No miracle. Augmented reality in Art education[1].

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Abstract: We would like to present brief case study from future teacher education environment. This text describes development of teaching materials for gallery education in one group of students of Art Education at the Charles University, Faculty of Education (Prague, Czech Republic). The students were asked to design worksheet with augmented reality (AR). The aim was to use AR as educational tool - for example as solution verification. Lectures were interrupted with the Covid pandemic and closure of faculty but continued in distance learning mode.

Keywords: art education, augmented reality, worksheets, gallery and museum education

1 Context

New material of Education Policy[2] of the Czech Republic until 2030+ will be published soon, the existing strategy is from 2014. Since 2005 Czech schools became independent from central curriculum and each school could create its own school educational program. Schools and educators gain space for their creativity, for their conception of education, they get competencies and responsibility. Education in the Czech Republic varied and expanded - next to alternative kids' groups, home education, private schools with alternative educational programs we can find progressive public schools testing different educational models and public schools of traditional cut too. Parents, nongovernment, civic organizations and initiatives, extracurricular and cultural organizations actively entered and enriched our education.

Main motive of existing strategy[3] (2014 - 2020) was effective interconnection of education and labour market. Discussion about this connection is still actual, it brought to light social and cultural stereotypes (such as position of women in family systems and on labour market, understanding of gender roles, conception of education and craft work, etc.). These stereotypes still survive, although

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[2] You can find full text on this link: Main Aims of Education Policy of the Czech Republic until 2030+, file:///C:/Users/lucie/Downloads/brozura_hlavni_smery_6.pdf (unfortunately it is available only in Czech language).

[3] You can find full text on this link: Strategy for Education Policy of the Czech Republic until 2020 http://www.vzdelavani2020.cz/images_obsah/dokumenty/strategy_web_en.pdf

they don't reflect actual needs and forms of society - it is because they are maintained by older generation of politicians and public figures in public discourse.

Inclusion, improvement of education and equal opportunities to education are main topics of recent years and at the same time the priorities of New strategy 2030+. The strategy requires transformation of learning contents (it proposes a 50% reduction) and transformation of ways of education focused on acquiring literacies and competencies for successful personal, professional and social life.

Authors of new strategy consider the fast-evolving technology to be the main mover in transformation of Czech education (see chapter about external influences on Czech education, page 11 - 12). The material, however, does not mention risks connected with use of digital technologies. What about cyberbullying, hate speech, deepening of social inequality, unequal access to education, safety and privacy protection? There are no proposals for measures, neither monitoring nor prevention of these risks. But corona-virus pandemic pointed clearly to necessity of conceptional solution of these problems.

Although new strategy declares need to increase the level of literacies, it does not mention visual literacy and visual culture literacy (which are, together with digital and media literacy, crucial for responsible handling with digital technologies in interpersonal relationships). The strategy surprisingly omits many other important external influences, such as environmental problematics.

Even though the new strategy has its blind spots, it is important to reflect its main trend. If Art education wants to survive and remain one of educational fields it should respond to challenges that new strategy and corona-virus pandemic brought. It is extremely hard to teach Art education remotely particularly in the situation when the subject was never considered neither by professionals nor by parents as core subject in the curriculum. It is crucial to explain and to show that Art education trains us in visual literacy (to understand and to orient oneself in the world based on visual communication). That it develops critical thinking, self-reflective skills, emotional, attitude, communication and moral sides of personality and that these are not developed just by the learning content but by methods of teaching too. Pupils are led to create, design, present, discuss their thoughts and attitudes and learn to reflect them in wider social and cultural context. It is really challenging to transform the subject based on relationship, empathy and multisensoric perception into distance form of education so that these qualities and its character will not disappear. Cultural and Art institutions are helpful in maintaining quality and continuity of Art Education in this situation. Educational teams of these institutions created attractive and thoughtful on-line programs and models of distance art education.

It is important to join them, support educators in schools and prepare future teachers of Art education for the "Copernican turnover."

2 Students of Orbis pictus

Separate didactic course, which will prepare students of Art Education to work with digital educational tools and teaching aids, on-line education methods or with distance educational opportunities in Art Education, was not yet proposed and accredited on our Faculty. After coming into practice students must discover these technologies on their own. According to new education policy in the Czech Republic we assume it is appropriate to include usage of digital technology for teaching into future teacher training. For the above reasons we decided to test and critically reflect educational opportunities of one digital tool, augmented reality (AR) with group of students of Art education.

Usage of AR as educational tool in gallery and museum education program was realised with group of 25 students of third grade of bachelor studies of Art Education within the subject called Orbis pictus[4] at department of Art Education on Faculty of Education Charles University. The teaching took place in summer semester 2019/2020 and it was interrupted by corona-virus pandemic in March 2020. Three lectures of ten were carried out in person.

3 Augmented reality

The augmented reality was originally developed in air and military industry in 1990s, the term was used for the first time by Boeing researchers Thomas P. Caudell and David Mizell (Flanagan, 2018). Its purpose was to expand perception of reality and to allow for example pilots to easily orient themselves in certain conditions. From there AR easily got out to entertainment and gaming industry, also visual artist started to use it, see for example project MoMAR (Katz, 2018) and the potential for education was discovered. (Morey, Tinnell 2017) Using the scanning (camera) and imaging tool (display) AR complements the perceived reality with digital layer. The digital layer contains visual, textual, audio or other information. AR connects reality with digital layer for example thanks to markers or location information. It is interesting that AR connects real place or object with complementary information in real time. Some museums and galleries took this opportunity and together with developers, designers,

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[4] Link on course sylabus
https://is.cuni.cz/studium/eng/predmety/index.php?id=73a72a846b64cf440839a606abf81e43&tid=&do=predmet&kod=OPBW1V144A&skr=2019&fak=11410

artists and curators prepare exhibitions where AR is used intentionally (se efor example Film Stills in Albertina Museum in Vienna 2017; Czech Inovation Expo, 2018).

4 Inspiration

For Orbis pictus course purposes we have chosen two inspirational resources. First inspiration is book for kids The Little prince from Antoine de Saint-Exupéry, which was supplemented with photographs and illustrations by Czech artist Eliška Podzimková (Fig. 1, 2). The book was published in Albatros in 2019. Images from the book were also introduced on interactive exhibition in Vnitroblock from 25th August until 16th December 2019 in Prague. Main illustrations have round format, they are photographs of Island landscape or original natural products from Island (different mosses, lava stones, lichens). Eliška Podzimková has added her drawings of persons from the story to these photographs. At the exhibition it turned out that the round images are more than just photographs, they were more like assemblages. Drawings and natural objects from Island were incorporated into the images. These images were augmented with short animation videos as well. They are started after the visitor downloads the application ARTIVIVE[5] and focuses his/hers smart phone on the image. The ARTIVIVE company developed platform for visual artists who want to use AR in their artistic work or to use it for promotion.

The second inspiration was work of Czech designer Vít Škop VIVIDBOOK[6] - the physics textbook with AR (Fig. 3). Vít Škop, in cooperation with physics teacher František Cáb, designed and created series of worksheets where short text introduces specific problem/topic from physics and pupils are trying to understand and solve it by drawing into a diagram. With help of AR they verify their solution and understanding.

Both examples work intentionally with interconnection between real and virtual world. Images in the book about Little prince are made up of pieces of nature, associating sounds, smells, touch of the wind, that further materialize and evoke other associations and ideas with short animations. The work of Eliška Podzimková inspired us to create our own augmented images - thanks to this book we realised that it is possible to let pupils to create their images with AR in school Art Education. Vít Škop´s VIVIDBOOKS are professionally visually, and thanks to AR also attractively, processed textbook. Škop moves AR technology from simple visual fun to area of sophisticated teaching aid.

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[5] Link to ARTIVIVE webpage https://artivive.com/
[6] Link to VIVIDBOOKS webpage https://www.vividbooks.com/

5   Teaching questions

When studying our inspirational resources several questions arose. For example: on the exhibition of Eliška Podzimková two different spectator's approaches were identified. First group of spectators didn't know about the possibility of viewing images through the ARTIVIVE application. These visitors viewed one image after other, they pointed at images and observed them from different angles, talked about images and stopped at active zones (drawing into lava sand, tactile puzzle in the hollow of the tree). Some of these spectators noticed that other visitors are observing images through their smart phones and subsequently asked what they are doing and if they can try it too. Some of these first group visitors left the exhibition without noticing the ARTIVIVE application and didn't see the augmentation. Second group of visitors already knew about the AR application and that this exhibition works with it intentionally. There were few visitors in this group who went through the exhibition and saw images just through the displays of phones or tablets and didn't pay attention to real images behind it. Students identified similar phenomenon when watching presentations at ARTIVIVE web page. How much time the spectator spends with physically present art and how much with augmented art? Does the AR prolong the time spent with art piece? How the AR influences the experience, enjoyment and understanding of artwork?

We decided with students to create AR to our worksheet with ARTIVIVE. The lecturer registered and created account for teacher and students; this account is for free and allows to create five works. During the creation of our AR few problems and questions arose. ARTIVIVE is based on original art works and respects the copyright. It is expected that AR will be created to one's own artwork. But we wanted to present certain problem or phenomenon from visual arts and culture so we needed to show it on certain artwork and its reproduction. What role has authorship while using AR? Under what conditions it is possible to create AR to an existing artwork presented in certain gallery or museum for educational reasons?

The textbook created by Vít Škop led us to reflection of the construction and the choice of learning content in Art education, and to think about function of worksheet with AR. We have defined these issues: is it possible to create worksheets with AR for Art Education? What themes will be suitable? What graphic design of the worksheets is suitable? What is good and what we miss in VIVIDBOOKS? What is the purpose of AR in worksheets? Are we going to work more with visual attractivity - to motivate pupils? Or is it possible to use AR as transmitter of certain information which the pupil should learn? Or is the AR a testing tool - pupils verify their theories, ideas and results?

6   Teaching and its aims

Main aim of teaching in Orbis pictus was to design and create prototype of worksheet with AR for educational reasons for gallery or museum educational programme. Due to corona-virus pandemic and closure of galleries and museums worksheets were designed to more general art problems, it was not possible to connect them with specific exhibition.

Next aim was to introduce one of the reachable digital tools - augmented reality - to students of Art Education, acquaint them with its currently available variants and let the students try how AR works in reflective and didactically based environment.

Personal and social aim of teaching in Orbis pictus was to allow students to work in a group, to share their experiences, to help each other, to develop their communication skills (explanation, argumentation of ideas, discussion and reflective dialogue) and work skills (distribution of working roles according to their individual skills, task planning, responsibility for completing the task).

At first lecture students were introduced to topic and main aim of course, inspirational resources were presented and students got task: make groups and create worksheet for art education lesson / gallery education programme for selected target group with AR. At next lecture students separated in to five groups and each group started to discuss the theme or problem for their worksheet (brainstorming). In last face to face lecture students presented their themes and we discussed the structure of worksheet: What will make the worksheet intelligible, functional and clear? We defined four aspects: 1) information text about art theme or problem, 2) instruction, 3) reflective questions, and 4) visual diagram/image that will allow users to create and to use AR. At the next lecture students should present ideas and design proposals for the form of AR and technical side of AR should be solved. Further work of groups was intended to be independent and the progressing work should have been consulted regularly with teacher. Students had a PC room with necessary software available (programmes for text, image, and video editing).

Distance learning was performed via on-line consultations with individual groups (Skype). For the purpose of archiving and sharing studying materials and student works the course in Moodle was created (centre for e-learning on Charles Uni). But this course turned out to be inappropriate for sharing of visual materials and their commenting - this Moodle environment was developed for natural sciences and tools for education in art are missing (atelier, galleries, exhibition, etc.). Due to lack of

capacity the lecturer didn't create alternative environment for sharing and discussing experiences and knowledge from worksheet creation. From five groups three finished worksheets into final prototype form (graphically adjusted worksheet, information text, image and functional augmented reality).

Key factors for successful and satisfactory teaching from students' perspective were (resource: internal document of evaluation of distance teaching at Faculty of Education, Charles Uni, 2020):

1) there was a student in each group who owns editing software needed for realization of worksheet and AR, students were offered help from lecturer;
2) regular contact and relationship with students (positive motivation, active questioning of personal and studying status) realized via e-mail and video consultation;
3) consistent assignment of tasks and unchanged requirements;
4) provision of specialised literature and other study resources, supports and inspirational materials for independent work.

6.1 Prototypes of worksheets

Three worksheets were finished to final form (Fig. 4, 5, 6). First worksheet focuses on depicting figures in ancient Egypt, the second focuses on basic rules of depicting human figure and the third worksheet is about mixing basic colours. The two unfinished worksheets deal with perspective and relationship of form and meaning (Fig. 7, 8).

6.2 Reflection of teaching

From the students' feedback after teaching it turned out that most of them acquainted with AR in the Orbis pictus course. From 25 students only two stated that they knew AR from the past - the internet and gallery. It was visible that AR interested students from first lecture and the reason could be also that it was new theme for them. Perhaps their interest was demonstrated by finishing three from five worksheets even thought students did not have to submit finished worksheets. The lecturer withdrew from the request due to closure of faculty and impossibility to work with needed digital tools (camera, PC, scanner, etc.) and software (for editing photographs, videos, and graphic design). Students evaluated teaching as more difficult - more difficult for them was designing the worksheet and creation of AR (short animated video). Students marked technical difficulties, inaccessible technical background, inability to work off-line with their team, uneven connection of group members, organization of study and management of personal time ass the most common problems. Roughly one third of students stated that will use AR in their own artwork.

6.3 Reflection of worksheets with AR

Students consider worksheets with AR as visually attractive; they believe that they can appeal more diverse group of users. One student stated: "I was impressed by AR´s liveliness, by interconnection of classic and IT techniques, large range of options and by playfulness." Students´ discussion showed that educational materials with AR could be integrated for pupils of 6 years age and older at all levels of school, also in basic art schools, in gallery and museum education programmes and in extracurricular art groups. To the question: How can we use AR for/in Art Education? students often suggested: to acquaint themselves with phenomenon from art and visual culture and as form of motivation to create own artwork. It is interesting that only few students mentioned the use of AR as identified in VIVIDBOOKS - for solution verification.

6.4 Reflection on creation of worksheets

Text

When working on information text it turned out that students cope harder with choosing and formulating necessary information into short and comprehensive unit. At first students should study their topic in the literature, make extracts and mark main concepts they want and needed to explain. (Slavík, Lukavský, Hajdušková, 2010) After that they wrote their own text and presented it to other groups and after a joint discussion they adjusted the text to its final form. Students frequently drew information from readily available sources such as Wikipedia and took over the finished wording. It was necessary to remember basic writing rules of professional text, rules for choice of sources, bibliographic and citation norm.

Diagram/ Image

Next step was creation of illustration, image or diagram that pupils could complete and verify with ARTIVIVE application or "extend" their solution. We were inspired by graphically plain and bolt conception of diagrams in VIVIDBOOKS. It turned out that application ARTIVIVE distinguishes imperfectly simple colour compositions (see Fig. 9 different variants of diagrams for mixing basic colours worksheet). The ability to recognize image is called "recognition speed" in the application. As long as the diagram was just black and white simple drawing there were no troubles to connect image and video together into AR. The troubles with diagram we solved with loading the whole worksheet in

to ARTIVIVE. This solution is not ideal, if we continued in the following course we would be looking for better solution. Another pitfall was to adjust aspect ratio of image and video - if their dimensions were not matching, AR does not work properly.

Testing prototypes

During winter semester worksheets are going to be presented at Faculty of Education and all students could try them if they are willing to download ARTIVIVE application to their mobile devices or tablets. Students were recommended to test worksheets in their internship in schools. It is interesting for us to gain opinion of teachers whether they can imagine using worksheets with AR in their lessons and how they think it should look like and consist of. We should test 1) pupils' abilities to understand and use worksheet independently, 2) pupils' ability to read and understand to the information text, 3) how pupils understand to the task, 4) whether are pupils able to answer reflection questions, 5) how pupils understand and complete diagrams, 6) whether are pupils able to use AR and verify by AR their solutions.

Conclusion

We named this case study "no miracle", it is ironic and self-critical name, but we really have not invented anything, we have not formulated a new theory and we have not discovered revolutionary solution. But it turned out that dealing with AR in Art Education makes sense and we would like to continue in examining their relationship.

So, what we have find out? That we chose a good topic, which is actual in field of visual art and in visual art education, and that it can capture attention of students of Art Education. In addition, it meets the requirements to increase teacher's digital literacy placed by the new educational strategy 2030+. Pandemic of corona-virus only emphasized the need to include such tasks in Art Education teacher programme. While solving this task we run into a problem - solving multimedia technology task without multimedia technology background is very hard. We realised we need to find way how students could work on multimedia projects in distance education mode, for example in shared access to professional graphic and editing software. Thanks to this experience we are considering whether it is worth it to establish free and guaranteed platform for teachers to help them develop and create their own didactical tools with AR.

We appreciate AR and we consider it as suitable digital educational tool because it maintains the relationship between living and by senses graspable reality and virtual world. (Stehlíková Babyrádová, 2012, str. 8) It seems to us that this feature is important and should not be lost from art education in advancing technological development. (Fulková, Kitzbergerová, Jakubcová Hajdušková, Raudenský, 2012)

We realised that using of AR in one's own designed teaching aid could help students to transform content from arts and visual culture into subject matter by three penetrating layers - information text, diagram / image and animation. Each layer is specific and represents different way of designing and mediation of subject- matter. (Knecht, 2007) Information text names key concepts (notions) of researched problem, it answers these questions: What are we going to deal with? What will we learn? Information texts in worksheets are different, some contain a number of facts and put them in to historical and cultural context, other rather work with pupils' pre-conceptions and bring them to talk by questioning. Diagrams visualise key concepts, concepts are not given in form of words but in form of images. Choice of concepts from information text is reduced in diagram. Diagram initiates creation and calls to observe, think through, and create. It answers this question: How can we solve this task/problem? Diagrams in worksheets have different forms, there is simple stylized drawing of human figure created in PC, next to it is sensitive realistic pencil drawing and minimalistic colour diagram, their form is in logical connection with presented subject matter. And the last layer is animation which starts to play when pupil points his/her phone or tablet to diagram in worksheet. Animation reduces the choice of key concepts again, it moves them or decomposes them, but in all three cases it puts them in the end into new unit, animation calls for reflection and explanation. It answers these questions: What we came up with? What did we find out and how did we come to this?

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