are involved in developing adult learners and tutors skills. There could be a separate section in SigMath website for this objective to attract visitor attention.

8 Annex A. Applying Moodle in Kaunas e-Learning Technology

Moodle is an open source framework. *Moodle* Learning Management system is highly developed and includes many features & plugins needed for controlling and managing the learning process. What is more, many *Web 2.0* [36] features (grade system, assignment, chat, discussion, blog, wiki, quiz, etc.) are built in to the system. Additional packages can be integrated as well. This gives high chances for *Moodle* to be used in projects like *SigMath* where *Lifelong Learning* program [37] is applied, math training resources are provided etc.

Kaunas e-Learning Technology center uses *Moodle* as the main Learning Management system (*LMS*). Majority of projects that involve e-learning relies on *Moodle*. Some of the projects:

- Kaunas adult education learning center [30]
- Baltic education technology institute [31]

Furthermore some of other projects and initiatives that apply *Moodle* in their learning process (Knowledge transfer institute [33], Lithuanian State Tax Inspectorate portal [35], Kaunas Junior's computer scientists school [32] etc.) are shortly described in Annex A.

8.1 Kaunas Adult Education Center

Adult Education Center was established in 1999 & is a budget institution that provides formal and informal education for adults. Center falls into Lithuanian basic education category where subjects are taught in Lithuanian language. Education quality & continuity is provided irrespective of learner age, sex, communication etc. Some of the education takes place in the center itself. Another part of training is organized in an e-learning environment. This aspect is important for people with disabilities.

Kaunas Adult Education Center e-learning environment provide courses in *Moodle LMS* according to Lithuanian secondary education standards. Subjects include physics, ethics, mathematics, chemistry, biology, geography, history, music, Russian, German, English language, Informational technology, Arts etc. Courses are structured by Lithuanian Qualification Framework Levels (2, 3 & 4).

Additionally there is a section that provides education methods courses:

- E-learning blended learning model implementation in *Moodle*
- Applying blended learning model in social communication,
- Applying blended learning model in video tutorials technology presentation,
- Active teaching methods.

Next small descriptions with screenshots are given for some of the courses provided in Kaunas Adult Education Center. Examples include *Moodle* mathematics, social communication & active teaching methods.

Math course: Picture 40 shows the structure of math course (topic outline view). Picture 41 illustrates individual topic view. Other courses are organized in a similar fashion. For detailed course information please look in Kaunas Adult Education Center website [30].

2 Laipsniai ir šaknys

Tikslas - taikyti veiksmų su laipsniais ir veiksmų su n-tojo laipsnio šaknimis savybes. Žinoti laipsniu (su racionaliuoju roc
išreikšti laipsniu su trupmeniniu rodikliu. Žinoti veiksmu su n-tojo laipsnio šaknimis savybes ir mokėti atlikti paprastus ve

- Laipsnis su sveikuoju rodikliu
- Laipsnis su racionaliuoju rodikliu
- Kvadratinė ir n-tojo laipsnio šaknis
- Literatūra
- Laipsniai ir šaknys (Pateiktis)
- Savarankiška užduotis
- Savitikros testas Nr. 2

3 Algebriniai reiškiniai

Tikslas - mokėti apskaičiuoti nesudėtingų skaitinių reiškinių reikšmes ir įvairių dydžiu reikšmes remiantis nurodyta formul
(sveikojo, trupmeninio) ar paprasčiausio iracionaliojo reiškinio apibrėžimo sritį (arba rasti kintamojo reikšmes, su kuriomis

- Algebriniai reiškiniai
- Veiksmų atlikimas reiškiniuose
- Algebrinių reiškinių uždavinių sprendimo pavyzdžiai
- Literatūra
- Algebriniai reiškiniai (Pateiktis)
- Savarankiška užduotis
- Savitikros testas Nr. 3

Picture40. Degrees, radix & algebraic expressions in Math course

Kvadratine šaknimi iš neneigiamojo skaičiaus *a* vadinamas toks **neneigiamasis** skaičius, kurį pakelę kva

$\sqrt{9} = 3, \quad nes \ 3^2 = 9 \ \ ir \ 3 > 0$

$\sqrt{9} \neq 3, \quad nors \ (-3)^2 = 9 \ \ bet \ -3 < 0$

Neneigiamas realusis skaičius b, su kuriuo galioja lygybė $b^n = a$, vadinamas n-tojo laipsnio šaknimi iš *a*

$$\sqrt[n]{a} = b, \ \text{jei} \quad b^n = a$$

$$\sqrt[3]{125} = 5, \quad \rightarrow \quad 5^3 = 125.$$
$$\sqrt[5]{-32} = -2, \quad (-2)^5 = -32.$$

$$\sqrt[n]{a \cdot b} = \sqrt[n]{a} \cdot \sqrt[n]{b} \quad \rightarrow \quad \sqrt[3]{3} \cdot \sqrt[3]{9} = \sqrt[3]{27} = 3$$
$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}} \quad \rightarrow \quad \frac{\sqrt[4]{32}}{\sqrt[4]{2}} = \sqrt[4]{\frac{32}{2}} = \sqrt[4]{16}$$
$$\sqrt[n \cdot k]{a^{m \cdot k}} = \sqrt[n]{a^m} \quad \rightarrow \quad \sqrt[6]{8} = \sqrt[6]{2^3} = \sqrt{2}$$
$$\sqrt[n]{\sqrt[m]{a}} = \sqrt[n \cdot m]{a} \quad \rightarrow \quad \sqrt[5]{\sqrt[4]{2}} = \sqrt[5 \cdot 4]{2} = \sqrt[20]{2}$$
$$\left(\sqrt[n]{a}\right)^n = a \quad \rightarrow \quad \left(\sqrt{4}\right)^2 = 4$$
$$\sqrt[n]{a^n} = \begin{cases} |a|, \text{ kai } n \geq 2, \text{ n - lyginis} \\ a, \text{ kai } n > 2, \text{ n - nelyginis} \end{cases} \quad \rightarrow \quad \sqrt[3]{2^3} = 2, \ \sqrt[4]{2^4} = |2| = 2$$
$$m \cdot \sqrt[n]{a} = \sqrt[n]{m^n \cdot a} \quad a \geq 0; m \geq 0 \quad \rightarrow \quad 3\sqrt{4} = \sqrt{3^2 \cdot 4} = \sqrt{36} = 6$$

Picture41. Square and nth degree root equations

Social communication course:

Dar niekada nebuvo dėstytojams taip paprasta pasidalinti informacija bei rasti naujų idėjų bei gerosios patirties pavyzdžių. Žemiau
mokytojams [3].

teachade.com - „TeachAde“ yra vienas iš pirmųjų socialinių tinklų, sukurtų specialiai dėstytojams bei mokytojams.

theapple.monster.com - „The Apple“ tinklas yra atvira socialinė bendruomenė dabartiniams ir ateities dėstytojams bei mokytojams. Spe
pamokų planais, vaizdine medžiaga bei naujienomis.

classroom20.com - „Classroom 2.0“ - tai bendruomenė internete, skirta švietimo darbuotojams besidalinantiems patirtimi apie Web 2.0 įra

academicaesthetic.com - „NextGen Teachers“ - mokymo(si) galimybės tinkle, pateikiami gerosios praktikos pavyzdžiai.

englishcompanion.com - “The English Companion” - tai bendruomenė internete anglų kalbos mokytojams, kurie nori susitikti tinkle bei pasi

wetheteachers.com - “We the Teachers” - ši paieškos sistema bei internetinė bendruomenė gali būti naudojama atrasti dominančius tinklu
pat skirta informacijos pasidalijimui.

teacherlingo.com - “TeacherLingo” tai internetinis tinklaraštis švietimo darbuotojams. Mokytojai gali kurti savo tinklaraščius ar tinklus nau

google.com/educators - tai bendruomenės diskusijų grupė, vienijanti dėstytojus Google aplinkoje.

applebatch.blogspot.com - „Abblebatch“ - mokytojų bendruomenė. Mokytojai gali pasidalinti patirtimi, mokymo(si) resursais bei kurti savo

teachersrecess.com - „TeachersRecess” atviras socialinis tinklas su daugybe naudingų mokymo(si) resursų su galimybe bendrauti, pasidalin

pbs.org/teachers - „PBS Teachers Connect“ - tinklas skirtas gerosios praktikos pavyzdžių pasidalijimui bei komunikavimui su kolegomis.

proteacher.com - „ProTeacher Community” - bendruomenė internete. Yra galimybė kurti tinklaraščius, forumus bei galimybė bendrauti reali

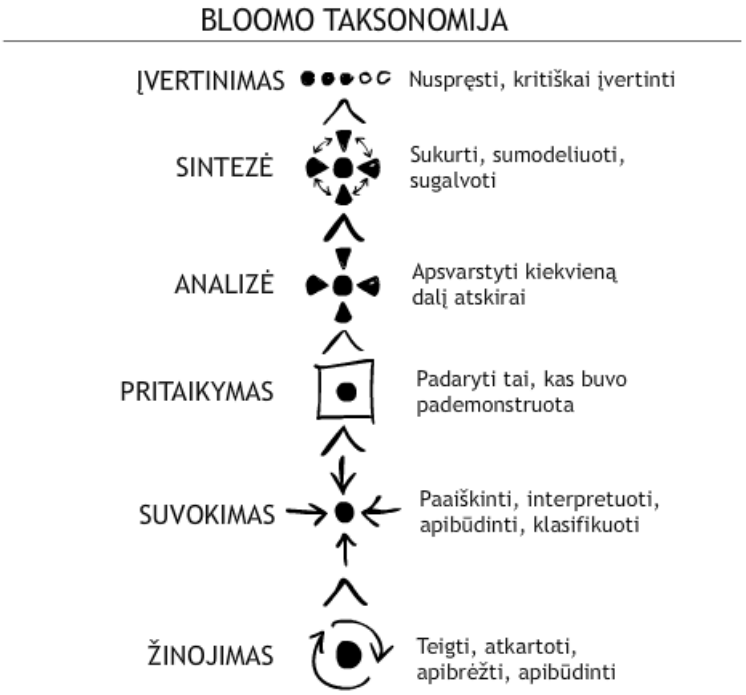
classscene.com - „ClassScene” specialus tinklas mokykloms su duomenų, vaizdo medžiagos, paveikslių saugykla. Tinklas skirtas bendrada

educationworld.com - „Education World“ - tinklas, vienijantis bendraminčius bei turintis didžiulę bazė mokymosi resursų.

teachersnetwork.eu - lietuviškas socialinis tinklas dėstytojams bei mokytojams, suteikiantis galimybę kurti tinklaraščius bei forumus,
pavyzdžius.

Picture42. Course Social networks useful links

Active teaching methods course:



Picture43. Active teaching method theory. Bloom taxonomy

8.2 Baltic education technology institute

BETI was founded in 2003 by an active team of professionals who have been working in the field of ICT and education technologies for more than 15 years. While implementing different activities in higher education and vocational training sectors the rich experience, knowledge and skills were accumulated in the field of ICT enhanced training, distance education methodology, learning technologies, multimedia production, development of web applications, etc. [31]

The team has been actively participating in national and European initiatives, namely, Framework, Eureka, Socrates, Leonardo da Vinci, Phare, UNESCO and others.

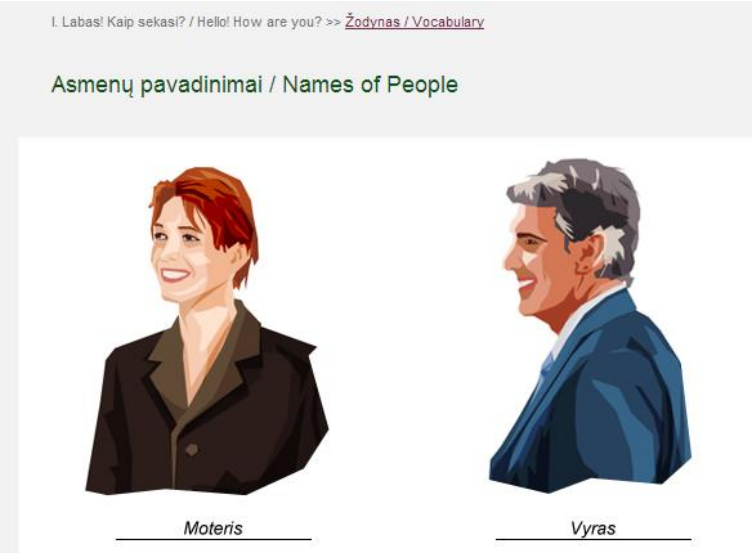
The main aims of the Institute are:

- To apply scientific, methodological and practical activities to encourage ICT based training and learning in order to balance smooth education, social and economic development
- To seek for development of democratic, wide-accessed and self-dependent training conditions for all citizens while implementing lifelong learning paradigm, developing distance learning initiatives, and creating information systems for training, guidance and counseling
- To support IT based project and process management, in cooperation with organizations and individuals seeking to ensure effectiveness and quality of implemented activities and provided services.

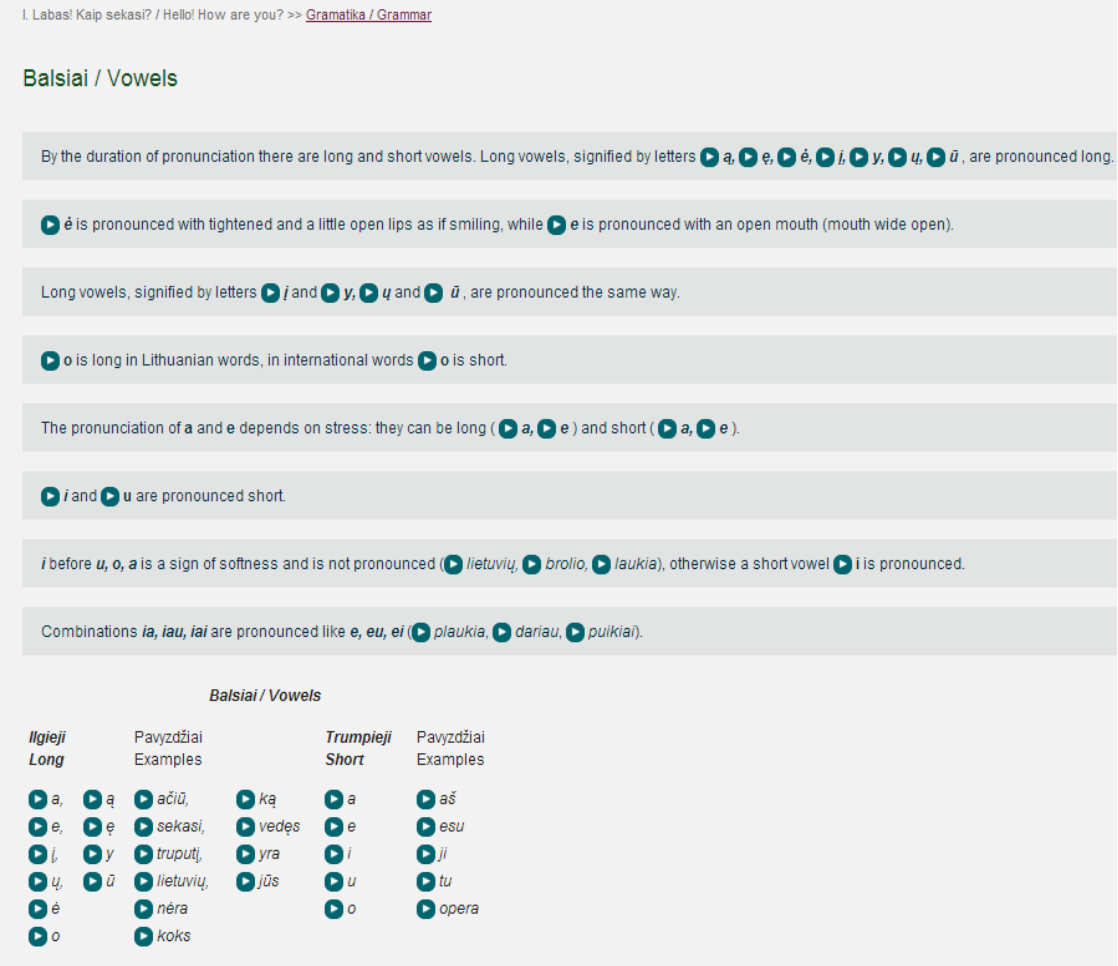
BETI e-learning courses include:

- Virtual Academy for Third Party Nationals course (General Lithuanian Language Course, Basics of Lithuanian Culture, Basics of Constitution of the Republic of Lithuania, Basics of Conflict Management, E-Services for Third-Country Nationals). Students from and exchange program or abroad usually take these courses
- Blended learning methods: (Physical Education e-learning, Music, Technologies, English language)
- IT courses for pupils: (programming, flash, databases, MS Office basics)
- E-Learning methods (seminar “creating school without sneer”, Education for parents, Education for pupils, Planning E-Learning courses, Video tutorials application method in E-Learning)
- Computer literacy
- Various (Developing web 2.0 skills for mentors, Computer Based Marketing and Communication, Business education, Creating courses design, Drawing basics, Understand IT course)

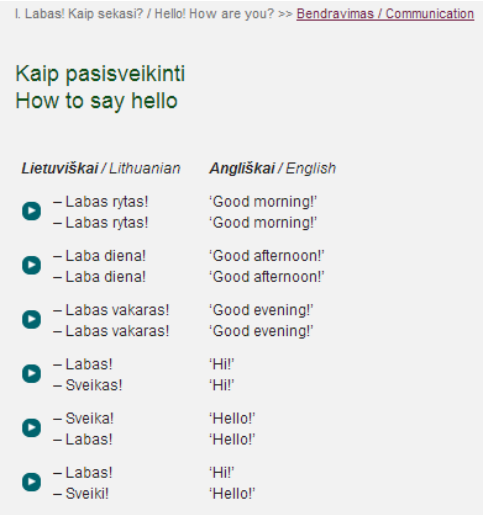
Picture44, *Picture45* and *Picture46* give an overview of how *General Lithuanian Language Course* is organized. Basically the course if for Third Party Nationals students who want to learn the basics (grammar, vocabulary, communication) of Lithuanian Language.



Picture44. General Lithuanian Course, introductory part. Vocabulary



Picture45. General Lithuanian Course, introductory part. Grammar



Picture46. General Lithuanian Course, introductory part. Communication

8.3 Other projects

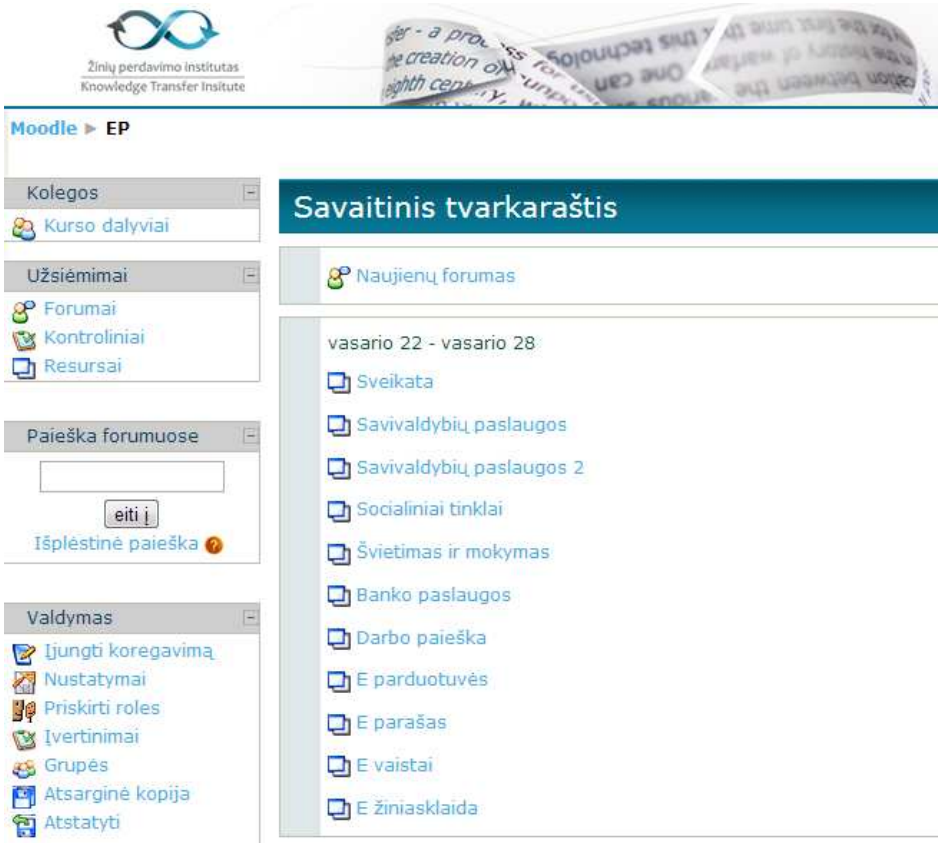
The public institution "Knowledge Transfer Institute" is a non-profit organization. Institute's goal is to encourage the collaboration of research institutions and small, medium-sized business, by implant new technologies & developing innovative products. The public institution "Knowledge Transfer Institute" implements this vision by encouraging entrepreneurship of researchers, prosecuting applied research and providing other knowledge-intensive services.

Institution activities & objectives:

- Search and practical applications of science's and business' collaboration models
- Application of information technology in organizational and learning processes
- Development of learning materials and expert assessment
- The scientific, methodological and practical activities to implement and maintain advanced technology-based training
- To promote modern technology-based applied research projects and management processes
- To allow a person to lifelong learning, to meet the needs of the knowledge gained to improve skills, gain additional qualifications

Institution e-learning courses are stored in *Moodle LMS.* Courses are shown below (*Picture 47*). Many of the listed courses have video material assigned to them. Structure:

- Health
- Municipality services
- Social networks
- Job search
- Teaching & education
- Bank services
- E-shops, e-medicine, e-signature, e-social media.



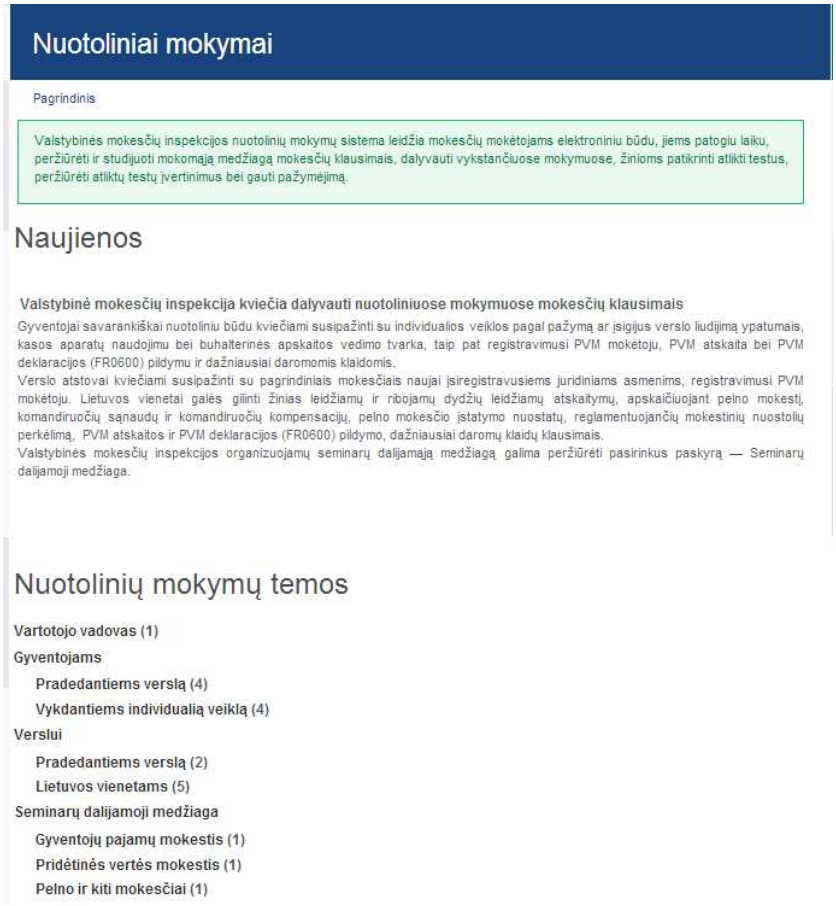
Picture47. Knowledge transfer institute e-learning courses

Lithuanian State Tax Inspectorate portal is the main resource in Lithuania, where people manage taxes and related operations online. Services & activities include individuals, juridical persons, business, public sector:

- Income declaration forms (include individual activities, assets declaration, land taxes, 2% income transfer etc.)
- VAT e-services (refund etc.)
- Public & administrative services
- Budget income
- Wage e-services
- Economy subject reviews
- Managing procurements
- Planning documents
- Carrier
- Financial reports
- Value added taxes
- Business license management services and many more.

Recently Lithuanian State Tax Inspectorate introduced an e-learning section. Courses are created for people to understand how system work and gain knowledge about concerned topics. Provided courses (*picture 48*):

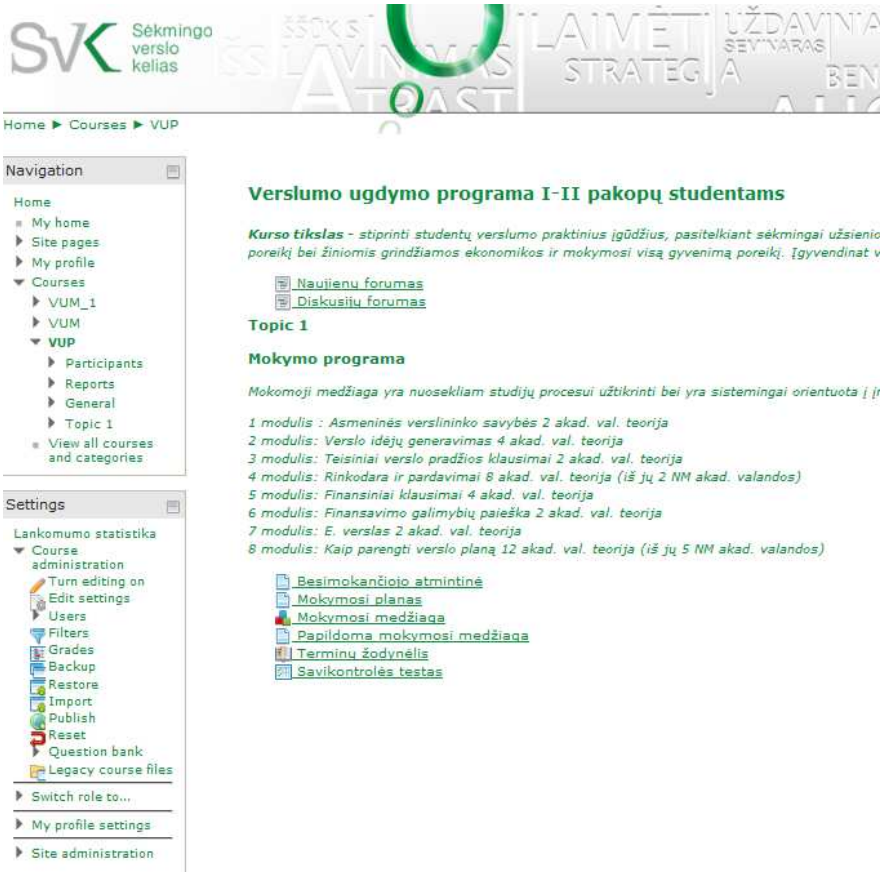
- User guide (discussions, user profile, e-learning services)
- Resident business start & individual activities services: cash register usage features, registering as a vat payment etc.
- Business (starting business, Lithuanian Units)
- Resident income tax
- Additional value tax
- Profit and other taxes



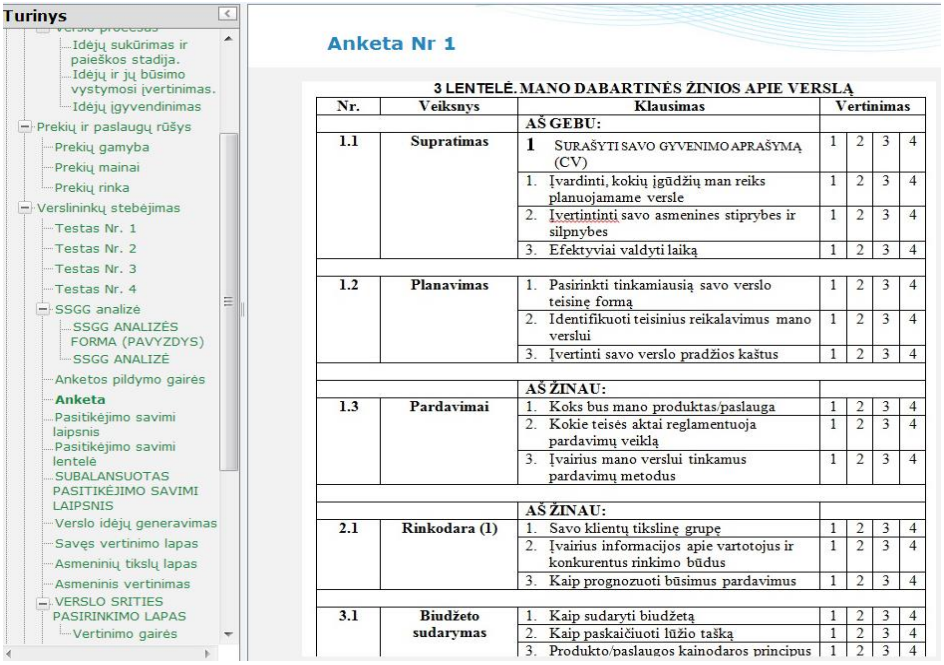
Picture48. Lithuanian State Tax Inspectorate e-learning topics

Another project that uses *Moodle* is called Successful business path. Objective of the project is to strengthen student's practical business skills by invoking a business education model and adapt it to the Lithuania high school learning program. High schools of Lithuania seek to install innovative education business models which should promote the establishment of civil society, changing market, knowledge-based economy and lifelong learning needs. Implementation of a business model intends to develop students' entrepreneurial spirit and activate their own business development opportunities [38].

E-learning courses are created for tutors, mentors, students to improve business skills & competence (*picture50*). Furthermore there is a course to present business process imitation.



Picture49. Educating Business program for I-II stage student course overview



Picture50. Educating Business program for mentors course details

Kaunas Junior's computer scientists school & Vilnius Computer Academy. These institutions provide courses for teaching pupils computer science.

Kaunas Junior's computer scientists school courses:

- C++ programming
- Hypertext & Multimedia

- Computer Literacy
- Photography
- Web technologies & design
- Business for pupils
- Graph Theory
- Robotics & Lego Robotics etc.

Vilnius Computer Academy courses:

- Programming (I, II and III courses).

Please visit [32] & [39] provided links for details.

Kaunas university of technology gymnasium: uses *Moodle* to create virtual e-learning courses [34] for pupils. Environment is developed enough and there is quite a lot of material to learn from. Structure of the courses:

- Computer publishing
- Programming with Python
- ECDL (European Computer Driven License) course
- Introduction to Algorithms
- Preparing for Information Technology mature examinations
- Programming C++ (11^{th}, 12^{th} grade)
- Introduction to databases
- Mathematics (geometry)
- Physics (lab work, exercises)
- Biology, Chemistry, Art, Philosophy etc.
- English, Russian, German, French Language

Picture51. KTU gymnasium e-learning *Moodle* courses

9 Annex B. Using Web 2.0 tools

9.1 Social networks

A social network is a social structure made up of a set of actors (such as individuals or organizations) and the dyadic ties between these actors. The social network perspective provides a clear way of analyzing the structure of whole social entities. The study of these structures uses social network analysis to identify local and global patterns, locate influential entities, and examine network dynamics. Social networks and the analysis of them is an inherently interdisciplinary academic field which emerged from social psychology, sociology, statistics, and graph theory. Social network analysis is now one of the major paradigms in contemporary sociology, and is also employed in a number of other social and formal sciences. Together with other complex networks, it forms part of the nascent field of network science [40].

9.1.1 *Facebook* usage examples in Lithuanian Education Institutions

Facebook [41] became one of the most popular social networks in the world. These days few organizations (institutions) exist that does not use *Facebook* for communication, promotion purposes. This social network is attractive because it is free & registration process is quick and simple.

Despite of the fact that *Facebook* has lots of features built in, this chapter only covers a few of them applied in education institutions. Examples include:

- Kaunas Junior Computer Scientists School. Facebook page [42] (*Picture 52*) includes photos, videos of school activities, posts likes, general contact information etc.

Picture52. Kaunas Junior Computer Scientist School Facebook Homepage

- Facebook page for Lithuanian math teachers & enthusiasts. Facebook page [43] was created by enthusiasts to popularize Math subject in Lithuania: share thoughts about various math assignments, post valuable links to resources.

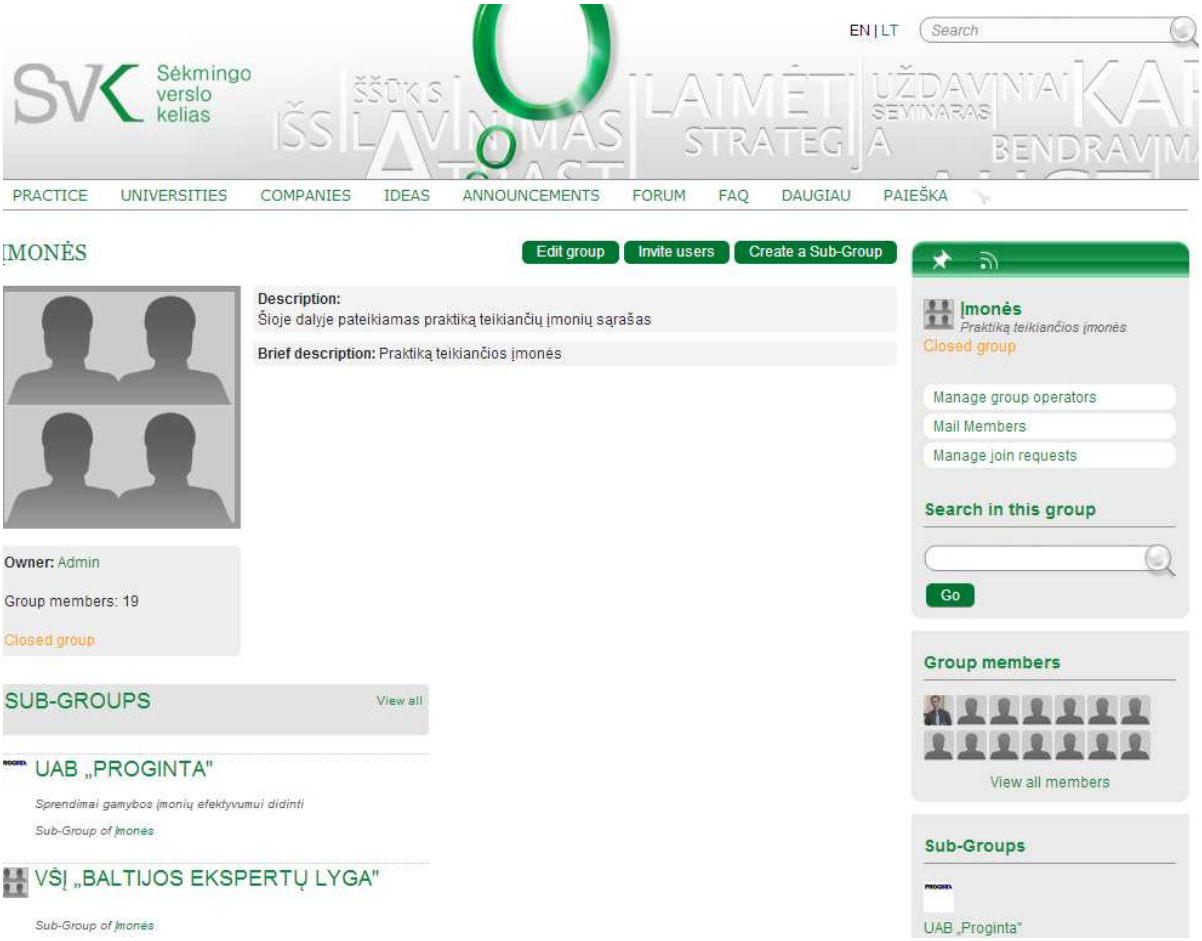
9.1.2 Applying Elgg social network in Kaunas e-Learning Technology Center

Elgg is an award-winning social networking engine, delivering the building blocks that enable businesses, schools, universities and associations to create their own fully-featured social networks and applications [44].

Elgg is an open-source application & Kaunas e-Learning Technology Center has some experience in building web applications with this social network engine. In these cases *Elgg* is usually integrated as a third-party application into a bigger system & is needed to implement this kind of functionality:

- Write reviews & diaries about subject area information
- Attach photo, video info to selected posts
- Share info about assignments, learning materials, reports with other members
- Carry out group work
- Create accessible files & documents to all group members etc.

Basic *Elgg* functionality is described using a sample Kaunas e-Learning Technology Center project "Successful business path" [45]. This project uses *Elgg* as student practice place management system. For example students can complete statement to apply for certain practice place in a company or university. Furthermore they can see organization profile details to have a better understanding where they want to apply (*Picture53*).

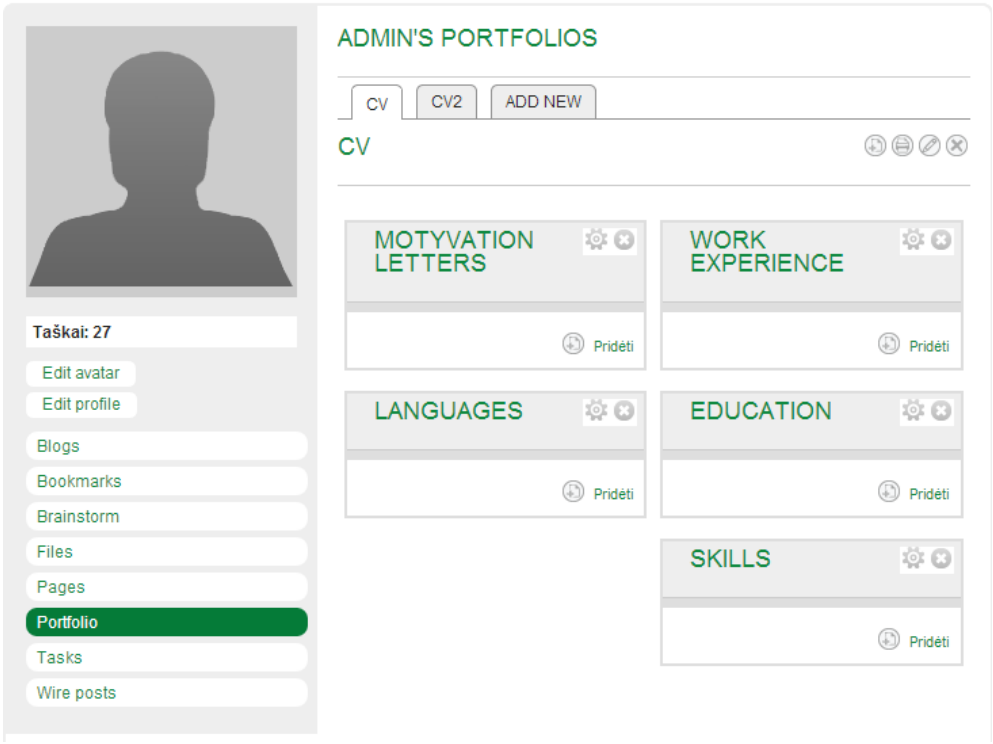


Picture53. Applying *Elgg* social network in Kaunas e-Learning Technology Center

Elgg is a huge system & has many features built in so to get more familiar with it please visit [8] resource. Kaunas e-Learning Technology Center has created more websites using *Elgg* but the concept remains the same & functionality is very similar.

Moreover *Elgg* system can be used as an e-portfolio [46]. This tool is a special plugin that lets a user access these additional features (*Picture 54*):

- Write CVs & motivation letters
- Describe language skills
- Describe work experience
- Create documents about qualification & education
- Identify additional (personal) skills etc.



Picture54. *Elgg* e-portfolio admin user interface

9.2 Blogs & blogging

A blog (a portmanteau of the term web log) is a discussion or informational site published on the World Wide Web and consisting of discrete entries ("posts") typically displayed in reverse chronological order (the most recent post appears first). Until 2009 blogs were usually the work of a single individual, occasionally of a small group, and often covered a single subject. More recently "multi-author blogs" (MABs) have developed, with posts written by large numbers of authors and professionally edited. MABs from newspapers, other media outlets, universities, think tanks, interest groups and similar institutions account for an increasing quantity of blog traffic. The rise of *Twitter* and other "*microblogging*" systems helps integrate MABs and single-author blogs into societal *newstreams*. Blog can also be used as a verb, meaning to maintain or add content to a blog [47].

Blogs are quite popular in Lithuania because people can create blog style websites free of charge. Furthermore majority of Internet users satisfy their needs with a blog because they only need to post and

publish information, comment posts, share post information on social network. Subject area in a blog varies widely, so math related information can be published there as well.

This chapter is divided into two subsections: about Lithuanian Blog Creation website and *Blogger* [49] with Blogspot.

9.2.1 Lithuanian Blog Creation website

Blog website homepage is displayed in picture 8. Basically every visitor can create a blog, nut registration for that is required. Depending on the chosen plan registration can be free or suggested for a symbolical fee. Once created, blog site administrator can manage posts & categories, share information, write comments etc.

Picture55. Blog creation website homepage

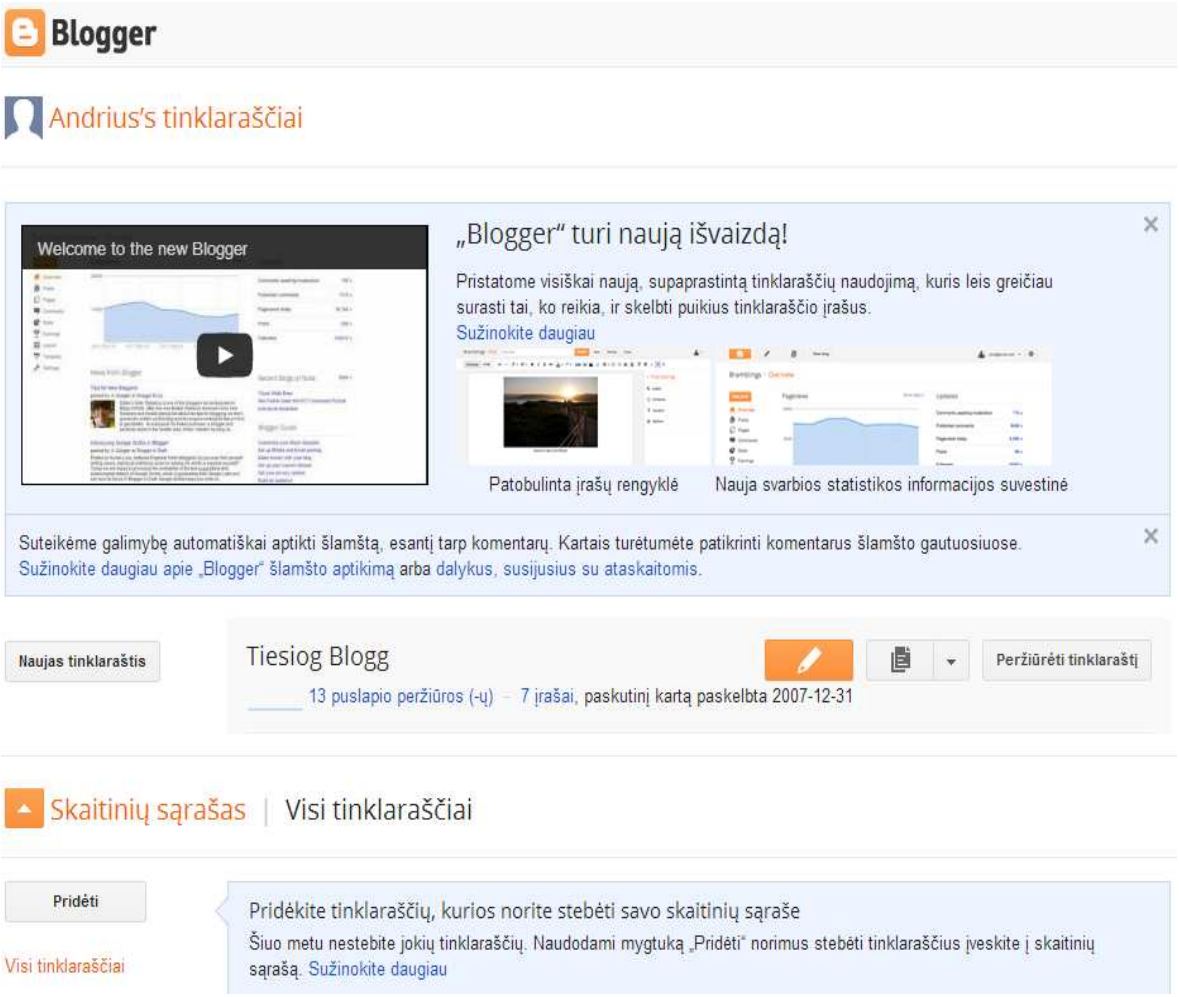
Websites features include:

- Show total number of created blog websites (*75041*)
- Site slogan & basic steps for registering a blog website: think a name, apply a template and post only in 2 minutes!
- Show most recent & popular blog posts
- Show recommended blog posts
- Login area
- Post tags
- Search blog posts information
- Analyze blog post list in alphabetic order & navigate to corresponding website
- Ask for help.

9.2.2 Blogger & Blogspot

Blogger is a service provided by Google for people to manage blog style websites. In order to create a blog, users must have a valid Google account. Nowadays it is difficult enough to find a person who does not use Google (email, Google drive etc.). Furthermore the registration is free & fast.

The blogger homepage view is illustrated in picture 56. It shows users already created blogs (number of posts, views, date) & also a feature to add a new blog.



Picture56. Blogger user account start page

The interesting part is that blog websites are managed via *Blogger* interface whereas the pages are hosted in *Blogspot*. For example: *namesample.blogspot.com* and so on.

Additional blog resources:

- Mathematics learning blog: this website [50] shares information about teaching/learning mathematics strategies. Resources include video tutorials, blog posts, links to other resources etc.
- Other mathematics learning blog topics cover: teaching mathematics through games, starting a math lesson, create a word search puzzle, 15 more places to learn algebra [51], multiplying numbers, creative mathematics [52] [53] etc.

9.3 E-portfolio tools

There are many definitions about e-portfolio. To my mind, L. Dawley (2007) defines it in the most appropriate way. Electronic portfolio is "A digital file based on internet technologies which is able to show person's learning competences in a public, fast and easy way" [54]. Electronic portfolio has appeared due to:

- Rapid invasion of internet into different spheres of our life: education, manufactory, business, etc.

- Data records on internet generated the opportunity to create, use and manage electronic documents without any effort
- The alternation of teaching/learning paradigms: there was a transition from learning once in a life time to for a long life learning
- For e- portfolio to become so popular and widely used, Wiki and Blog appearance had a great influence.

At the moment there are many e-portfolio systems. They differ in functionality, approachability, etc. Some work independently, while others are integrated into already existing systems. Most of the systems are commercial and made for the specific enterprise and its needs.

This chapter covers popular open source e-portfolio system *Mahara, e-folio Minnesota,* & Moodle learning management system (*LMS*) plugin Exabis E – Portfolio. Note that *Elgg* social network system (described in previous chapters) has an add-on module for portfolio as well.

9.3.1 Mahara

Mahara is totally independent and stand-alone system where user himself has to put his achievements. However not all features are compliant with e-portfolio conceptual model requirements (Sharable Content Object Reference Model (SCORM), competence category, data import, interaction with a learning environment). Next, *Mahara* usage examples ant its basic functionality is described.

Mahara e-portfolio system is used in Lithuania Vytautas Magnum University [55]. Registration is required for people to access the website. System features include:

- Create & manage personal profile (general, contact info, instant messaging, occupation, cover letter etc.)
- Upload files that other users could see or for personal needs
- Create new views (customizable *Mahara* web pages information). This can be blog, blog posts, external feeds (*RSS, ATOM*), videos, images, files, some HTML, folders, files to download, embedded media, site navigation, plans list, forum messages, view notes, contact & personal information, resume. Furthermore, a custom predefined style sheet can be applied to a view page
- Join or find friend groups, create new ones
- Find friends who have registered into the system & created e-portfolio
- Search site user, control posted information visibility etc.

9.3.2 eFolio Minnesota

eFolio Minnesota [56] is a Web-based portfolio designed to help you create a living showcase of your education, career, and personal achievements. System offers two different registration type: student or professional. After the process user can manage e-portfolio website from the backend & show the results after that to others. Site management panel include:

- Page layout preview
- Page navigation menu management. Menu items: “Personal Info”, “Education”, “Coursework”, “Photo Gallery”, “Web Links”. Users can create edit delete information on each of the suggested pages. What is more, new pages can be constructed as well.
- Add new content. It’s types:
  - Personal. Can create activity, affiliation, contact, event, goal, skill, questionnaire

- Education. Can create activity, affiliation, contact, Course Taken, Course Taught, Credential or Degree, Event, Skill, questionnaire
- Work. Can create activity, affiliation, contact, employment, event, skill, questionnaire
- Web content. Google docs, HTML, URL, YouTube
- Upload. File, Image, *LodeStar* object
- General. Create basic page.

- Analyze t*o-Do* list (for example add a class that you are or have been enrolled in etc.)
- Analyze created & sent to trash content
- Manage website design (look & feel)
- Manage website utilities (History, storage & more).

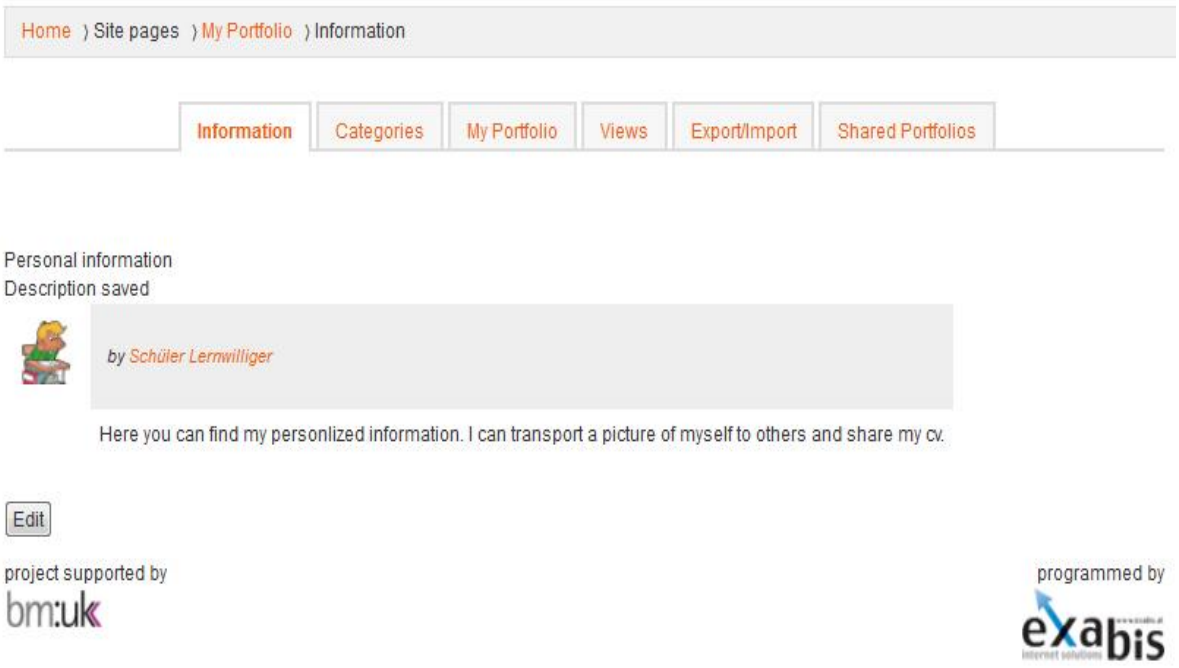
If user does not customize a typical eFolio page, then the webpage is rendered with 6 menu links, header footer & main content page area. Default design is chosen.

9.3.3 Exabis E-Portfolio

Exabis E-Portfolio [57] is a plugin for the *Moodle* learning management system. *Exabis* is one of the most feature rich e-portfolio tools. It includes the following functions which can be considered essential for ePortfolio-work:

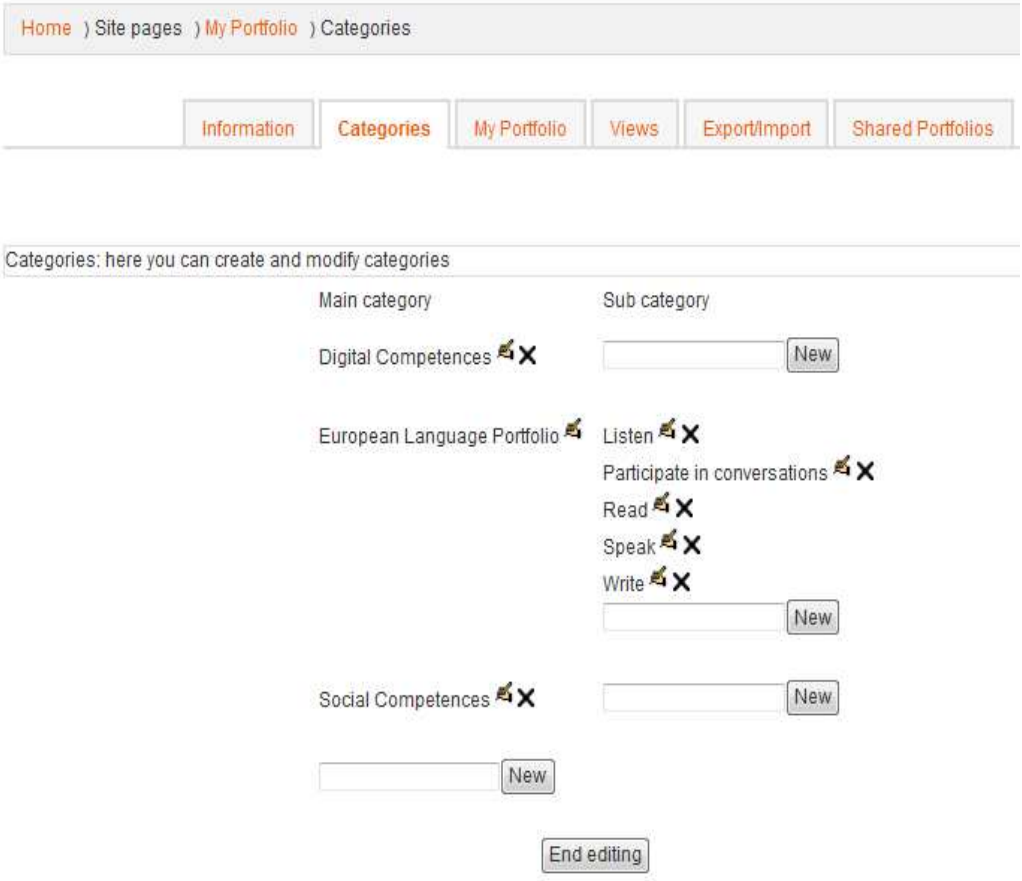
- An individual start-page (i.e. intro, curriculum vitae, etc.)
- management of categories on two levels (main- and subcategories)
- management of documents and links within the manageable categories (i.e. to publish ones' best work)
- publication of arte facts to other users of the same Moodle-installation or as an external link into the internet using views
- self-reflection and documentation of the personal advancement in a learning field
- commenting-function of published views to gain feedback of other users
- Export-possibility of selected *ePortfolios*-views in a SCORM-zip-format
- course-independent use of ePortfolios
- import of assignments given within the same Moodle installation
- import of external SCORM-packages into the individual ePortfolio
- association of competences with ePortfolio-arte facts
- notification when sharing views
- user-based grouping of views
- interface to *ePOP* (electronic personality oriented portfolio – the first smartphone-based ePortfolio-app).

Some of these main features are shortly overviewed in this section however the user is advised to read the plugin documentation [57] for additional information & usage examples.



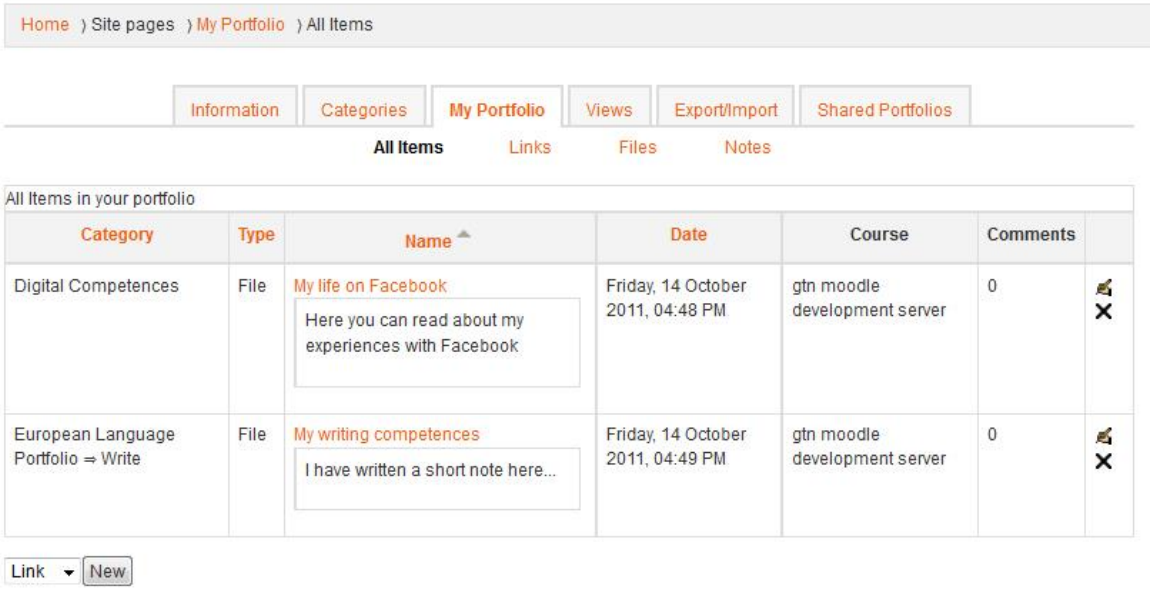
Picture57. Exabis E-Portfolio general information page

Picture 58 shows an example of how categories can be created & managed in Exabis e-portfolio. For example digital competences, European language portfolio (competence for listening participating in conversations, reading, speaking, writing), social competences.

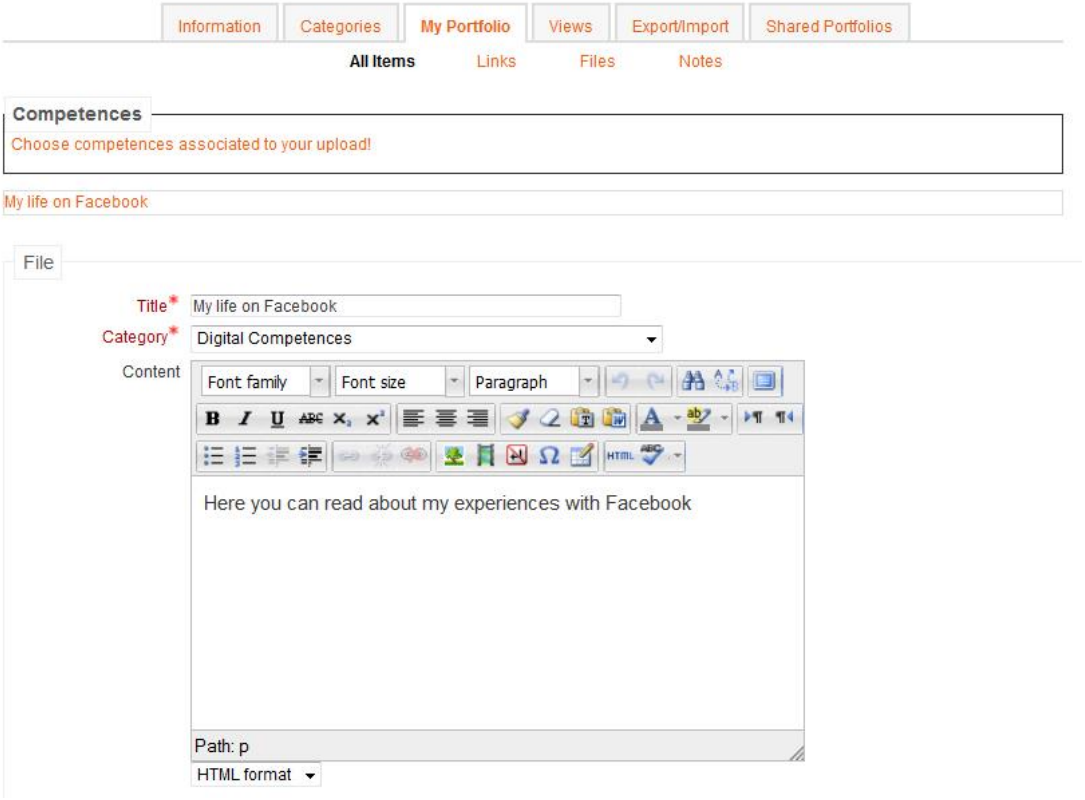


Picture58. Exabis E-Portfolio categories page

59 illustrate an example of how items can be listed in a user's *My Portfolio* page.



Picture59. Exabis: listing items in *My Portfolio*



Picture60. Assigning competence to Exabis My Portfolio

To sum up, e-portfolio tools listed in the 4-th chapter of this document can be applied in mathematics course for participants to collect information about their math knowledge, skills, competence, achievements, & compare it with others.

9.4 Podcasts

Podcast is a type of digital media consisting of an episodic series of audio radio, video, PDF, or ePub files subscribed to and downloaded through web syndication or streamed online to a computer or mobile device. A list of all the audio or video files currently associated with a given series is maintained centrally on the distributor's server as a web feed, and the listener or viewer employs special client application software, known as a pod catcher, that can access this web feed, check it for updates, and download any new files in the series. This process can be automated so that new files are downloaded automatically, which may seem to the user as if the content is being broadcast or "pushed" to them [58].

This chapter describes some of the online podcast math resources assuming that they will identify good practice in how this kind of resources could be used for *SigMath* project.

9.4.1 Mathgrad

Mathgrad [59] is a website that stores audio media about mathematics. Mathgrad gives some basic information about a podcast, useful links to other resources. Each podcast is up to 10 minutes long. Topics include:

- Voting theory
- Scaling & sizing
- Probability theory
- Exponentials, factorials
- Modular arithmetic
- Sudoku mathematics etc.

So Mathgrad podcasts discuss everyday mathematics in a way that even the most unmathematical person can benefit. However some podcasts are orientated to those learners (students etc.) who already have basic knowledge about mathematical problem solving.

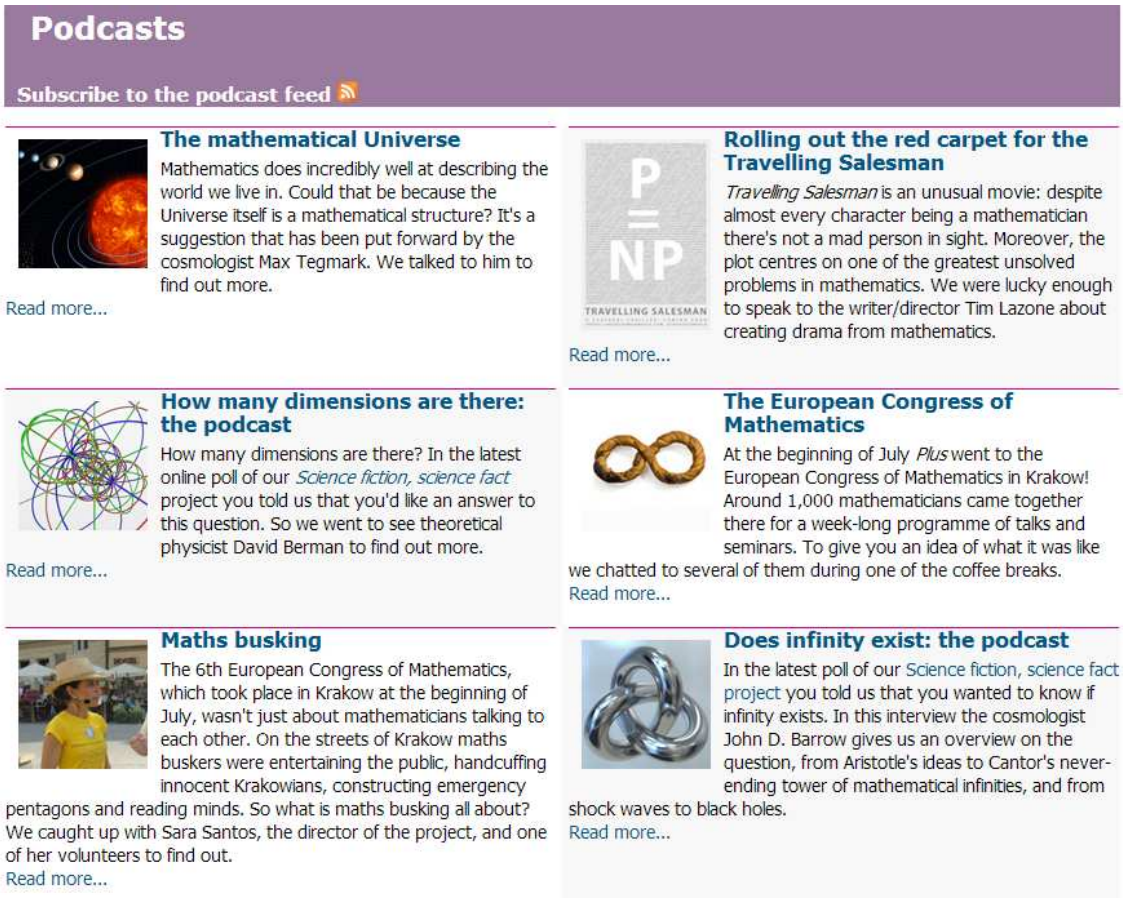
9.4.2 Math plus podcasts

This resource is an internet magazine which aims to introduce readers to the beauty and the practical applications of mathematics. A lot of people don't have a very clear idea what "real" math consists of, and often they don't realize how many things they take for granted only work because of a generous helping of it. Apparently, some people even have the idea that it's boring! Plus provides articles and podcasts on any aspect of mathematics, covering topics as diverse as art, medicine, cosmology and sport, a news section, showing how recent news stories were often based on some underlying piece of math that never made it to the newspapers, reviews of popular math books [62].

Podcasts include:

- Mathematical Universe
- Travelling Salesman problem
- Dimensions
- Infinity existence
- Time puzzle
- Math in the Movies
- What happened before the Big Bang?
- What is like being a mathematician etc.

Math plus internet magazine also provides math related posters, articles, news, blogs, carrier section, various reviews about books.



Picture61. Math podcasts list

So, to sum up Math Plus internet magazine is for those who think about mathematics philosophically & like to hear how people talk & visually represent math related topics.

9.4.3 Math podcasts on Recap

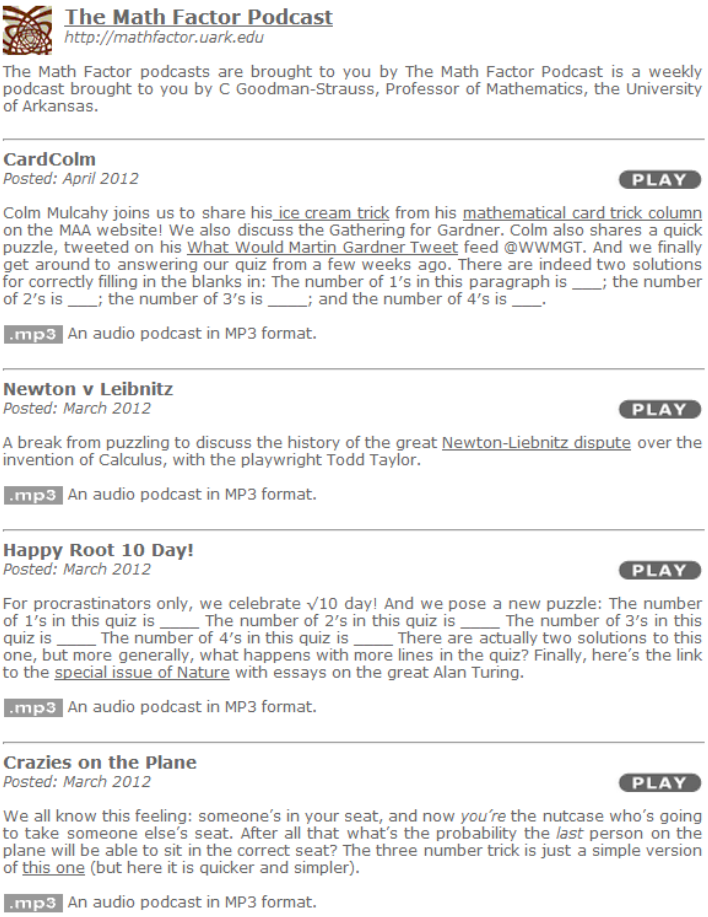
Recap provides podcasts for educators, schools & colleges. Podcast topics vary a lot & include:

- Podcast from schools
- Home & family
- Colleges & universities
- Information Communication Technologies (ICT) topics
- Design & food technology
- Business & education studies
- Modern & traditional languages
- Math & science
- Creative arts & design
- Creative music & sound
- Physical education & sports
- Religious education
- Personal, social & health

- General studies & citizen ship
- Professional items & news.

In SigMath project scope, math related podcast are the most important. There are 28 podcasts in this category (some of them are about astronomy, water, math mutation, math in motion [63]).

Picture 62 shows “The Math Factor Podcast” example. When user chooses a desired category a list of podcasts (with a name, short description, publication date) are displayed. Podcast starts after the “Play” link is clicked.



Picture62. Math podcast sample on Recap

Additional podcast resources:

- ITishnikai [64]
- BBC math podcasts [65]
- Math primate [66]
- MAA podcast center [67].

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