

Modular Learning Design: A Modern Curriculum Structure, Including a Teacher Training Plan, Suitable for K-12 Schools, Based on Theoretical and Practical Teaching and Assessment of 21 st-Century Skills

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The European Conference on Technology in the Classroom 2016
Official Conference Proceedings

Abstract

Modular Learning Design is a structure for K-12 schools Curriculums. The designing must happen depends on learning. Instead of making curriculum, unite-lesson plans for learning objectives, transferring information; Modular Learning Design allows and suggests making curriculum for skills. This article explains and examines practical usage by different concepts such as: Goal, Method, Center, Key point, Assessment, Unit Plan, Technology Usage, Flexibility-Modularity, 21.Century Skills and the theoretical foundations of modular learning design, particularly constructivism and constructionism, and notes the similarities and differences among implementations, including project-based science (Blumenfeld, 1991), Understanding by Design (Wiggins, 1996), Learning by doing (Piaget, 1960), Proof upon practice (Skinner, 1945), Assessment and teaching 21st Century skills (Griffin,2011), Zone of Proximal Development (Vygotsky,1962) , Discovery learning (Bruner, 1961), Criterion-Referenced Measurement (Glaser, 1963), disciplined inquiry (Levstik & Barton, 2001). Finally, practical advice and recommendations for modular learning design are discussed, including beginning slowly with the implementation, teaching students to negotiate cooperative/collaborative groups and establishing multiple forms of performance assessments.

MLD proposes a new paradigm for schools to ensure holistic learning of individuals to address 21st century needs of human. This will be an introduction and demonstration of a new curriculum framework designed for students aged 3 to 12 with evaluating 21.Century Skills especially for assessment of 21st century skills with the interactive sample of "Collaborative problem solving"

Keywords: technology, 21 st-century skills, curriculum, teacher training, learning

Introduction

Modular Learning Design is a flexible framework for curriculums in K-12 Education. Purpose of this Design ensure the realisation of lifelong, whole and meaningful learning fits 21 st Century. It accepts the speed of Change, the increasing importance of personal differences and support all modern learning methods as much as traditional, such as: Social Learning (Bandura,1963), Learning by doing (Piaget, 1960), Montessori (1912/1964), Zone of proximal development (Vygotsky, 1962), Bloom Taxonomy (Bloom, 1956) Assessment and teaching 21.Century Skills (Griffin,2011), Understanding by design (Wiggins, 1996). MLD(Modular Learning Design) which use Inquiry-based (Levstik & Barton, 2001) and Discovery-based (Bruner, 1961) consider the speed and immensity of reaching and sharing information and individual learning (lifelong- at the school & outside of the school).

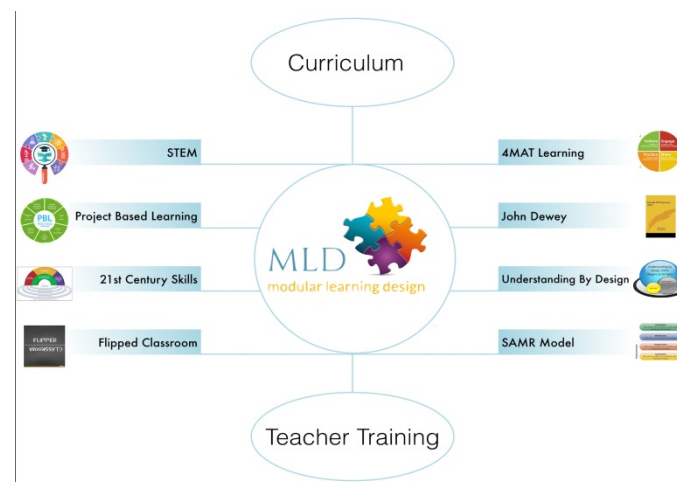


Figure 1: Schema of Modular Learning Design.

MLD aims a learning continuum in a flexible and modular construction according to student group potential and skills, infrastructure of school, timing of the learning, abilities of teacher and technological opportunities. For this MLD accepts learning is a change that have occurred in the life of individuals and offers learning objectives on the curriculum should be real-world engaged. MLD provide this with construction on skills progress. MLD points to kind of skills: Social and Cognitive: Collaboration, Problem Solving, Analysing, Synthesis, digital Literacy, Learning (to learning), researching, memory, Organising, Emotional Intelligence, innovation, creativity, adaptation, changing, learning also include skills referred to as 21. century skills. MLD accepts Learners and teaches are people who have active and variable roles during learning progress and keeps realisation of learning at the whole process.

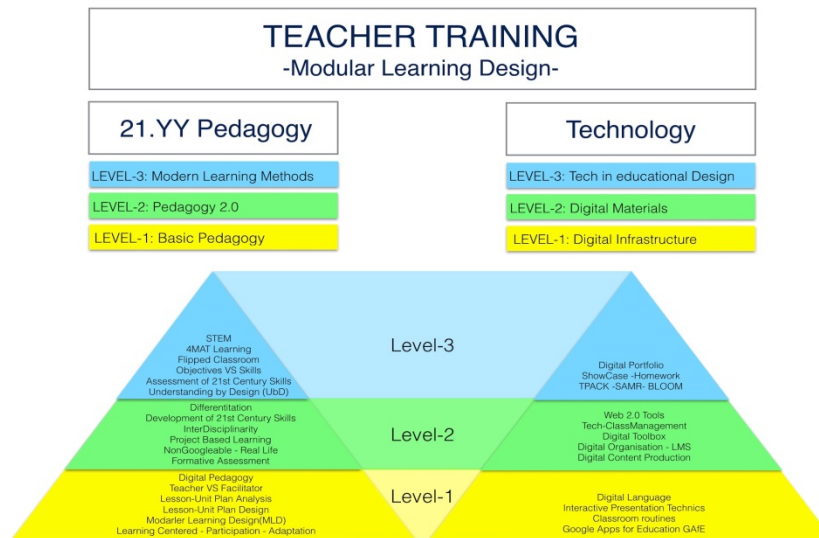


Figure 2: Teacher Training Schema of Modular Learning Design.

When design a program there is an order for instructor: Identify real life production that student will create, Connecting the real life production and learning objectives, Identify tools and skills will be developed, Assessment of the learning process. MLD accepts assessment is a part of learning process by summative and formative styles and for student awareness of learning progress, for the teachers it is a tool for analysis of learning and development of the plan. Technology is a tool in this whole process such as traditional ones for MLD. MLD suggest use of technology when it is necessary within possibilities at the all learning steps in this instruction.

Infrastructures

Goal

To realise a deeper and meaningful learning at 21. Century. To raise young people who can solve the problems that actually humanity have never faced before. To give them skills that they will need when they are in the workforce.

Method

“Tools for Learning Objectives” paradigm is traditional learning aim for the time between 20th and 21st Century. MLD says learning design should start with the point “Learning Objectives for Tools”. Learning objectives (common core, ministry of educations expect from curriculum makers) was the main aim of schools. While we are teaching these objectives we can use some tools such as, researching, debating, discussion, group work, flipped classroom, presenting...

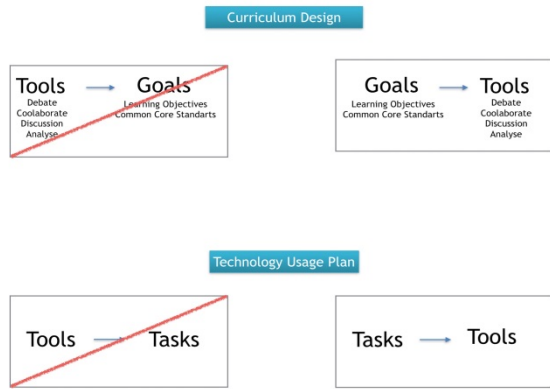


Figure 3: Tools and objectives order.

MLD believes more important one is Tools & Skills, Not the Learning objectives. In the meantime MLD believes Learning is subjective, individualised not objective. About education and cognitive development: the discovery versus instruction principle is a basis of Montessori's (1912/1964) educational methods. Using these methods, a teacher gives no formal instructions but equips the classroom with materials selected to encourage exploratory actions by the children that lead them to discover the principles that the teacher wanted them to learn. Soviet psychologists also endorsed the discovery versus instruction principle. For example, Pavel Blonsky recommended it as a method for school instruction (Kozulin, 1984, p. 131). Discovery has also been a basic developmental principle, perhaps especially in dialectical theories. Examples are Piaget's cognitive psychology (e.g., Piaget, 1970) and Soviet psychology (e.g., Lisina, 1985, pp. 8-9).

Discovery Learning is a student centered method that allows students learning by their observations and activities. (Sözer, 2000, p. 101; Özdemir and Sönmez, 2000 2, p. 63). Senemoğlu (1997, ss. 65- 66) points some practical advices of Bruner's method: Students must learn with their own discoveries. Discovery activity could be in just a lesson or in a whole unit Children must have enough background information which allows to learn new thing connected to that. Students must have a learning environment allows them progress self-paced.

Center

At the center of MLD there is just Learning. Student centeredness or teacher centeredness is not the balance point. MLD say Learning should be at the center of curriculum design. and define roles and responsibilities of teachers and students.

On the each design these can change. Teacher can be a coach on a project then at the next one can be presenter. next one Debate Judge. etc... Also for student, inquirer, researcher, presenter, listener, doer etc. Metacognition, or "thinking about thinking" refers to the mental processes that control and regulate how people think. Metacognition is especially important in project work, because students must make decisions about what strategies to use and how to use them. Marzano's (1998) research of 4000 different instructional interventions found that those that were most effective in improving student learning were those that focused on how students think about their thinking processes and on how students feel about themselves as learners. Constructivist classrooms do more at promoting the children's social, cognitive, and moral development than teacher-centered programs. (Devise & Kohlberg)

Key Points

21st Century Skills are the core of the Design, Social and Cognitive skills: Collaboration, Problem Solving, Analysing, Synthesis, digital Literacy, Learning (to learning), researching, memory, Organising, Emotional Intelligence, innovation, creativity, adaptation, changing, learning.



Figure 4: 21 st Century Essential Cognitive Skills for MLD.

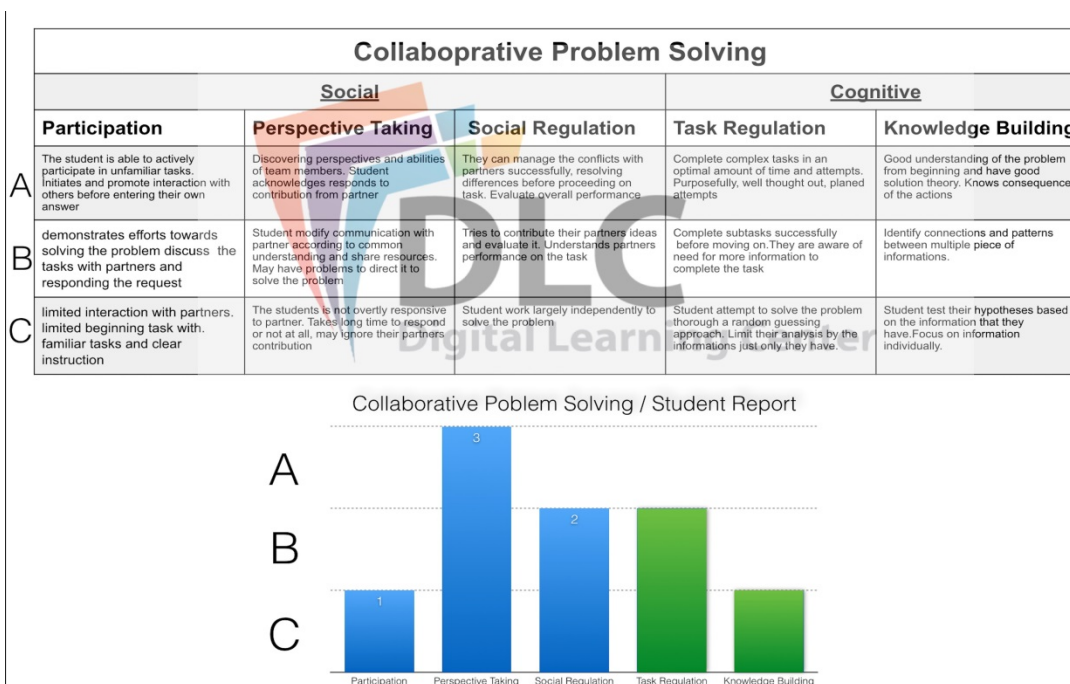


Figure 5: Assessment for Collaborative Problem Solving.

The literature shows that classrooms promoting self-directed learning develop students who are curious and willing to try new things (Garrison, 1997), view problems as challenges, desire change, and enjoy learning (Taylor, 1995). Taylor also found students in these environments to be motivated and persistent, independent, self-disciplined, self-confident and goal-oriented. All of these characteristics support the 21st century skills that students must acquire to be successful in their future endeavours.

Collaborative Problem Solving

Find The red area!

ABCD bir diktörtgen ve BEC daire dilimidir . Kırmızı renkli alanı bulunuz. (Gerekli bilgiler mail olarak iletilecektir.)

Lütfen çözüm için konuşmanızı alttaki kutulara yazınız.

Öğrenci 1 ertuğrul	Öğrenci 2 efehan
A-B kenarı 12	başka bir şey daha lazım mı eşitlik olayı fin
D-E 8 ise E-C 4	bence EC ve BC eşit bu yüzden BC 4 AD 4
E-C 4 ise e eferin varsayımını ele alırsak	DC 12 AB 12 EC 4 BC 4 AD 4
diktörtgenin alanından dairenin alanını çıkartmamız lazım	12.4= 48 olur ABCD diktörtgeninin alanı 48
12.4=48 ise dairenin alanı bulmamız gerek	daireyi bulcaz o zmn EC zaten yarıçap
dairenin alanı pi.rkare	tam olarak düşünürsek dairenin tamamın alanını bulup 4 e bölelim
16.3= 48 dairenin alanı	4ün karesi 16 oğlum benim tarafıma geçme yav .D
48/4=12	güzelmiş kardeşim :D 48 / 4 e böl insanlığı
48-12=36	12 oluyo diktörtgenin alanında 48 ise
E-C İLE B-C eşit olmaz çünkü bu bir diktörtgen	48 - 12= 36 bu kadar easy :D sen ne diktörtgen

KUTLUHAN				
İgbirlikçi Problem Çözme				
	Sosyal		Bilisel	
Katılımcılık	Bağış açısına sahip olma	Sosyal Yönelimlik	Görev Yönelimlik	Bilgi İnşası
Öğrenci alışık gelen çözüm yollarını görece aktif olarak kullanabilir. Kendi cevabını vermedikçe diğerleri ile etkileşimi teşvik eder, başlar.	Arkadaşından gelen çözüm yollarını değerlendirir veya geliştirir. Arkadaşının farkındalığına göre iletişimi teşvik eder, yönlendirir.	Öğrenci başkanı olmasın hareket etme, anlaşmazlıkların üstünde durma, görevi yerine getirmeye yönelik davranışlar sergiler. Arkadaşlarının performanslarını değerlendirme eylemlerini gerçekleştirir.	Verilen karmaşık görevi eleştirir, sürede ve geçeri sayısında derinleşir ve sistemli bir şekilde ilerler. Karşılaştığı problemleri çözme için gerekli bilgileri toplar, planlar oluşturur ve bunları uygulamaya geçirir. Bilgi ve becerilerini kullanmaya çalışır.	Problemi baştan sona ele alır ve soruyu çözmek için anlamlı bir öneri sunar. Yapılacak hareketin bir deneme olduğunu söyler. Öğrenciler buldukları yeni bilgiler veya denemeleri işığında problemlere yeni çözümler üretir.
Sorunu çözmeye yönelik diğerleri ile tartışmaya katılır, sorularına cevap verir, çabalarını gösterir.	Arkadaşları ile fikir alışverişinde bulunur ve diğerleri ile tartışmaya katılır. Katılma rolünü çözüme yönelik hareketle destekler, yönlendirir.	Karşısındaki diğerleri ile fikir alışverişinde bulunur ve diğerleri ile tartışmaya katılır. Katılma rolünü çözüme yönelik hareketle destekler, yönlendirir.	Karşısındaki diğerleri ile fikir alışverişinde bulunur ve diğerleri ile tartışmaya katılır. Katılma rolünü çözüme yönelik hareketle destekler, yönlendirir.	Mevcut bilgileri bir araya getirip analiz eder, başlangıç ve sonuçları karşılaştırır. Öğrenciler sahip oldukları mevcut bilgiye dayanarak oluşturdukları çözümleri tartışır ve tartışmaların sonucunu değerlendirir.
Diğerleri ile sınırlı katılım gösterir. Genelde açık yönlendirmeler ve tartışma rolünü üstlenir, kendi başına çözmeye çalışır.	Arkadaşlarının taleplerini ve önerilerini dikkate alır. Kendi çözümünü diğerlerinden bir şekilde öğrenmeye çalışır.	Çözümleri başlatarak hareket eder. Kendi çözümünü arkadaşlarına aktarabilir.	İstenen görevi tamamlama sürecini yönetir. Sorunu analiz eder ve çözüm için gerekli bilgileri toplar. Deneme yapar ve sonuçları değerlendirir. Problem anlamazsa çözmeye çalışmaz.	Verilen görevin küçük bir parçasını çözmeye dener. Başta bir fikirten başlayarak çözüme ulaşmaya çalışır. Çözümü doğrulamaya çalışır.

Figure 6: Online Collaborative Problem Solving Example.

Technology

Technology is a major tool for support to realise self learning, researching, organising, archiving, creativity. Today's K-12 students are very different from even their recently graduated peers. These students are digital natives, a term attributed to futurist Marc Prensky to distinguish between those who have grown up with technology and those who have adapted to it [Prensky, 2001] Platform-free or device-free is the ideal way to support. But technologic developments will affect that strongly. In that case Institutes must decide that according to their case. To choose BYOD or 1-1Tablet or just a Computer Lab etc... SAMR Model is an important rubric for integrating technology into learning tasks.

TPACK is an n important tool for defining teachers role during the learning process. Technology implementation should be according to Classroom and learning routines. It must support learning circle: Background information, introduction, delivery-lecture-learning, student reflection - sharing learning outcomes, assessment, feedback, revision.

Flexibility-Modularity

Learning process must let student progress self pace and support them individually. Curriculum makers provide options for different needs. According to Students groups, learning objectives, time of the year, location geography, culture, technological infrastructure, economic realities, common core standards, school and family

expectations and Local-national-international exams; Learning design should allow changes and flexibilities about parts, assessments, timing and progress.

Unit Planing

Backward Planning is also the important part of the designing. Students must involve and shape the project parts; Goals, aims, targets, rubrics, success criteria, skills they will develop.

Learning Objectives: Graphs of quadratic equations, understanding of the symmetry axes of parabola, finding the equation of the graph given, extreme points

Lesson:	Mathematics	Product	Learning Activities	Background Info	Intro	Reflection
Class:	Grade 10 (50 Students)	Students create catapult that works based on instructed. (Test, improve evaluate, create)	1) Video analysis of basketball shots 2) Investigating real life parabolas 3) Statistics of catapult shot trails. 4) Mathematical explanations of parabolic movements	Factorizing, simple equations, Linear equations	Basketball shot guess with slow motion video activity	Video Journal of the production Catapult working capacity
Subject:	Quadratic Equations					
Duration:	4 weeks					
Technology		Vernier for testing catapults	Desmos, FreeGraCalc, Google-research-analysis, Nearpod-presenting	Nearpod for self reflection of students	Video analysis with Vernier Physics, Graph with Desmos	imovie
Modern Learning Theories	Collaborative problem solving		Pencil, eraser, ruler			
	Flipped Classroom	Create scaffold at home			Watch videos	
	Project based Learning	PBL	PBL	PBL	PBL	PBL
	Challenged based Learning	best basketball shot?				
SAMR Integration	STEM					
	Understanding by design	UBD	UBD		UBD	
	•Substitution		Google - Encyclopedia	Book - nearpod		
	•Augmentation		freegracalc - TI calculator			
4MAT Learning (Student)	•Modification				desmos-analysis video	
	•Redefinition	Vernier - Throw movement	vernier - movement analysis			
	•Engage (WHY?)	Why we test?		What we need?		
	•Share (WHAT?)	How we produce?	How we design?			How we can show?
Individualised	•Practice (HOW?)					
	•Perform (IF?)					
	•Interdisciplinary	Geometry - Vectors	Physics - Throws, dynamics		History - Armies - Weapons	
	•Advanced Students	find the lowest basket shot		degree of the equations	Angry birds and rockets research	
Assessment	•Support needs	Make a catapult just throw something			repeat secondary equations, factoring	
	•Formative		quiz for basket shot equations	quiz for background info	(Homework) parabola at home	slow motion movement analysis
	•Summative	Catapults test results	describe movement with equations			
	•Creativity	production	design		connections - real life	description
21st Skills	•Critical Thinking	evaluation of product				
	•Communication		designs and decisions			
	•Collaboration	Production jobs				Production movie jobs
	•Problem Solving	Test and Improve			real life connection	

Figure 7: Unite Plan Example / Mathematics / Grade10.

Learning Objectives: Digital citizenship, cyberbullying, cybersafety, digital laws, copyrights, citation, digital profile

Lesson:	ICT	Product	Learning Activities	Background Info	Intro	Reflection
Class:	Grade 5 (40 Students)	Students will create schools Wikipedia Page	1) Create online platform to create a webdesign. 2) Get the efficient (Informations. 3) get the resources. 4) Become a wiki-writer 5) Publish it.	Wikipedia, MIT Wikipedia, Edit a page, digital share and collaborate	Students check schools current (old) Wikipedia page, and let them see somebody hacked it. How did it happen?	They will choose a way to show how they did it to other schools
Subject:	Digital Citizenship					
Duration:	6 Weeks					
Technology		Grammarly for citation	Google sheets for pre-web design	Google Chrome and Drive	web: digital citizenship, wikipedia	imovie, Explain everything, bookcreator
Modern Learning Theories	Collaborative problem solving		How to edit wikipedia		Research who did?	
	Flipped Classroom					
	Project based Learning	ProjectBL	ProjectBL	ProjectBL	ProjectBL	ProjectBL
	Challenged based Learning					
SAMR Integration	STEM		How do you secure a web?			
	Understanding by design					
	•Substitution	Grammarly-teacher				
	•Augmentation		GoogleSheets - collaboration			
4MAT Learning (Student)	•Modification		Manage the school page		Create the schoolpage	
	•Redefinition					
	•Engage (WHY?)		What we put as content?			
	•Share (WHAT?)		How to edit?			
Individualised	•Practice (HOW?)				What if somebody hack again?	
	•Perform (IF?)					
	•Interdisciplinary	Interview - Literacy	Create your own Language version - MFL			
	•Advanced Students	Adding picture and video?	How many people visit school wikipedia?			Prepare a presentation for other grades
Assessment	•Support needs			Drive Share rules	Become Wiki-Writer	
	•Formative	Working collaboratively in digital rules	Grammar check			
	•Summative	Website is proven by Admin	Grammar check			peer assessment - job completion
	•Creativity				webdesign	
21st Skills	•Critical Thinking					
	•Communication					presentation
	•Collaboration		research		webdesign	
	•Problem Solving					

Figure 8: Unite Plan Example / ICT / Grade5.

Before process start, students must know what they will learn, which skills they will try to develop, what are the success criteria and what are the assessments. Real life production that student will create: First start find a product that student will create for the Unit. This product should be anything related subject and observable on the real life of student.

Connecting the real life production and learning objectives: Design learning process according to learning objectives and production process together.

Identify tools and skills: Identify which skills and tools will need and develop.

Assessment of the learning process: Adjust formative and summative assessments on the progress steps.

Assessment

Assessments should give feedback to people who responsible for learning. teachers should evaluate their role and Plans for unit and lessons for complete the learning and fixing the rest of the plan also redesigning for future.

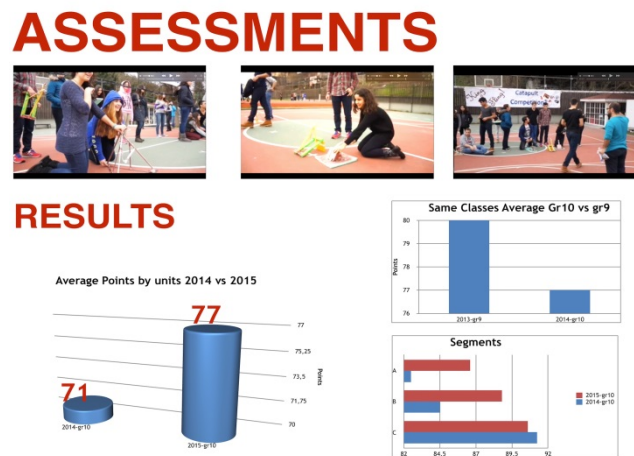


Figure 9: Assessment examples and results.

And students evaluate their learning according to targets and move on for self pace, get what they need and self organise. Assessment should be a part of learning process. And motto about it “What do you assess is actually what you teach” What type of knowledge is being assessed: reasoning, memory, or process? (Stiggins, 1994)

Self assessment - reflection: After finishing the project, students need to reflect on the strengths and weaknesses of their work, make plans for improvement, and integrate the assignment with previous learning (Paris & Ayres, 1994; Stiggins, 1997; Wiggins, 1998). Students’ self-assessments are an essential part of guiding instruction because they provide further evidence of student efforts and achievements. Self-assessments improve communication because students become aware of areas in which they are having difficulties and are better able to articulate their needs (Kulm, 1994). Interviews are better than traditional assessment methods for determining students’ reasoning and level of understanding, Interviews allow for the direct response to students’ misconceptions and errors (Moon and Schulman, 1995; Stiggins, 1997).

Students Collaboration

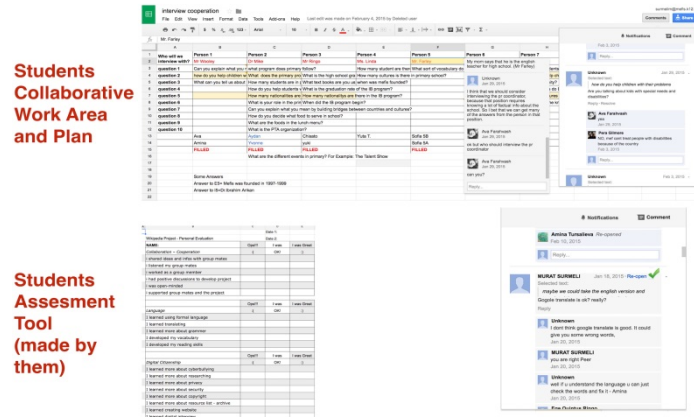


Figure 10: Online Collaboration sheet and self assessment tool from students.

Here some practical examples and essential questions about self-learning for elementary and middle school students: With this project I learned... I was good at (students must create a concept map here as a variation) I was good at How well did i work with others in my group? I can't figure out..., It was really hard to.... What do I want to know more about? I still have questions about.... I am curious about If i do the same activity next time i change....

Positions and responsibilities of student and teacher

Teacher is not just a resource of information. And learning process is not an information transfer process. Teacher positions mostly: facilitator, coach, judge, presenter, supporter, guide etc. depends on the unit and learning approaches. Student roles: doer, researcher, project manager or presenter etc. depends on the unit and learning approaches.

CLASSWORK

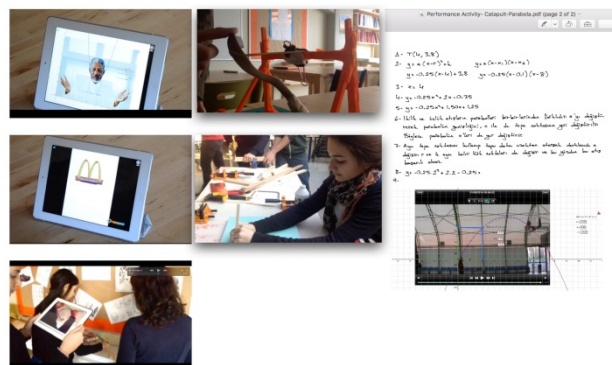


Figure 11: Classwork examples about real life learning.

MLD use 4MAT Learning style for defining roles of student and teacher. It has essential questions by student. The 4MAT Model, that humans learn and develop through continuous, personal adaptations as they construct meaning in their lives, is

derived from the work of John Dewey, Carl Jung and David Kolb. And the essential connectedness of knowledge and experience can never be omitted without consequence to the development and individuality of the learner.

Fundamentals

Constructivism (Perkins, 1991; Piaget, 1969; Vygotsky, 1978) explains that individuals construct knowledge through interactions with their environment, and each individual's knowledge construction is different. So, through conducting investigations, conversations or activities, an individual is learning by constructing new knowledge by building on their current knowledge. Constructionism takes the notion of individuals constructing knowledge one step further. Constructionism (Harel & Papert, 1991; Kafai & Resnick, 1996) posits that individuals learn best when they are constructing an artefact that can be shared with others and reflected upon, such as plays, poems, pie charts or toothpick bridges. Another important element to constructionism is that the artefacts must be personally meaningful, where individuals are most likely to become engaged in learning. Also Project-based learning allows in-depth investigation of a topic worth learning more about (Harris & Katz, 2001) such

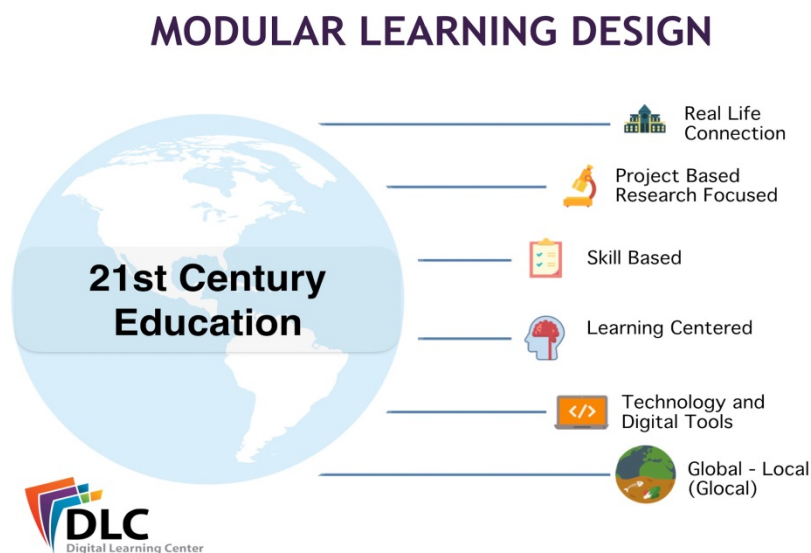


Figure 12: 21 st Century Education Concept for MLD.

as problem based learning. Through the construction of a personally-meaningful artefact, which may be a play, a multimedia presentation or a poem, learners represent what they've learned (Harel & Papert, 1991; Kafai & Resnick, 1996). In addition, unit, project, problem or product based learners typically have more autonomy over what they learn, maintaining interest and motivating learners to take more responsibility for their learning (Tassinari, 1996; Wolk, 1994; Worthy, 2000). For example at project based learning, with more autonomy, learners "shape their projects to fit their own interests and abilities" (Moursund, 1998, p.4)

Lave and Wenger (1991) argue that learning should not be viewed as simply the transmission of abstract and decontextualised knowledge from one individual to another, but a social process whereby knowledge is co-constructed; they suggest that

such learning is situated in a specific context and embedded within a particular social and physical environment

Differences

MLD define “learning, understanding, perceive, realise” different. Learning should give a reflection on real life of a person. High-Fidelity of assessment, tasks, reflections. Students must work on the tasks actually based on real life conditions. results should affect life. MLD doesn’t suggest make educational approaches to create a learner profile. MLD support individual development of students as who they are with their all differences. A presentation, play or poster is not enough to understand real learning realised.

What is new

(Teaching-Learning-evaluating Skills): MLD believes we can observe all the behaviours if we have the skills and sub-skills and define them, then develop and assess. Schools should give report at the end of the semesters, Academic and skills on a developmental continuum bases.

Conclusion

Current technology integration process in education substitutes tools in the classroom and changed the way pupils reflections about learning, however woefully lacks the aspects which technology can be useful in the whole learning progression, especially, analyse, deciding, applying, collaborative working, peer learning; shortly, when learning is happening. This presentation proposes a new paradigm for schools to ensure holistic learning of individuals to address 21st century needs of human. This will be an introduction and demonstration of a new curriculum framework designed for students aged 3 to 12: Modular Learning Design (MLD). With collective rich experience of several years and teachers have experienced Modular Learning Design personally. This new education will achieve: -Pupils ready with values, perception and skills for using their aptitude to effectively use technological advances meaningfully. -Differentiated and productive education -Learning-centered education -High-fidelity in education -Skill based development on individuals -Readying Gen-X to be able to lead and mentor Gen-Y for realising their full potential. -Evaluating 21.Century Skills With this presentation participants, will get the examples of unit-lesson plans, digital materials and students works designed by Modular Learning Design. Participants can join the activity for assessment of 21st century skills with the interactive sample of "Collaborative problem solving"

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