MATHEMATICS OPENS NEW HORIZONS

PHD. Valerica Doina MUNTEAN[1]

Abstract

Facilitation is often described as the art of making things easy for others, but if you make things too easy you risk returning to the spoon-feeding tradition in which learners passively digest whatever the educator wants them to. In essence, facilitation is an enabling role in which the focus is usually on what the learner is doing and experiencing rather than on what the educator is doing. Here are some styles that are used to facilitate Mathematics educators.

Keywords:
Non-directive facilitation - there are some issues on which you should not attempt to be neutral;
Appreciative facilitation - emphasizes what works well and pays attention to success and achievement;
Activity facilitation - emphasizes the facilitator's role during a group activity.

1. INTRODUCTION

For the last decade, sustained, innovative professional development has been widely acknowledged as essential to the improvement of Mathematics education. In support of Mathematics education development is the cultivation of cadres of "mathematics specialists," groups of teacher-leaders positioned to offer demonstration lessons and classroom consultations, facilitate grade-level meetings, and lead professional development workshops and seminars.
Going Mathematicss opens new horizons. It can be a journey into an unfamiliar world - a world of differences where norms and routines are left behind and where people dress, feel, think and behave differently. Going Mathematicss can also be a voyage of discoveries where people find things out about themselves, about each other and about the natural world.
It is of course possible to venture into the Mathematicss and discover very little. Differences may not be noticed much, or if noticed may not be enjoyed, and even if enjoyed may not have much educational value. The process of discovery in the Mathematics can falter if the visitors are not in the mood for discovery nor have the confidence to be discoverers.
It is direct encounters with the natural world that generate the experiences at the heart of most kinds of Mathematicseducation. And it is the interaction between self, others and the environment that shape these experiences. Each of these three influences (self, others and the environment) can be very powerful.
You (as a facilitator) first need a reasonably clear picture of what it is that you want to facilitate: a meeting, an activity, group development, personal development, self-directed learning, a learning climate, a learning outcome, learning skills, self-esteem, support, an adventurous attitude, a self-reliant expedition, a commitment to sustainability, curiosity about nature, spiritual awareness, independence, interdependence, almost any experience or change valued by participants.

[1] ISJ Satu Mare, Romania

Once you know what it is that you want to facilitate, it is useful to consider any other facilitative forces that could be influencing how things turn out. Amongst these will be the personal attributes of participants, their individually different experiences, the group dynamics, the nature of the activities, and the influence of the natural environment. In Mathematicseducation settings there are so many potentially facilitative influences around, that it makes sense to ensure that they are identified, appreciated and engaged.

There is an enormous range of facilitation styles to be found in Mathematicseducation. This diversity can be confusing. Despite much overlap in practice, facilitation is commonly understood to be less directive than teaching.

A rule of base which distinction between facilitation and teaching is that in facilitation, the goal is usually for people to learn something that nobody knows at the beginning, whereas in teaching the goal is usually for people to learn what the teacher already knows.

In most forms of Mathematicseducation it is likely that both kinds of goal exist - so you may want to move between “facilitating” and “teaching”. But even when you have the knowledge or skill that others are trying to learn, it does not automatically follow that you abandon facilitation. There are many aspects of Mathematicseducation. But with imagination the skills and topics can be learned by experiential methods and appropriate facilitation.

This is the challenge for all Mathematicseducators: to make students' own experiences central to the whole process. Mathematicseducation is not just about changing the scenery. It is an opportunity for much deeper change – which facilitation can help or hinder.

2. VARIETIES OF FACILITATION

Facilitation is often described as the art of making things easy for others, but if you make things too easy you risk returning to the spoon-feeding tradition in which learners passively digest whatever the educator wants them to. In essence, facilitation is an enabling role in which the focus is usually on what the learner is doing and experiencing rather than on what the educator is doing. Some of the facilitation styles that are used by Mathematicseducators are described next.

Non-directive facilitation

Even if you do not adopt a non-directive stance all of the time, there are situations where it can be an effective strategy – for example, where you believe that students can work things out for themselves and will find it more rewarding to do so. An impartial stance can also help to encourage discussion or defuse conflict or help students become more independent and responsible. But there are some issues on which you should not attempt to be neutral.

Appreciative facilitation

Appreciative facilitation emphasizes what works well and pays attention to success and achievement. At its simplest, it involves catching students at their best moments and providing positive feedback about what they did or said. Alternatively you can invite positive comments from participants for each other following a group exercise. Appreciative facilitation draws on ideas and principles from Appreciative Inquiry (an approach to organization development) and Solution Focused Brief Therapy (“Be careful what you attend to. What you focus on expands.”). Appreciative facilitation fits well with Mathematics education, both as a source of techniques and as a philosophy.

Activity facilitation

This approach emphasizes the facilitator's role during a group activity. Sometimes the facilitator may simply be enabling a group to achieve a task in the time available. But where the purpose of

the activity is to generate experiences from which people will learn, the facilitator may want to intervene during the activity in order to influence what is experienced. This will typically involve changing the rules in some way – with or without consultation with the group. Mathematicseducators have less control over the many variables that influence what is experienced, but there are always plenty of ways in which activity facilitation can enhance the quality of the experience.

Group facilitation

Group Facilitation can apply to any group situations - from the running of effective meetings (and keeping to the agenda) through to sensitivity group training (where there is no agenda). Like it or not, the group dynamics in Mathematicseducation can have greater impact than the Mathematicss. If the development of group skills is not a priority it may still be necessary to use group facilitation skills to redirect attention to the Mathematicss. If the primary aim is social development or team building, group facilitation is clearly a must. But whatever your main purpose, you will at the very least want to ensure that the group climate is a highly favorable climate for learning and development.

3. CHOOSING A FACILITATION STYLE

In practice, facilitators often have style that corresponds most closely to their values, and pick and mix ideas from other sources.Inconsistency appears to be what effective facilitators have in common! Facilitators are: flexible, adaptive, proactive, responsive and resilient.As a facilitator, you will be most effective when you are being your natural self and allowing your own personality to be expressed. People get permission to be themselves from the way a facilitator behaves – that is, through modelling. If you are stiff and formal, the group tends to be like that. If you are relaxed and self-expressed, the group tends to be like that too.

Search hard enough and you can probably find research supporting your own preferred facilitation style. Whatever that may be, the research reported above suggests that you should not be a slave to just one style. Such advice is particularly relevant in the unpredictable arena of Mathematicseducation. You need freedom for maneuver, room for judgment, flexibility to respond and to make the most of unexpected events and experiences. The challenge is to develop a facilitation style or combination of styles that works for you and your students and that makes good use of the many facilitative influences that are found in Mathematicseducation settings.

Making sure that you select the right level of development for your students will help them learn from the experience. It is also important that you think about what kinds of activities and methods of learning will best suit yourstaff. Students learn differently from each other and prefer different learningstyles and techniques. They may also be comfortable learning in differentenvironments or situations.

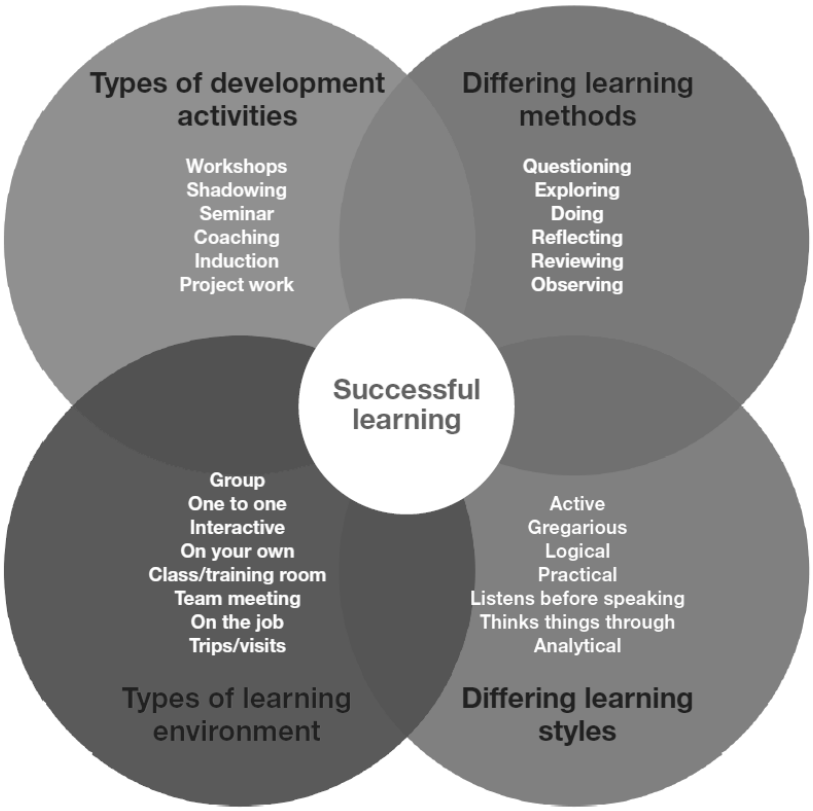

Figure 1. Elements of successful learning

Within the learning resources of Mathematics are a range of materials that can be adapted and added to suit a variety of students and learning situations. Using them creatively and flexibly is required to suit your student's needs,the time available and your business objectives.

4. FACILITATING REFLECTION

Quality action and quality reflection on that action are of fundamental and equal importance.
Whatever style is adopted, one of the facilitator's primary roles in Mathematics education is to facilitate reflection on experience. This process is referred to variously as reviewing or debriefing or processing.
Without the sense of action to the Debrief, it is often a lifeless, futile exercise ... The experience can come alive in the Debrief. The experience can be relived. The discussion is not a static, safe, merely cognitive exercise. It has feeling, anger, frustration, accomplishment and fun.
What students experience during a review is at least as important as the experience that they are reviewing? It is not enough to expect that the stimulation of the activity will keep students alert and involved during a dull review in which the facilitator runs through a series of questions. Review sessions are an ideal opportunity for enabling students to be more active learners. Experiential learning is based on learners being active, curious and creative. We should at least seek out learners' own questions. When reviewing in the Mathematicss there is no shortage of opportunities for active reviewing. The Mathematicss provides:

- a breath of fresh air and change of scene that can inspire a refreshingly new approach to learning

- an abundance of visual aids, some of which are the real thing rather than substitutes for it
- a naturally stimulating environment for learning that is more brain-friendly (and arouses more intelligences) than the most well equipped indoor classrooms
- space that is useful for more physical reviewing such as action replays, human sculpture, human graphs, or human scales
- privacy for solo reflection
- freedom from fixed or cumbersome furniture - you can move quickly between large group, small group, paired and individual reviewing activities
- opportunities for walking and talking - for paired discussions or for interviewing each other
- sand or soft earth for drawing anything such as a graph for showing ups and downs, a journey towards a goal, a force field, a flow chart, or a learning model
- natural objects and materials that can be collected and arranged as collages or sculptures or maps of a journey
- natural objects that can be arranged and moved to represent the changing group dynamics
- viewpoints from where participants indicate places that evoke thoughts or feelings associated with the experience being reviewed
- opportunities for reflective exercises such as guided reflections or making personal gifts from natural materials
- opportunities for reflective drama inspired by the location or by environmental themes such as life cycles, the food chain, the web of life
- the opportunity to "walk through" what happened or perform an action replay
- "teachable moments" or "learning opportunities" which are best caught there and then as they happen.

Once you discover that you can abandon indoor teaching aids and exploit resources and opportunities in the Mathematicss for reviewing, you will become tuned in to spotting good reviewing locations and making the most of them. By making reviewing active, mobile and Mathematicss, the reviews themselves can be at least as memorable as the Mathematicsexperiences being reviewed. This makes the learning as memorable as the experience in which it is grounded.

Schools have a central role to play in delivering high-quality Mathematics education. Mathematics education have thepotential to make a substantial impacton the personal and social developmentof the young people they engage with;for many this is their primary purpose.

All good facilitators or trainers will have a sound knowledge of learning,including development methods, learning environments and learning styles. Learning interventions that aim to challenge, engage and motivate participants generally require facilitators to have good skills in leading and managing groups, strong interpersonal skills.

5. WHAT ARE THE OUTCOMES OFHIGH-QUALITY MATHEMATICS EDUCATION?

In high-quality Mathematics education youngpeople are encouraged to engage in theplanning of their Mathematics activities andtake maximum ownership whilstparticipating. Time spent or reviewing the activity ensures thatlearning outcomes are emphasized,reinforced and applied in the future.

When schools are providing high-quality Mathematics education, they see young people who:

1. Enjoy participating in Mathematics activities and adopt a positive attitude to challenge and adventure.
2. Are gaining personal confidence and self-esteem through taking on challenges and achieving success.
3. Are developing their self-awareness and social skills, and their appreciation of the contributions and achievements of themselves and of others.
4. Are becoming alive to the natural environment and understand the importance of conservation and sustainable development.
5. Are acquiring and developing a range of skills in Mathematics activities.
6. Are demonstrating increased initiative, self-reliance, responsibility,perseverance and commitment.
7. Are developing and extending their key skills of communication, problem solving, leadership and teamwork.
8. Are displaying an increased motivation and appetite for learning that is contributing to raised levels of attainment in other aspects of their education.

Competition features in Mathematicseducation as one means of challengingyoung people to develop theirknowledge, skills and confidence.Competition should be used as a spurto encourage all to strive to do theirbest, and, having done so, to take pridein their achievements.

In the high-quality Mathematics education, students are engaged as far as possible at a level that matches their own abilities and development. Activities are planned that can be adapted to present challenges at different levels appropriate to different group members, or permit group members to take ondifferent roles. Student's progress is monitored to ensure they can becontinually motivated by new challenges.

Effort versus Performance

There is a fine line between performance and effort.How does teacher praise affect students' self-perception and motivation in a Mathematics classroom? This question is complex because it possesses many different components that need to be discussed and considered before a research-based answer can be provided.

An increasing number of instructional theoriesstress the importance of rich learning environmentsbased on real-life tasks as the drivingforce for learning. Such tasks are expected tohelp learners integrate knowledge, skills andattitudes, and improve transfer of what islearned to work settings or daily life.

However, a severe risk of such learningtasks is that students may not be sufficientlymotivated to deal with their complexity. Students will exert "effort" to obtain a "want" to fulfill a "need." If you can assign students to a task they see as beneficial to their"need," you can channel their efforts toward increasing the team's productivity.Rewards are tools for harnessing and channeling student effort. Students will exert more effort on a task if completing it provides something they want.

There is evidence to suggest that there are educational benefits in setting studentschallenges which require significant effort on the part of the learner rather than themsimply being able to do something or not. Many teachers make a point of rewarding the efforts made by students who try hard to achieve. This can be problematic in thecase of some young people in contemporary school education where achievement isprimarily measured through exam success.

The current literature on motivation in learning suggests the value of a mastery approach to learning and contrasts "narrow" and "broad" views of education.Narrow education experiences are in essence activities which are short in duration and focus on high thrills, but require little

effort on the part of the student who takes minimal responsibility for his or her actions.He contrasts this with broad education which provides the converse, but most notably requires the student to take responsibility for their actions and sustain effort.

Table 1.Dimensions Associated with Narrow and BroadConceptions of Mathematics education

Narrow View of Mathematics education	**Broad View of Mathematics education**
• Short timescale of experience	• Long timescale ofthinking
• High thrillchallenges	• Many challengesvaried in thinking
• Little or no effortinvolved	• Some or much effortinvolved
• No responsibilitiesdeveloped to students	• Responsibilitiesdevolved to students

As noted a good learning experience may involve a wide variety of learning opportunities. At times one form of development may find more emphasis than atothers, but there is often the potential for intellectual, physical, emotional, aesthetic and spiritual development to take place. The mix will vary from individual to individual and from time to time.

Of the many factors influencing academic performance, the student's personal inputsto learning are recognized as among the most critical. Some of these inputs are thefocus of this study of performance in an introductory statistics course. The individualstudent's inputs that are hypothesized to be central to academic performance areeffort, ability and relevant prior training. Ability and training are necessarily fixed atthe commencement of any course, with only effort potentially under the student'scontrol during the course. Effort is not directly observable and the use of self-reportingof personal actions is widely recognized as problematic. Consequently inthis paper effort is measured by (voluntary) attendance, although it is recognized thatattendance is only one part of a student's engagement with the course content. Abilityand prior training are jointly measured as a single score from a simple numeracy testadministered at the start of the course. We found that individual students' scores onthis test, as well as their levels of attendance, were strongly related to academicsuccess in the course. These results allow a discussion of the impact of studentengagement, closely related to effort and specifically to attendance. Changes inuniversities and society over the past two decades have tended to reduce studentengagement, and the longer-term consequences of changes designed to facilitatelearning may be the opposite of those intended. Methodological problems involved inthis and similar studies are discussed at greater length than is usual.

The relationship between a student's academic performance and the inputs thestudents brings to a well-defined course of study is examined. The course of study is"well-defined" in being a quantitative subject where academic performance isexaminable against objective criteria. An individual student's inputs are preparednessand effort, and these are also open to objective measurement. The student'spreparedness is a combination of their mathematical ability and prior math's training andexperience. Attention is also focused on how attendance and preparedness combine toaffect performance in a compulsory first year business statistics course.

Students in mathematics believe they achieve for a variety of reasons, andtheir beliefs and interests are very important in determininghow they deal with failure, the risks they are willing to take,and the ways in which they interact with problems and learningopportunities. Therefore, students' interests and their beliefsabout the reasons they succeed or fail can dramatically affecttheir achievement.

Analyzing the components of ability and effort attribution provides important information affecting future studentperformance.When students attribute their success to ability or receivefeedback that attributes their success to ability, they developa higher self-efficacy and

expectations for future skill development Gifted and talented students tend to attribute quality work toability and not effort.Praise from teachers andparents for students' ability may increase the students' fearof failure.

If students in mathematics have a fixed entity theory of intelligence, attributingfailure to lack of ability is very dangerous. This outcomeattribution removes individuals' control over the situation. If, however, students have a malleable incrementalintelligence theory, attributing failure to a lack ofability could inspire them to work harder and look forward tobeing exposed to new information that could increase theirability to overcome the failure. These students do not interpretfailure as an inherent judge of their ability but as astepping-stone to improving their ability.

Attributing failure to effort gives students the control toimprove the next time. Failure can be especially motivatingfor those students in mathematics who hold a malleable incremental intelligencetheory because they believe they can increase theirintelligence by working through a problem. They engage inpositive self-monitoring and instruction to work through achallenge. They may not see failure as a reflection of their intelligence;rather, they may see it as an opportunity for growth.

For students in mathematics who hold a fixed entity theory of intelligence,self-handicapping or learned helplessness can occur when theyattribute their failure to effort. Itallows them to maintain their self-assessment of their ownability. When the tasks become more challenging, they do nottry, because this provides an excuse that does not involvealtering their perceptions of their ability levels.

Interest has not been explored to the extent that ability andeffort have been with respect to its responsibility for attributionof success and failure; however, interest is a determiningfactor in academic motivation. Task value directly influencesachievement choices and is composedof attainment value, intrinsic interest, and utility value. Intrinsic interest can be definedas showing a value orientation toward the subject of taskand examined as an individualcharacteristic or a situational-dependent characteristic.

Interest-enhancing strategies can promote subsequentinterest in tasks that might be considered boring. Thisis particularly important because some level of interestand involvement may be essential to maintain performanceof uninteresting but important activities. Thissuggests that an important component of self-regulationto reach valued outcomes includes regulating theexperience of interest while working toward those outcomes.

Students in mathematics achieve for a variety of reasons, and personalinterest is paramount.In all talent areas, interestwas related to perceived performance. Parents and educatorswho are concerned about their students' academic performancecannot overlook the important role interest plays inperformance. They need to make every effort to learn student'sinterests and tie those interests to academic tasks.

6. MATHEMATICS EDUCATION

Perceptions of the nature and role of mathematics held byour society have a major influence on the development ofschool mathematics curriculum, instruction, and research. Theunderstanding of different conceptions of mathematics is as importantto the development and successful implementation ofprograms in school mathematics as it is to the conduct andinterpretation of research studies.Mathematical statements are clear and unambiguous. At any moment, it is clear what is known and what is not known.

Many educated persons, especially scientists and engineers, harbor animage of mathematics as akin to a tree of knowledge: formulas, theorems,and results hang like ripe fruits to be plucked by passing scientiststo nourish their theories.

The conception of mathematics held by the teacher mayhave a great deal to do with the way in which mathematics ischaracterized in classroom teaching. The subtle messages communicatedto children about mathematics and its nature may,in turn, affect the way they grow to view mathematics and itsrole in their world.

Mathematics education has been a focus of attention around the world over the last few decades. On one hand, scholars, designers, and practitioners have produced exciting new developments in research, curriculum, and assessment. New standards for instruction and curriculum have been developed and an international discourse community on mathematics education has grown. On the other hand, mathematics education has been the target of intense criticism and debate among different stakeholders and communities. The need for new scholars and leaders in mathematics education is great. New advances in the field - in practice and in research - as well as focused concern make it a particularly good time to earn a graduate degree in mathematics education. Our doctoral concentration prepares graduates to be leaders, creative scholars, and teachers in mathematics education. With a concern for the interdisciplinary nature of the significant problems in our field, we create opportunities for our graduate students to learn to work across conventional domains - mathematics as discipline, the world of schooling, professional education, educational scholarship, and policy.

The concentration in Mathematics Education prepares scholars to work as researchers, expert practitioners, or policy professionals with a special focus on the teaching and learning of mathematics. In this program, mathematics education is considered in its intersections with the nature of mathematics as a discipline; considerations of teaching and teacher learning; the design, implementation and effects of curriculum and instructional interventions and their implementation and effects; contemporary developments in learning theories and technologies; issues of equity and social justice; and the framing and enacting of educational policies.

Students in Mathematics school take a common set of core courses, dealing with curriculum, learning, teaching, and research in mathematics education. They also select electives from other areas, within the School of Education and from programs and departments elsewhere in the university. In addition, we engage our students in two practicum experiences to provide focused opportunities to learn to use what they are learning in the contexts important to work in mathematics education.

Students in the Mathematics school specialization may work on any portion of the span from pre-K through college, and they may focus on mathematics as encountered in or out of school. In an intensive program consisting of coursework, practice, and apprenticeships, students engage in practice and scholarship alongside nationally recognized specialists in their field. Many opportunities are provided for students to work collaboratively with each other and with faculty, but students are encouraged and expected to develop and examine their own research questions and emphases.

The importance of mathematics has never been greater than now and for the foreseeable future. Mathematical skills are crucial for a wide array of analytical, technological, scientific, security and economic applications. Training students to become adept users of mathematics and to appreciate its usefulness is of paramount importance for the future. If you love doing mathematics and helping others to understand how mathematics can be useful and important to them, mathematics education may be your calling.

Mathematics teaching is an area of national need so the demand for mathematics educators. Learning to communicate clearly about mathematics with learners will be a fundamental component of the training as you will be spending time in school classrooms working with students during your training.
Mathematics is the key to opportunity for these jobs. Through mathematics, we learn to make sense of things around us. As technology has mathematicised the workplace, and as statistics has permeated the arena of public policy debate, the mathematical sciences have moved from being a requirement only for future scientists to being an essential ingredient in the education of all students.
A highly educated and skilled labor force is what drives innovation and production.Early math ability predicts later outcomes. Science and mathematics are at the heart of modern life. They are essential to understanding the world and provide the foundations for economic prosperity.
Digital technologies, cross-disciplinary skills and the age of big data will all have a significant impact in the classroom and on teachers. Mathematics and science must be placed at the heart of education systems.
Mathematics education prepares young people to navigate a rapidly changing world and provides the foundations for economic prosperity.
The focus on mathematics education and the growth of research in mathematics education reflects a renewed interest in the philosophy of mathematics and its relation to learning and teaching.

7. E-LEARNING A VITAL FACTOR IN THE EQUATION OF MATHEMATICS EDUCATION

E-learning is the use of Internet technologies to enhance knowledge and performance. E-learning technologies offer learners control over content, learning sequence, pace of learning, time, and often media, allowing them to tailor their experiences to meet their personal learning objectives. In diverse Mathematics education contexts, e-learning appears to be at least as effective as traditional instructor-led methods such as lectures. A developing infrastructure to support e-learning within Mathematics education includes repositories, or digital libraries, to manage access to e-learning materials, consensus on technical standardization, and methods for peer review of these resources. E-learning presents numerous research opportunities for faculty. Innovations in e-learning technologies point toward a revolution in education, allowing learning to be individualized (adaptive learning), enhancing learners' interactions with others (collaborative learning), and transforming the role of the teacher. The integration of e-learning into Mathematics education can catalyze the shift toward applying adult learning theory, where educators will no longer serve mainly as the distributors of content, but will become more involved as facilitators of learning and assessors of competency. A recent shift toward competency-based curricula emphasizes the learning outcome, not the process, of education.
E-learning refers to the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance. E-learning can be used by Mathematics educators to improve the efficiency and effectiveness of educational interventions in the face of the social, scientific, and pedagogical challenges noted above. It has gained popularity in the past decade; however, its use is highly variable among Mathematicsschools. In this article, we review the current state of e-learning in Mathematics education by outlining the following: key terms, the components of e-learning, the evidence for its effectiveness, faculty development needs for

implementing e-learning, evaluation strategies for e-learning and its technology, and the potential for e-learning to be considered evidence of academic scholarship.

E-learning is also called Web-based learning, online learning, distributed learning, computer-assisted instruction, or Internet-based learning. Historically, there have been two common e-learning modes: distance learning and computer-assisted instruction. Distance learning uses information technologies to deliver instruction to learners who are at remote locations from a central site. Computer-assisted instruction (also called computer-based learning and computer-based training) uses computers to aid in the delivery of stand-alone multimedia packages for learning and teaching. These two modes are subsumed under e-learning as the Internet becomes the integrating technology.

A concept closely related to e-learning but preceding the birth of the Internet is multimedia learning. Multimedia uses two or more media, such as text, graphics, animation, audio, or video, to produce engaging content that learners access via computer. Blended learning, a fairly new term in education but a concept familiar to most educators, is an approach that combines e-learning technology with traditional instructor-led training, where, for example, a lecture or demonstration is supplemented by an online tutorial.

In Mathematics learners find that multimedia e-learning enhances both teaching and learning. These advantages can be categorized as targeting either learning delivery or learning enhancement.

Learning delivery is the most often cited advantage of e-learning and includes increased accessibility to information, ease in updating content, personalized instruction, ease of distribution, standardization of content, and accountability. Accessibility refers to the user's ability to find what is needed, when it is needed. Improved access to educational materials is crucial, as learning is often an unplanned experience. Updating electronic content is easier than updating printed material: e-learning technologies allow educators to revise their content simply and quickly. Learners have control over the content, learning sequence, pace of learning, time, and, often, media, which allows them to tailor their experience to meet personal learning objectives. Internet technologies permit the widespread distribution of digital content to many users simultaneously anytime and anywhere.

An additional strength of e-learning is that it standardizes course content and delivery; unlike, for instance, a lecture given to separate sections of the same course. Automated tracking and reporting of learners' activities lessen faculty administrative burden. Moreover, e-learning can be designed to include outcomes assessment to determine whether learning has occurred.

Advantages in learning enhancement are a less well recognized but potentially more revolutionary aspect of e-learning than are those related to learning delivery. E-learning technologies offer educators a new paradigm based on adult learning theory, which states that adults learn by relating new learning to past experiences, by linking learning to specific needs, and by practically applying learning, resulting in more effective and efficient learning experiences. Learning enhancement permits greater learner interactivity and promotes learners' efficiency, motivation, cognitive effectiveness, and flexibility of learning style. Learning is a deeply personal experience: we learn because we want to learn. By enabling learners to be more active participants, a well-designed e-learning experience can motivate them to become more engaged with the content. Interactive learning shifts the focus from a passive, teacher-centered model to one that is active and learner-centered, offering a stronger learning stimulus. Interactivity helps to maintain the learner's interest and provides a means for individual practice and reinforcement. Evidence suggests that e-learning is more efficient because learners gain

knowledge, skills, and attitudes faster than through traditional instructor-led methods. This efficiency is likely to translate into improved motivation and performance. E-learners have demonstrated increased retention rates and better utilization of content, resulting in better achievement of knowledge, skills, and attitudes. Multimedia e-learning offers learners the flexibility to select from a large menu of media options to accommodate their diverse learning styles.

Creating e-learning material involves several components: once content is developed, it must be managed, delivered, and standardized.

Content comprises all instructional material, which can range in complexity from discrete items to larger instructional modules. A digital learning object is defined as any grouping of digital materials structured in a meaningful way and tied to an educational objective.

Learning objects represent discrete, self-contained units of instructional material assembled and reassembled around specific learning objectives, which are used to build larger educational materials such as lessons, modules, or complete courses to meet the requirements of a specified curriculum. Examples include tutorials, case-based learning, hypermedia, simulations, and game-based learning modules. Content creators use instructional design and pedagogical principles to produce learning objects and instructional materials.

Content management includes all the administrative functions (e.g., storing, indexing, cataloging) needed to make e-learning content available to learners. Examples include portals, repositories, digital libraries, learning-management systems, search engines, and e Portfolios. A learning-management system, for example, is Internet-based software that facilitates the delivery and tracking of e-learning across an institution. A learning-management system can serve several functions beyond delivering e-learning content. It can simplify and automate administrative and supervisory tasks, track learners' achievement of competencies, and operate as a repository for instructional resources twenty-four hours a day.

Content delivery may be either synchronous or asynchronous. Synchronous delivery refers to real-time, instructor-led e-learning, where all learners receive information simultaneously and communicate directly with other learners. Examples include teleconferencing (audio, video, or both), Internet chat forums, and instant messaging. With asynchronous delivery, the transmission and receipt of information do not occur simultaneously. The learners are responsible for pacing their own self-instruction and learning. The instructor and learners communicate using e-mail or feedback technologies, but not in real time. A variety of methods can be used for asynchronous delivery, including e-mail, online bulletin boards, newsgroups, Weblogs and Wikis.

In addition to establishing, managing, and delivering content, a fourth component is part of the e-learning equation. It is becoming increasingly clear that standards are needed for the creation of new e-learning material. Such standards promote compatibility and usability of products across many computer systems,facilitating the widespread use of e-learning materials. Several organizations have been engaged in creating broad e-learning standards. Although not specifically designed for Mathematics education, these standards offer Mathematics educators important advantages.

The effectiveness of e-learning has been demonstrated primarily by studies of higher education, government, corporate, and military environments. However, these studies have limitations, especially because of the variability in their scientific design. Often they have failed to define the content quality, technological characteristics, and type of specific e-learning intervention being analyzed. In addition, most have included several different instructional and delivery methodologies, which complicate the analysis.

Yet three aspects of e-learning have been consistently explored: product utility, cost-effectiveness, and learner satisfaction. Utility refers to the usefulness of the method of e-learning. A substantial body of evidence in the non-Mathematics literature has shown, on the basis of sophisticated cost analysis, that e-learning can result in significant cost-savings, sometimes as much as 50%, compared with traditional instructor-led learning. Savings are related to reduced instructor training time, travel costs, and labor costs, reduced institutional infrastructure, and the possibility of expanding programs with new educational technologies.

Studies in both the Mathematics and non-Mathematics literature have consistently demonstrated that students are very satisfied with e-learning. Learners' satisfaction rates increase with e-learning compared to traditional learning, along with perceived ease of use and access, navigation, interactivity, and user-friendly interface design. Interestingly, students do not see e-learning as replacing traditional instructor-led training but as a complement to it, forming part of a blended-learning strategy.

Thanks to the growth of educational technologies and the Internet, the number of e-learning resources available to educators has dramatically increased. Within Mathematics education, repositories or digital libraries have been established to manage access to e-learning materials.

Adopting e-learning and its technology requires large investments in faculty, time, money, and space that need to be justified to administrators and leadership. As with other educational materials, there are two major approaches to the evaluation of e-learning: process and outcomes.

Process evaluation examines an e-learning program's strengths and weaknesses and how its results areproduced, often providing information that will allow others to replicate it. Peer review is one type of process evaluation. Traditional peer review for journal articles verifies the quality of content. E-learning requires the consideration of additional dimensions. For example:

- Is it easy to navigate through the online material?
- Is the appearance conducive to education?
- Are multimedia elements used effectively?
- Is the interactivity appropriate for the level of the learner?
- Are special computer skills, hardware, or software required?

These and other questions place new demands on peer reviewers engaged in process evaluation of e-learning.

Tracking and monitoring learners' knowledge, attitudes, and skills via a learning-management system can greatly simplify the process of evaluating the gains made through e-learning. An approach that combines assessment of skills and attitudes using e-learning technology with facilitator-mediated observation would allow a more in-depth evaluation of skills and behavior. By contrast, evaluating the direct result of an education program by measuring changes in learners' behaviors, institutional changes, and better patient care is often complex, time-consuming, and costly. E-learning assessments can be one valuable component in such overall evaluation of Mathematics school curricula.

Numerous research opportunities exist in the relatively new field of e-learning. Faculty, administrators, and the public will demand that educators evaluate the impact of e-learning on the quality and efficiency of Mathematics education.

The integration of e-learning into existing Mathematics curricula should be the result of a well-devised plan that begins with a needs assessment and concludes with the decision to use e-learning.

8. KNOWLEDGE ASSESSMENT

Certain aspects of mathematics, such as computation, occur in all content areas. Although the names of the content areas (as well as some topics in those areas) have changed from one framework to the next, a consistent focus has remained on measuring student performance in all five content areas. The distribution of questions among each content area differs by grade to reflect the knowledge and skills appropriate for each grade level.

To become experienced in using different types of assessment to collect data about students thinking and understanding about a subject is undoubtedly the most important skill a teacher can develop. The information we collect about our students not only help differentiate instruction to meet the needs of all students, but helps our students to take control of their own learning allowing them to obtain most of any learning environment for the rest of their lives.

Valid assessments accurately target specific skills, strategies, and knowledge. Responding to multiple choice questions on problem solving in mathematics, for example, a teacher really does not give information about how well students solve problems. Answer these questions correctly can demonstrate that students have memorized how to use a strategy to solve the problem or show that they have highly developed skills-guessing, but it will show how students performed in accordance with authentic problem-situations solving. Rarely are they easy to apply for skills assessment score of 21 century.

The goal of the Knowledge Assessment is to identify strengths and weaknesses in university knowledge leveraging capability to seek, build, use and leverage strategically its organizational knowledge. It is also typical to conduct a Knowledge Needs Assessment in conjunction with or as part of the Knowledge Assessment.

For assessment data to help teachers draw useful conclusions it must be both valid, showing something that is important, and reliable, showing something that is usual.

Assessing higher-order thinking demands that students be engaged in complex activities that require them to select and effectively use appropriate thinking strategies.

Although some cognitive operations such as reasoning and problem solving may be assessed using tests, cognitive operations generally require demonstration and performance in real-life problem-solving and decision-making tasks.

Performance assessments, such as reports, multimedia presentations are engaging, authentic, and give students opportunities to show what they know in their particular learning styles. They also give teachers who are looking for it, a wide variety of information about students content knowledge, thinking skills, and collaboration and research processes.

Assessing any higher-order thinking skill requires careful planning and instruction. Proficiency at a thinking skill can be assessed in a number of ways, through activities which target certain thinking skills and strategies, even though paper-and-pencil exercises, as well as through observation.

9. ENCOURAGING SELF-DIRECTION AND COLLABORATION

The ultimate goal of education is to produce students who can learn on their own. This is especially critical in the 21st century, a time of rapid technological change, when skills must be constantly learned and relearned. Self-directed learners are efficient at planning and following through without prompting. They know how to identify and use a wide variety of resources and tools. They take appropriate risks and learn from their mistakes.

Methods, goals, and instruments used for self-direction and collaboration used in the Mathematics education:

Project Plans - project plans help student's take ownership of learning. Students identify goals, design strategies to meet goals, create timelines, and define criteria for assessment.

Project plans are usually contracts between students and teachers that describe the components of a project,such as the goals, the process for reaching the goals, a timeline, and criteria for assessment of learning. Plans are either developed solely by the student's themselves or more often with teacher assistance. When the student's has a plan to refer to throughout the project, it helps them monitor their progress, adjust as necessary, reflect on the process, and ask for guidance when needed. This method balances student's choice in their learning with responsibility for expectations.

There are two distinct areas of assessment when using project plans:

- The resulting product or performance that is assessed by the criteria established in the plan
- The student's process of setting up and carrying out the project is also a performance that can be assessed

Initially, students need help setting goals and deadlines for these plans. Goal setting is critical because students need clear targets to measure their performance. Students often set goals and timelines that are too difficult to reach. Facilitate this process by questioning, negotiating, and helping students create feasible plans of action. Also consider modeling learning strategies such as predicting, questioning, clarifying, and summarizing, so that students will develop the ability to use these strategies on their own while they work on projects. Critical questions to ask include:

- What do you intend to learn?
- What strategies and resources will you need?
- What evidence will you produce to demonstrate your learning?
- What will be the criteria for assessment? How will you know you have been successful?
- What is your timeline for completing your learning?

During project implementation, control gradually shifts from the teacher to the student. Some of the benefits of using project plans include:

- Encourages responsible self-directed learning
- Allows for individual pacing
- Targets meaningful tasks
- Provides students with clear goals and expectations
- Fosters self-reflection and self-assessment

Self-Assessment and Reflection: Self-assessment and reflection provide students opportunities to assess their own progress, thinking, and learning and reflect on methods for improvement.

To become capable assessors of their learning, students must have clear goals, the opportunity to help create a definition of quality work, ongoing feedback, and the opportunity to correct or self-adjust their work before they turn it in. Through self-assessment, students become more responsible for their own educational growth; more reflective, autonomous, motivated, and effective.

Self-assessment takes many forms, including:

- Writing conferences
- Discussion
- Reflection journals

- Self-assessment checklists
- Teacher-student interviews
- Rubrics

One effective way to promote self-assessment among students of first year, is asking them to develop personal benchmarks.

When students are able to suggest how to help the learning process and to indicate what activities or instructional strategies are most effective, they become more responsible and actively involved in learning.

Peer Feedback: Peer feedback helps students internalize the characteristics of quality work by assessing the work of their peers.

When providing feedback to peers, students are learning about learning by reflecting on the activities of other students. Students are forced to think analytically about their peers' performance and, in turn, they are able to extend that thinking to their own performance. Peer feedback encourages a greater sense of involvement and responsibility and helps students define what excellence looks like.

It is very important to set clear criteria for students when they provide feedback to their peers. They need to know what to look for in their peer's work.

Observation of Groups: Observation of group work supports assessment of collaboration skills.

The higher economic education is particularly useful allocation of tasks working groups, allowing them to use a variety of thinking processes and strategies.

The following strategies are observed and assessed while students are working together to complete tasks:

Note the content and communication skills while the students are facing some difficulties with the content and help them understand.

Leadership strategy use when the students participate in any of the various roles, and help a group to achieve its objectives.

Negotiation strategies are observed when students present different ideas for the group to consider.

Analyzing strategies are used when students summarize points of discussion, simplify complicated ideas, or put points in perspective.

Negotiating skills are used when the group is asked to reach consensus, a process skill that honors the opinions of all involved to come to an agreed-upon outcome.

Synthesizing strategies are used when students are asked to present work or to facilitate on-going work.

Feedback strategies are used to inform peers or the teacher about the group's process, the task, and other aspects of the group work.

A variety of methods and instruments can be used to assess these strategies while students work in groups, including: questionnaires, checklists, rubrics, and prompts.

10. MONITORING PROGRESS

For better monitoring of progress, teachers at the Mathematics school, use the collection ofinformation on concepts, while students working on projects.

In this regard we use the following methods, goals, and tools for monitoring progress:

Progress Checklists: Progress checklists are necessary where projects require students to meet specific requirements in sequence and on a schedule.

Progress Reports: Progress reports help students to document progress or explain something new in their understanding. A report might be a rough draft, a storyboard, or data summary.
Project Meetings and Conferences Agenda: Project meetings allow for approval or signing off on student's readiness to advance to the next stage or milestone of a project. Use to check progress, maintain commitments in group work, and plan next steps.
Progress monitoring assures that what Mathematics schools are implementing is working. Ongoing progress monitoring is extremely important. The continual collection of data and measurements provides a unique portfolio outlining student needs. Progress monitoring assists school personnel in making decisions about the appropriate levels of interventions provided to students.
The practice of progress monitoring will most likely be unique from school to school as schools have various assessments and intervention strategies already in place. Monitoring progress assists classroom teachers in identifying student performance levels, for example, students who are struggling to make adequate progress. Through monitoring the students' progress using classroom-based measures, the teacher may adjust instructional strategies, curriculum, methods of delivery, etc. to better meet individual student needs.
Gathering classroom or school behavioral data is an example of Tier I progress monitoring. If, through progress monitoring, school personnel determines that appropriate student progress has not been made, the school team would provide or recommend supplemental instructional programs and practices to reinforce skills and improve progress.
When teachers use systematic progress monitoring to track their students' progress in mathematics they are better able to identify students in need of additional or different forms of instruction, they design stronger instructional programs, and their students achieve better.
Monitoring progress is an educational practice by which student learning is regularly assessed and compared to established benchmarks or standards. The goal of progress monitoring is not punitive, but rather is to ensure that students are learning what the objectives of a curriculum have suggested will be taught.

11. DEMONSTRATING UNDERSTANDING

Demonstrating Understanding is made and using the following methods:
Products and performance assessments emphasize what students can do or create, not just what they know. This type of assessment provides information about how students understand and apply knowledge, as well as their thinking and reasoning. Use performance-based assessments to make observations on a student's performance within a specific time frame and setting. Checklists, scoring guides and rubrics are created before the observation takes place and are then shared with students so that they know the requirements or necessary skills in advance and can prepare for them. This allows students the freedom to work on those skills or areas where they feel they might be weak.
When students create products, such as models, presentations, and publications, their work is authentic, resembling the kind of work that people do in real life. A carefully designed product assessment will require critical thinking and problem solving, the deep understanding of relevant concepts and the proficient use of appropriate skills. Product-based assessments also allow students to make some choices about format and topic so they can use their strengths and interests to support their learning.

Effective product and performance-based assessments must address several factors. Determining the purpose of the assessment is paramount to a successful assessment.
Valuable information is gained about how to help students improve when utilizing these performance-based assessment strategies.
Student portfolios are purposeful and organized collections of students work assembled over a period of time that tell the story of a student's efforts, progress, and achievement. Portfolios support assessment of difficult attributes, such as creativity and critical thinking, responsibility for learning, research strategies, perseverance, and communication skills.
Most items in the portfolio are accompanied by reflections which explain why each item is evidence of some significant learning. When undertaking the process of producing a portfolio, students take ownership and responsibility for their learning by establishing ongoing learning goals and assessing their progress towards those goals. We take into account the following elements must be contained in a portfolio:

- An effective solution to a difficult problem
- A creative use of technology to demonstrate understanding
- An application to an out-of-school situation
- A piece showcasing higher-order thinking
- Something a student is proud of
- Something that demonstrates the attainment of a goal
- Something a student enjoyed learning or doing
- Something that shows great improvement over previous efforts (include the first piece for comparison)

Student-Led Conferences: Student-led conferences require students to organize and communicate their learning by sharing their goals, work, self-assessments, and reflections.
Prior to the conference, students must be adequately prepared and provided with guidelines for the conference. It cannot be assumed that students will possess the self-confidence, organizational skills, and communication skills necessary to lead a successful conference. To help students gain confidence, provide students with forms, prompts, and the necessary time to collect, prepare, interpret and reflect on the information they will share with teachers.
Scientific sessions organized by the Mathematics school, offers an excellent opportunity for students to share the contents of portfolios and to explain why each piece was selected for inclusion. Students may indicate specific work that reflect qualities that they have received, such as scoring guides the project work, test results, pieces of writing which shows the process of writing, checklists collaboration, and the number and types of missions that are missing.Developments in e-learning and technologies are creating the groundwork for a revolution in education, allowing learning to be individualized (adaptive learning), enhancing learners' interactions with each other (collaborative learning), and transforming the role of the teacher (from disseminator to facilitator).
Adaptive learning uses technology to assess learners' knowledge, skills, and attitudes at the beginning of online training in order to deliver educational materials at the level most appropriate for each learner. In the online environment of e-learning, adaptive learning is possible through identification of the learner,personalization of content, and individualization of tracking, monitoring, support, and assessment. Adaptive learning is the ultimate learner-centered experience because it individualizes a unique learning path for each learner that is likely to target his or her specific learning needs and aptitudes.

The potential for collaborative learning to break the isolation of learners is realized in e-learning technologies. Advances in synchronous distance education and collaborative technologies like Weblogs, message boards, chats, e-mail, and teleconferencing are making such collaborative learning more readily available. Quantitative and qualitative studies of collaborative learning in economy have shown higher levels of learner satisfaction, improvements in knowledge, self-awareness, understanding of concepts, achievement of course objectives, and changes in practice.

An evolving emphasis within economic education on lifelong learning and competency-based education has forced educators to reevaluate their traditional roles. In this changing paradigm, educators no longer serve as the sole distributors of content, but are becoming facilitators of learning and assessors of competency. E-learning offers the opportunity for educators to evolve into this new role by providing them with a set of online resources to facilitate the learning process.

E-learning refers to the use of Internet technologies to deliver a broad array of learning modes that enhance learners' knowledge and performance. There is evidence for the effectiveness and acceptance of e-learning within the economic education community, especially when combined with traditional teacher-led activities in a blended-learning educational experience. Several digital repositories of e-learning materials exist, some with peer review, where instructors or developers can submit materials for widespread use or retrieve them for creating new materials. The evaluation of e-learning should include a peer-review process and an assessment of outcomes such as learner satisfaction, content usability, and demonstration of learning. Faculty skills in creating e-learning may differ from those needed for traditional teaching; faculty rewards for scholarly activity must recognize this difference and should be commensurate with effort. With technological advancement, the future offers the promise of high-fidelity, high-speed simulations and personalized instruction using both adaptive and collaborative learning. Centers of excellence in e-learning can provide national support for the design, development, implementation, evaluation, collaboration, and sharing of digital e-learning materials. The integration of e-learning into undergraduate, graduate, and continuing Mathematics education will promote a shift toward adult learning in economic education, wherein educators no longer serve solely as distributors of content, but become facilitators of learning and assessors of competency.

CONCLUSION

Finally, to assess knowledge in Mathematics education, we must take into account:

- Be largely performance-based. We need to know how students apply content knowledge to critical-thinking, problem-solving, and analytical tasks throughout their education, so that we can help them hone this ability and come to understand that successful learning is as much about the process as it is about facts and figures.
- Make students' thinking visible. The assessments should reveal the kinds of conceptual strategies a student uses to solve a problem.
- Generate data that can be acted upon. Teachers need to be able to understand what the assessment reveals about students' thinking. And school administrators, policymakers, and teachers need to be able to use this assessment information to determine how to create better opportunities for students.

- Build capacity in both teachers and students. Assessments should provide frequent opportunity for feedback and revision, so that both teachers and students learn from the process.
- Be part of a comprehensive and well-aligned continuum. Assessment should be an ongoing process that is well-aligned to the target concepts, or core ideas, reflected in the standards

Give students a chance to voice their experiences and you and they will find endless rewards in learning from experiences Mathematics.Mathematics education is primarily an approach to teaching and learningthrough these activities and experiences. The common thread is the focus on positive outcomes in personal and social education.

Mathematics education also complements other activities in the broader school curriculum which share some of the same outcomes in personal and social education.

Students are developing their self-awareness and social skills, and their appreciation of the contributions and achievements of themselves and of others.The students you work with:

- overcome their apprehensions to take part in challenging activities,
- want a second go at things they find challenging first time,
- succeed where before they felt they could not succeed,
- feel proud of what they have achieved,
- want to move forward to the next challenge,
- talk openly about their successes, and their failures,
- feel positive about themselves
- display social confidence
- feel they can make a positive contribution to the success of their group or school,
- are able to recognize and modify aspects of behavior that may restrict their own achievements.

Students are acquiring and developing a range of skills in Mathematics activities.They are demonstrating increased initiative, self-reliance, responsibility,perseverance and commitment.

Mathematics Education is seen as drawing on three main areas of Mathematics activities, education of thought and social and personal development. A good outdoor educator may well be focusing attention or one or other of these at any given time but will still be sensitive to opportunities to guide experience within the complementary areas. However, all experience must take place within a framework of safety. Appropriate decision making and the discrete maintenance of a safe environment within which Mathematics experiences take place are a hallmark of professionalism.

It is worth exploring the rationale behind their use as a particular case of experientiallearning. Whilst there are many ways in which such activities are used there is broadagreement that the process comprises most or all of the following elements.

- The educational intention is to stimulate personal and social development. Those who work in this field have learning aspirations for their students beyond physical recreation to the academic, aesthetic, and spiritual, social and environmental.
- The themes of Mathematics Education are all important to some degree in the process, which should not simply be recreational, nor should it take place without at least some experience of the Mathematics.
- The process engaged in is that of learning ‘experientially’. To maximize the effect, theexperience should be direct rather than mediated, with the facilitator acting as a guiderather than in the usual formal capacity of a teacher.

- The result of this approach being applied in the powerful context of the Mathematics is that many report the experience to be effective as a means of personal and socialdevelopment, and in increasing awareness of community.

A number of studies noted earlier provide evidence of positive outcomes from programs which involve experiential learning and new or adventurous activities. Most indicate the key role of choice of appropriate activities and goals, high quality facilitation, program duration etc. Such studies also report modest gains in personal and social skills.

There appears to be an ever-widening gap between the interests and knowledge perceived as interesting by the pupil on the one hand, and the 'knowledge' offered by the school on the other. The logical consequence, namely to ask the pupils about their needs and wishes, their constructions, is only possible in schools to a limited extent. One obvious conclusion is to find places where pupils can experience things directly and make concrete associations. A direct and well thought out analysis of nature and our environment enables us to make individual constructions and deconstructions about things which are created as subjective reality. The individual may ascribe their own interpretative or descriptive values to these constructions and experience them as relevant in connection with their own reality.

REFERENCES

1. Muntean Valerica Doina (2011): *e-Economia*, Editura Cibernetica, Bucureşti.
2. John Boghosian Arden (1999): *A transdisciplinarity approach*, Editura Madison.