

THE DEVELOPMENT OF MULTILITERACY WITH LEGO DEVICES

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Abstract: In the digitalised school of the future students and teachers are connected to a network with digital devices while simultaneously maintaining the cognitive perspective of the printed culture and the attitudes required by the information-based society. This duality manifests itself in the phenomenon of multiliteracy impacting the very concept of literacy as well. We aim to explore how has multiliteracy influenced the teaching and learning process in today's schools while identifying the main features of education in the information-based society and examining the potential of multiliteracy in enhancing the effectiveness of the knowledge acquisition process. LEGO device-supported story-telling can provide such opportunities. Various schools in several countries encourage teachers to strengthen the playful aspects of learning and prepare the related educational materials. This gamification-oriented approach helps teachers to increase student involvement in designing and solving the respective assignments. Thus, the process emphasizes the nurturing and not the suppressing of the playful attitude in children.

Keywords: multiliteracy, LEGO, competence, story-telling, gamification

1 Introduction

Digital schools require a digital methodology in order to reflect the basic principles of digital pedagogy forwarded by the education community. The digital competence of teachers promotes the efficiency of the instruction process utilizing transversal competences. Consequently, it not only means the shifting of traditional instruction into a digital context, but calls for a new perspective and methodology. Comparing the educational process in the industrial and information-based society, Bertalan Komenczi (1999) asserts that before the emergence of the world wide web and the social integration of digital technologies ready-made solutions and the transmission of closed knowledge units dominated, while current education practices emphasize competence. Therefore, in addition to formally acquired knowledge learning takes place throughout life and in extracurricular contexts while the dividing

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line between leisure time, work, and learning is blurred. In the industrial society the source and acquisition of knowledge was restricted to the schools, the education was subject matter and teacher focused, and frontal instruction played a dominant role. Conversely, contemporary learning emphasizes the use of on-line sources in an inspiring learning environment in which knowledge is independently acquired via individualized learning routes.

2 The concept of multiliteracy

The 2014 curriculum reform radically altered the system of key competences in Finland by introducing transversal (cross-curricular) ¹ competences. The most significant aspect of the curricular reform is the shift from learning objectives to more comprehensive competences exceeding the framework of the school.

This perspective introduces the concept of multiliteracy entailing versatile reading and writing skills both in the context of native tongue and foreign languages. This basic competence known as communication competence in Estonia implies the comprehension, composing, and evaluation of written, oral, or multimodal texts in the Finnish context appearing in a well-developed textual environment. (Kiili és Eskelä-Haapanen, 2015 quoted by Racsco, 2017).

Consequently, students can interpret or comprehend the surrounding world easier along with understanding cultural diversity by relying on the skills of critical thinking and self-regulated learning. By creating various printed, analogue and digital texts they can express or articulate themselves better helped by the tools of digital literacy providing solutions which they are familiar with.

¹ The concept of transversal competence has already appeared in the 2012 declaration of the European Commission titled "Let's reconsider the education process". (European Commission, 2012 qtd. by Racsco, 2017) Accordingly *"transversal competences including critical thinking, initiative, problem solving, and collaboration prepare individuals to cope with the diverse and unpredictable development of current careers. Special attention should be paid to the improvement of entrepreneurial skills."* Svecnik (2012 quoted by Racsco 2017) emphasizes that the European Union considers or uses the term 'transversal competences' in a cross-curricular sense.

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3 The impact of the culture shift on the individual

The current digital revolution radically transforms human capabilities. As Bruner (2004) asserts cultural changes have a direct impact on individual skills as the operation of the human mind depends on the availability of the respective devices. In our case the emergence of the computer and smart devices are the basis for such changes. (Racsko, 2017).

It is important to know, however, that computerised devices only create the conditions for the maximization or realization of the potential of the human mind by multiplying the combination capability and options of the human brain. (quoted by Z. Karvalics 1997 after Lima and Piaget). At the same time such devices transform the functioning of the brain in several areas as well.

Technological improvements of the digital age increased the speed and carrying capacity of information transmission based on spatial and visual stimulation. Thus instead of profound interpretation of or immersion in readings, the memory only records impressions. This results in weakening reading comprehension while conceptual thinking is superseded by a thought process dominated by ready-made images. (Gyarmathy, 2012).

In other words the virtual world fosters virtual skills since experiences are acquired in a passive manner as digital technology makes active corporeal and neural participation along with several traditional skills unnecessary.

Thus the subsequent drastic decline of reading comprehension skills in the digitalized world calls for unprecedented methodological solutions. Taking advantage of the motivational and cognitively beneficial aspects of playfulness assured by LEGO® devices can be such an option.

The LEGO® company was established in 1932 (the name originates from LEG GODT meaning "to play well") and launched the LEGO® EDUCATION program in 1980. The LEGO® EDUCATION offers a complete methodology for the development of crucial 21st century competences (textual comprehension, algorithmic thinking) and soft or social skills implying communication, responsibility, and team spirit. Presently, more than 60 countries including Germany, China, Peru, and Singapore apply the methodology of the LEGO® EDUCATION.

4 Learning in the information-based society

By now the prevalence of computers and info-communication technology has made autonomous learning, knowledge acquisition, and the establishment of individual learning routes ubiquitously available in our complex world. Some of these new methods can be integrated into public education. Thus gamification can be a playful form of knowledge monitoring in classroom context

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while the emergence of digital storytelling resulted in the shifting of group work or project assignments into an interactive on-line environment. Simultaneously with the dominance of on-line communication and media the traditional obstacles or barriers are gradually being eliminated in the learning and teaching process leading to more experimentation and system-wide changes. As a result of the integration of info-communication technologies into everyday life the mechanism of information acquisition, teaching, and learning has radically changed (Molnár, 2015).

5 Gamification in education

Gamification can be considered more as a methodological component than a full methodology. The educational use of gamification aims to convert learners from passive receivers of information into active and interactive participants in the learning process. Prior to the emergence of the information-based society several attempts were made to increase the playful aspects of education including serious games, edugames, or games developed exclusively for instructional purposes. Such developments laid the foundation for game-based learning eventually leading to gamification.(Szűts, 2019). Most people do not play for results, rankings, or points, but simply want to enjoy the game. Gamification can be most effective in a classroom context in which the appropriate technological conditions are available and teachers possessing high digital competences can pay adequate attention to the integration of such approaches into the teaching and learning process (Dicheva and associates, 2015).

6 Digital story telling

Similarly to gamification digital storytelling is also a methodological component and not an independent methodology. It is based on the establishment of learning-related content during which students tell a given story from their own point of view via the help of info-communication devices and digital platforms either individually, in pairs, or in group work. The creation of narratives in the environment of digital story telling integrates new aspects into story telling. According to the classic theory the reader has to start from a point identified by the writer and has to arrive at another specified point in a linear manner. Vilmantė Liubinienė and Saulius Keturakis assert that narratives have always played a major role in cultures and learning as well (*Liubinienė and Keturakis, 2014*). Their purpose was to preserve traditions and pass them on to the future generations. Narratives also offered moral comment and consequences, explained past events, and provided a direct, hands-on or personalized experience for the listener. Readers can enjoy

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these narratives as they are linear and linearity can express the world it wishes to describe in an ordered and stable manner.

7 Integrating the LEGO® perspective in education

"Imagine that you can be a teacher in a school where your main responsibility is to come up with ways to improve the playfulness of students, and where the most important part of preparing for the class is to develop the playfulness of the subject matter." (Thomsen, 2018)

While several schools in various countries have adopted this perspective, the promotion of playful learning is a crucial component of the educational philosophy of the "LEGO® schools" in Denmark where teachers strive to involve students in designing and solving the given tasks.

The primary objective is increasing playfulness in children instead of extinguishing it and this playfulness should be the foundation of the whole system. Furthermore, students must learn to make mistakes and integrate the respective experiences into the problem solving process.

Open ended assignments offering several ways for solving the given problem are prevalent. (i.e. Students are given a package of a pre-determined number and colour bricks and are instructed to build a duck. The solution illustrates that there are no two identically appearing constructs but all solutions are correct.)

Teachers play a key role in promoting the realization of educational goals with playful means. They are responsible for continuously searching ways to integrate games into the learning process. In order for an institute or school to become satisfied with the work of the teacher the latter has to demonstrate that he or she can incorporate games in the learning and teaching process in a "continuous" manner.

Thus instead of frontal instruction this approach calls on the teacher to become a facilitator or moderator – assisting and not directing the students.

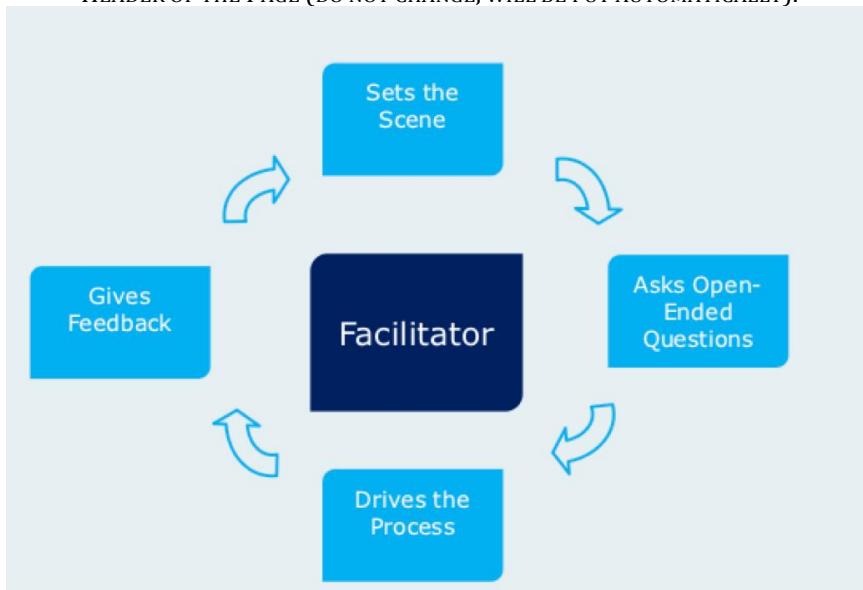


Figure 1. (based on: Thomsen, 2018) The components of changing teacher roles (Facilitator, presentation of topic, developing open-ended questions, controlling and monitoring solutions, providing feedback)

Evaluation is an important aspect of the learning and teaching process. In Denmark teachers are provided continuous feedback on their work and the assessment of educational performance, usually carried out by the school principal, is crucial. One form of assessment is a discussion during which the educator evaluates his or her performance with special attention to the introduction of playful elements into the teaching process.

In addition to providing feedback to teachers student evaluation is also a significant component. Teachers continuously document and record the students' academic progress. Every six weeks they invite the parents and introduce them what their children learned during the given time. It is important that parents understand that this is a different type of instruction. Demonstration lessons help to show parents how their children's skills improved.

Naturally this type of perspective has not been innately adopted by all educators and schools in Denmark as not all schools are LEGO® schools. Consequently, in order to learn how to implement this perspective or philosophy

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most effectively teachers participate in continuous training programs. Playfulness and gaming as an other requirement for success should be continuous among teachers as well.

8 Pedagogical models in the LEGO® philosophy

Learning with LEGO® bricks should be considered a holistic experience as it contributes to the development of several skills in a simultaneous manner:

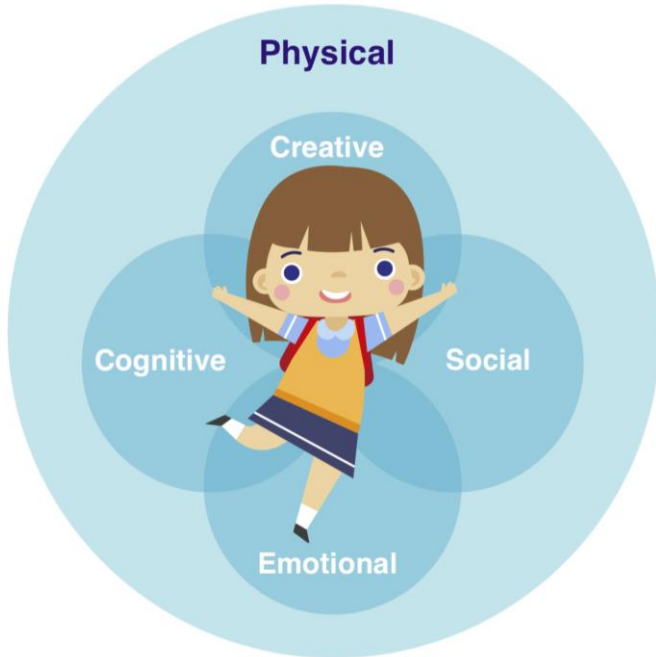


Figure 2. A holistic approach to learning (Source: Lego Foundation 2020) Physical skills, Creativity, Social Skills, Emotional skills, Cognitive skills

According to the holistic approach to learning model the knowledge acquisition process can be described by the 4C scheme (Connect, Construct, Contemplate, Continue). The creative, cognitive, social, and emotional aspects of learning guarantee skill development and a deeper integration of the subject matter into the learner's thought process.

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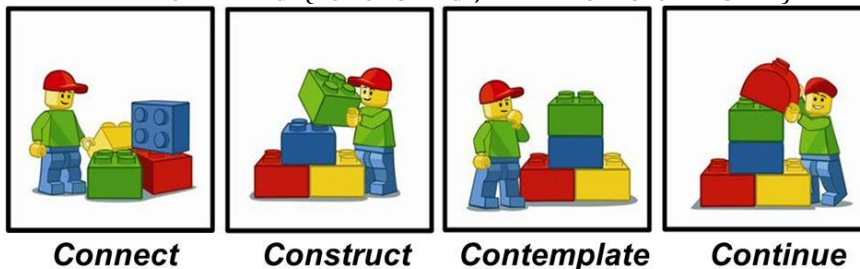


Figure 3. The components of the 4C model (Source: Joosten, 2018)

Connect (establish connection): The task design should utilize the curiosity of students, and teachers should assign tasks that are motivating and relevant to the earlier experiences of students.

Construct (build): The construction or compilation of the given task enables learners to gain hands-on experience. This is the active, learning, or constructive stage of the process providing students with the opportunity of constructive or action-based learning. The involvement of their hands into the solution of the given task compels students to a more active thinking.

Contemplate (development of perspective): If students summarize what they learned during the construction process and the given conclusion is not drawn by the teacher then students can develop their skills in composing constructive questions. Teachers should encourage students to answer the questions and draw the conclusions themselves. Students should share the new knowledge and task-related experiences with each other.

Continue (carrying on the activity): In order to provide challenges to students the knowledge and skills acquired during the first three steps should be integrated into a new task. This will help them to fortify and solidify their knowledge and skills along with achieving and maintaining the Flow experience. Problems and assignments with open ended questions or requiring creative solutions can help them to reach the fourth "C" step.

Surveying the cognitive areas impacted by learning with bricks leads to the conclusion that this activity significantly engages both the left and right hemisphere of the brain. Therefore it contributes to the equalization of cerebral hemispheric dominance forming a bridge between the analog and virtual world at the time of a cultural paradigm shift brought on by digital transformation. (Gyarmathy, 2012)

Gradual task processing focusing on relations and detail, or in case of sequential functions including speech, writing, reading, counting, logic and skills

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related to appropriate fitting of parts are regulated by the left hemisphere of the brain.

The right hemisphere of the brain helps in comprehensive and simultaneous processing of information. along with providing for spatiovisual skills, musical comprehension, imagination, and humour. Furthermore, the composition of the whole from the parts belongs to this field as well.

We illustrate below how working with LEGO® (i.e. rendering a brick-based version of a story) requires complex and comprehensive activities engaging both hemispheres of the brain.

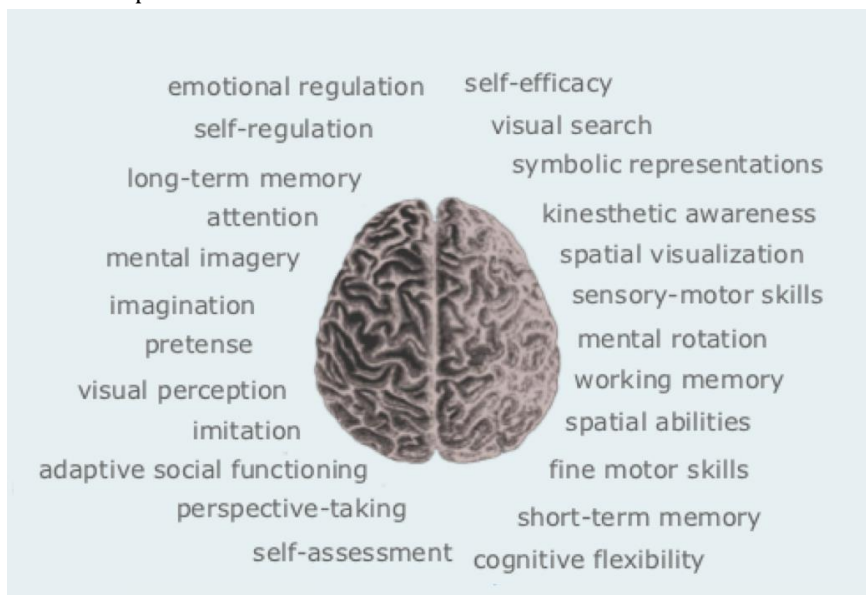


Figure 4. Activities to be carried out by LEGO® and the cognitive areas that can be improved (based on: Thomsen, 2018)

spatial skills, adaptive functioning in community, perspective-based vision, short term memory, mental rotation, work memory, peripheral vision, discipline, imitation, attention, fine motor skills, flexible thinking, kinesthetic awareness, self-evaluation, emotional regulation, self-regulation, self-efficiency, long-term memory, attention concentration, mental imagination, visual perception, visual search, symbolic thinking.

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The first area is physical skills, primarily referring to fine-motoric activities but it also includes sense of balance, coordination of movement, and spatial or peripheral comprehension.

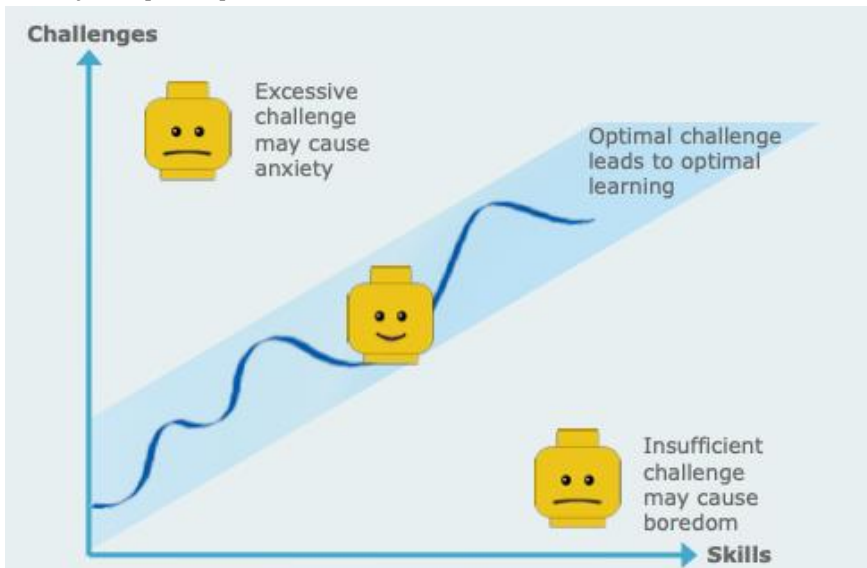
Furthermore, it develops social competences including collaboration, communication, understanding others, the acceptance of new perspectives, observing the rules of communication, conflict resolution, and empathy.

The other area is the development of creative skills implying openness to new developments, new ideas, perspectives, creative use of devices, mental representation, transformation of existing ideas, cognitive association and the use of symbols.

The third aspect entails emotional (soft) skills including self-confidence, trusting others, self-control, thinking, persistence, empathy, ability to express oneself, regulation of one's emotions.

An important component of this philosophy is the achievement of the flow experience during which *"[...]the individual gets immersed in an activity, which overshadows everything else, and the given experience becomes so enjoyable that the person wants to continue the activity at any cost, just for the sake of the given action"* (Csíkszentmihályi, 2001. p. 11.)

The flow experience frequently accompanies playful activities implying the expectation of an optimal performance to promote optimal level of student activity and participation.



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Figure 5. The FLOW level in the learning process, the optimal proportion of challenges and skills can facilitate the achievement of the FLOW experience.

(Source: Egles, 2012)

Excessive performance expectation leads to anxiety.

Optimal performance expectation leads to optimal learning.

Lack of a sufficient challenge makes the task boring.

It can be concluded that activities performed in analog and digital contexts, that is, creative construction and compilation of content, along with digital storytelling implying further consideration of a situation in a digital context represent the highest, or creative level of the Bloom taxonomy (1976).

The effectiveness of the method is illustrated by the Dale pyramid or experience cone model (1969). Accordingly, dramatization, the simulation of reality, and the obtaining of real experience increase the depth and efficiency of learning. Research indicates that 90% of what was said and done could be recalled within two weeks.

9 Introducing the LEGO® StoryStarter

The StoryStarter is a LEGO® set designed for educational purposes containing special building blocks, stickers, and a parts catalogue assisting classroom management.

The use of the elements of the StoryStarter helps students to re-interpret real life situations, literary works, and various narratives. Their stories can be recorded with modern ICT devices into their own digital narrative while constructing characters, designing comic strips, and films accompanied with subtitles or narration. The StoryStarter package containing carefully chosen LEGO® parts includes selected characters, animals, accessories, devices, basic bricks, buildings, and sheets for the creation of no more than five scenes.



Figure 6. The library of secrets A part of a story enhanced with digital solutions
(In 3008 three good friends solve a school assignment with 21st century methods during a special trip in the library of secrets.)

The LEGO® Story Starter is a unique creative learning device expanding the knowledge of students while allowing them to experience the joy of creation and story telling.

The StoryStarter involves students in the educational process and motivates them to use their imagination during the formation of the characters and the stories. Storytelling is an effective device for improving writing and reading skills and encouraging students to communicate with self-confidence. The method promotes comprehension, strengthens fantasy and creativity and helps students to realize or carry out new innovative ideas.

Furthermore, students can gain experience in describing characters, the composition of dialogues and the shifting of the stories into a different historical age or venue.

The stories are constructed along Laswell's (Wenxiu, 2015) 5 W model. The plot and then the full story emerge from the given parts including the bricks and the answers to the following questions:

- Who? Who are the characters?
- Where? Where does the story take place?

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- When? When does the story take place?
- What? What happens in the plot?
- Why? Why does it happen?

The StoryStarter method helps students to communicate with self-confidence in various situations, to break the stories into different parts and reconstruct them while improving speech and reading comprehension and reading and writing skills. Consequently, students will be able to analyze the characters and scenes of stories along with identifying the given genres, recognizing the respective features and applying digital technology in a creative manner.

The LEGO® StoryStarter supports the development of native tongue-related competences primarily reading and textual comprehension, and text creation along with the development of abstract and critical thinking typical of adolescents of secondary school age.

Digital storytelling in practice

In addition to integrating the students into a playful process the educational application of the LEGO® Story Starter increases task solving motivation while functioning as a device or medium supporting communication. The diverse assortment of figures promotes thinking and can launch the story creation effort. The methodological solutions described earlier direct the process while guaranteeing the fulfilment of the given educational goals. This method has proven to be useful to promote independent text creation along with processing the reading of literary works and the elaboration of alternative conclusions to the stories. Furthermore, the method helps in promoting the awareness of composition structures and the analysis of genre-specific features for the upper level elementary and secondary school students.

In addition to their capability of promoting creativity the LEGO devices play an important role in supporting the development of digital competences. Value creation in digital culture includes digital literacy implying the effective use of a wide variety of digital devices, conscious use of digital sources, communication and making media products (Lengyel-Molnár, 2016).

After constructing one or more episodes of a story from LEGO components, and depending on the age of the students, the work is digitalized, still and motion pictures are prepared and with the help of an age-appropriate digital comic strip preparation software the participants make their own comic strips or e-books. The story components displayed on comic book scenes or

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e-book pages are enhanced with various backgrounds, dialogue panels and the final product is shared with peers. The solution of the given task, however, does not mean the completion of the process and in order to guarantee the fulfilment of the requirements of the Contemplate (development of perspective) stage of the 4C model and the maintenance of the flow experience students should be given an opportunity to perform or introduce their work to their classmates. This step assures the fulfilment of the method's final objective, as summarizing the subject matter in their own narrative and their reaction to feedback from peers develops argumentation and communication skills.

At the same time we have to take critical views into consideration. W. J. T. Mitchell (1994) asserts that as a result of the image-based turn the images not only represent, but shape the surrounding world and the life of people. As Mitchell argues images play an increasing role in the construction of social reality. Moreover, "we have to cope with the impact of television and Internet-based learning on the culture of future generations. Students read less, but are more proficient than adults in processing visual information" (Golnhofer, 2011, 41).

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