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E-LEARNING COURSE OF SOFTWARE FOR TEXTILE DESIGN

Ion Razvan Radulescu[1], Antonio Dinis[2], Benny Malengier[3], Andrej Cupar[4], Mirela Blaga[5] and Radek Polansky[6]

[1]*INCDTP – Bucharest, Str. L. Patrascanu 16, 030508 Bucharest 3, Romania*
[2]*University of Minho, Department of Textile Engineering, Campus de Azurem, Guimaraes, Portugal*
[3]*Ghent University, MATCH, Technologiepark-Zwijnaarde 70A, Gent, Belgium*
[4]*University of Maribor, Institute of Engineering Materials and Design, Smetanova 17, Maribor, Slovenia*
[5]*Technical University "Gh. Asachi" – Iași, Faculty DIMA,Str. D. Mangeron 29, Iași, Romania*
[6]*University of West Bohemia, Faculty of Electrical Engineering, Univerzitni 2795/26, 301 00 Pilsen, Czech Republic*

ABSTRACT

Industry 4.0 and digitization are nowadays important trends in the textile industry. The need for well-prepared professionals in software for the design and modelling of textile products requires the creation of up-to-date educational resources. Virtual learning supported by e-learning offers the instruments to continue education during pandemic restrictions. As such, six research and education providers on the European level have joined forces to create educational resources in e-learning format for students and professionals in textiles: the content is related to software for design and modelling of weaving, knitting, virtual prototyping of clothing, embroidery of e-textiles and experimental design, as well as technology transfer. The educational resources were implemented on the Moodle e-learning platform of the Erasmus+ project (www.advan2tex.eu/portal/) and will be further used to support classroom / virtual courses with students and professionals in textiles. The paper introduces the course and its foreseen impact within the current context.

KEYWORDS

E-textiles, Software, Design, Modelling, Higher Education Students, Professionals

1. INTRODUCTION

Our paper presents Open Educational Resources (OERs) in the field of software for the design and modelling of e-textile materials. The resources are structured on six modules in relation to the leading textile technological fields: weaving, knitting, clothing, embroidery, and experimental design, plus a module on technology transfer. The resources are available in six European languages: Czech, Dutch, English, Portuguese, Romanian and Slovenian. The state-of-the-art of our OERs is based on three main pillars:

1. The significance of e-learning for safety during a pandemic;
2. The e-textiles as a future trend and niche of modern textile products;
3. The software solutions for textile design.

Aim of the paper is to present the prepared OERs as response to a current need from the world-of-work.

1. E-learning is a well-established technique and has gained a new significance during the pandemic (Grosseck et al., 2020). A close link is related to the Emergency Remote Teaching Environment (ERTE), enabling online learning in critical situations, like the current COVID-19 pandemic. The main idea is to shift classroom learning towards virtual learning in emergency situations with a well-established conceptual framework (Whittle et al., 2020). Many Vocational Education and Training (VET) schools and Higher Education (HE) universities have organized virtual teaching courses for the last two years in Europe and worldwide. The main challenge of online teaching was to keep the trainees connected to the course, bridge activities needing direct interaction with the tutor (such as support with direct questions), and evaluate assignments. E-learning courses could support part of these challenges, for they enable flexible learning hours with the possibility to study within the most convenient timeslots, it allows synchronous and asynchronous communication methods between tutor and trainee, such as Chat and Forum for Q&A, and

they permit precise evaluation of assignments via multiple-choice tests and questionnaires. Some other challenges where virtual learning and e-learning have drawbacks are a lack of interaction control. However, the e-learning resources with open access are of substantial support for improving the learning process in various disciplines and for different target groups. Such resources are called Open Educational Resources (OER) (Grosseck & Craciun, 2020). OERs have a content-centred approach focusing on creating and reusing resources (Ehlers, 2011). In recent years, the quality improvement of OERs has been a challenge for reaching a more practice-centred approach and a better interaction between tutors and trainees. The so-called Open Educational Practices (OEP) are the future trend and include the online teaching experiences and best practices within the educational resources as well (Grosseck et al., 2020). Looking at the field, we can conclude that e-learning brings valuable support to classroom and virtual learning and that it has reached more significance during the pandemic.

2. E-textiles have emerged with the progress of spinning techniques by producing metallic yarns and with the progress of electronics by miniaturization of electronic components. Various descriptions and classifications of e-textiles have been proposed, depending on their subsystems (Carames & Lamas, 2018) or their integration techniques (Simegnaw, 2021). The subsystems of an e-textile are: sensing, actuation, control, communication, location, power, storage, and display subsystem. The possible integration techniques are: mechanical connectors, soldering, sewing and embroidering, hybrid solder and sewing, electrical conductive adhesive, inkjet, and 2D screen-printing, three-dimensional (3D) printing, stretchable electronics, and finally, the latest trend of electronic connections on threads (e-threads). Some of the main applications of e-textiles are: baby vest connected to a laptop (not wirelessly) for monitoring of vital signs, smart suit for elderly people for collection of physiological data – transmitted by Wi-Fi to a remote server, smart suits for athletes for collection of ECG and accelerometer data via Bluetooth and smartphone, etc. As such, e-textiles represent a future trend in the textile industry, in correlation with the European strategy in the textile field, which is focused on high value-added products.

3. Software for textile design emerged with the evolution of IT in the early 2000 and now brings consistent support for designers. Textile technology is grouped on main techniques to manufacture fabrics, such as: weaving, knitting, clothing/garments, and embroidery. The available software applications are specialized in one of these technologies. The main added value of software is the possibility of virtually testing the properties of the designed textile materials and changing parameters without having to manufacture the products. Moreover, most modern weaving or knitting machines require software to control and manufacture desired fabrics. In the case of clothing, the 2D/3D patterns are of utmost importance when designing a garment on a human model, and software may predict draping and customizing problems. Knitting machines require specialized programming of patterns and can produce seamless garments. Embroidery is usually done on an existing textile substrate, and the software of the embroidery machine may lead to the desired pattern to achieve, e.g., an e-textile product with metallic yarns. Another possible application is using statistics tools, such as the experimental design, to conduct research experiments on smart and technical textiles (Tatu et al., 2012). In such a case, the use of the software is indispensable too. Some textiles software applications are proprietary; others are open-source and can be readily for educational purposes.

2. THE ERASMUS+ OPTIMTEX SOLUTION

The Erasmus+ project "Software tools for textile creatives" aims to offer a solution in this regard by providing educational resources in the e-learning format of software for textile design and modelling. Six European research and education providers have joined forces for tackling this objective: INCDTP-Bucharest, TecMinho / University of Minho – Portugal, Ghent University – Belgium, University of Maribor - Slovenia, Technical University Iași – Romania and University West Bohemia – Czech Republic. Main target group of the educational materials are students of higher education in fashion textile and technical textile fields as well as young professionals from the industry. The project has an implementation period of two years (Dec. 2020 – Nov. 2022). It is an ongoing project, with the creation of educational materials for the first year and the organization of courses and multiplier events for the second year. Courses of Intensive Study Programs are meant for students, and Multiplier events are meant for young professionals. Figures 1 a) and b) show the Erasmus+ and the project's logo.

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Figure 1a). ERASMUS+ logo

Figure 1b). PROJECT's logo

More information is available on the project's website (www.optimtex.eu).

3. THE E-LEARNING COURSE

The e-learning course of software for textile design was implemented on a Moodle e-learning platform (www.advan2tex.eu/portal/). This platform includes the OERs of four Erasmus+ projects, implemented during 2014-2022, with INCDTP – Bucharest as coordinator.

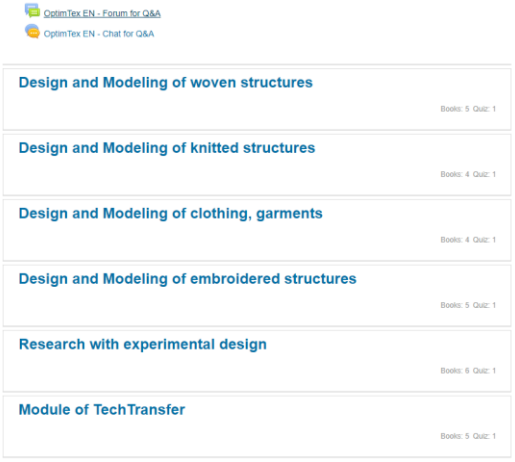

Figure 2. PRINT screen of the six modules - English course

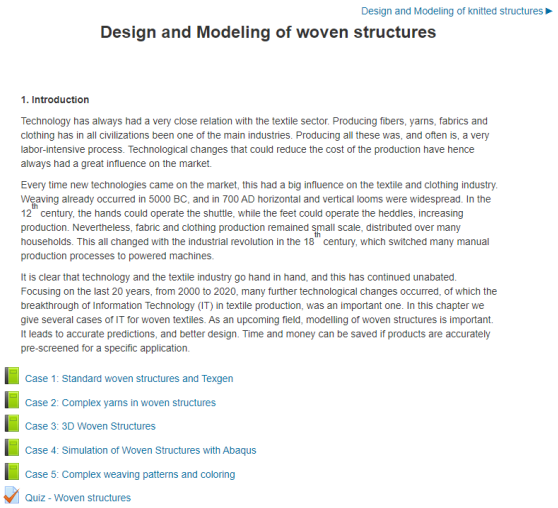

Figure 3. PRINT screen of the first module on weaving software

The OptimTex course has developed six modules in the field of design and modelling software for textiles. Each module tackles a textile technology field (figure 2) and includes 4-5 examples sets (figure 3). One example set includes: description of Example, the corresponding Theory, the available software Application, and the Multiple choice questions. The course is available in English and the five European languages of the partnership: Czech, Dutch, Portuguese, Romanian and Slovenian. A course category for the OptimTex educational resources was created on Moodle, with six courses in topic format for each language. Each course has one topic for the corresponding module. Book resources were implemented for each Example, Theory, and Application. The Books include navigation buttons and table of contents for a rapid selection of the desired element of the course. The Multiple choice questions were implemented as Moodle Quiz activities. The 20 questions per module were uploaded via Aiken format and some of them have images. A Forum and a Chat activity ensure the communication between tutor and trainee. Images and videos were embedded in the courses for the visual understanding of the materials. Figure 2 presents a print screen of the six modules of the English course and figure 3 presents the first module of weaving software and its 5 examples. Table 1 showcases the specific sets of examples.

Table 1. THE EDUCATIONAL examples of the course

Design and Modeling of woven structures	**Design and Modeling of knitted structures**	**Design and Modeling of clothing, garments**
E1: Standard woven structures and Texgen E2: Complex yarns in woven structures E3: 3D Woven Structures E4: Simulation of Woven Structures with Abaqus E5: Complex weaving patterns and coloring	E1: Knitted fabrics with normal loops E2: Knitted fabrics with modified loops E3: Spacer weft knitted fabrics E4: 3D shaped knitted fabrics	E1: 3D human body scanning using the 3D photogrammetry E2: 3D human body modelling and reconstruction E3: Construction of a kinematic 3D body model E4: 3D virtual prototyping of personalized smart garments
Design and Modeling of embroidered structures	**Research with experimental design**	**Technology transfer of textile software solutions into the industry**
E1: Technical computerized embroidery E2: Design and digitizing of technical embroidery E3: Textile Based Heating Element E4: Illuminated fabrics E5: Textile based water leak sensor on fabric	E1: Factorial design of plasma treatment for hydrophobic fabrics E2: Central composite design for optimizing plasma coated electric conductive fabrics E3: Factorial design of plasma treatment for hydrophilic textiles E4: Central composite design and bivariate analysis of process variables for EM shield development E5: Draping Simulation using Tensor Flow E6: FEM Analysis using Python	E1: WeaveEXVBA - Academic software development for weaving E2: Spin-off UMinho TO-BE-GREEN - Screening and Business plan E3: IOTech a driver to Industry 4.0 - Business development E4: Protechdry® - Reusable underwear for urinary incontinence SWOT analysis

In order to tailor the e-learning resources to the specific of these educational materials, the www.optimtex.eu website includes two additional resources:

- The E-learning instrument with a HTML5 button of Example, Theory, Application and Quiz for each set of examples – programmed in JavaScript (TAB Instrument);
- The Glossary of terms and definitions on the key terms within the modules in all languages of the partnership (CZ, NL, PT, RO, SI and EN), meant to support the students during the courses taught in English – programmed in PHP / MySQL (TAB Glossary).

Evaluation of the educational performance of these two e-learning resources will be tackled in future work.

4. DISCUSSION

This project and the created educational resources started from a need of the textile industry: the need of professionals mastering software of knitting machines. Since the recent evolution of textile technology involves software for design and modelling patterns and structures, the OptimTex course is in line with the Digitalization trend of Industry 4.0. The overall need for IT specialists is increasing, since all domains require digitization. There is close compatibility between IT education and e-learning, due to the same technological profile and engineering structure (Radulescu et al., 2017).

The educational resources of OptimTex project will be validated in 2022 by pilot courses organized by each partner with their own students and by three Intensive Study Programs with the mobility of 60 students and 15 lecturers. UGent has already organized a pilot courses with 19 students of the International Master of Science in Textile Engineering, as part of the practical part of the course Computation Sciences and Engineering Principles for Textiles. In all these settings, the OptimTex material was well received.

Several courses were already implemented during 2014-2020, within three Erasmus+ VET partnership projects. The courses were organized either as classroom courses combined with e-learning – the so-called blended courses, or as virtual courses and e-learning - during the pandemic. The courses were organized in the national languages of the partnerships (CZ, IT, NL, PT, RO, SI), and in our experience translation of the educational modules brings a lot of support to the learning process. The organized classroom and virtual courses had as objective a brief presentation of the modules and instructions for e-learning. These courses were followed by one week of e-learning for each module. Our Moodle e-learning platform has at this moment 933 users, including VET trainees and HE students, lecturers, professionals, stakeholders from the industry/associations and the project teams. More than 650 trainees followed one e-learning course.

5. CONCLUSION

An e-learning course in software for design and modelling textiles was created on the Moodle platform www.advan2tex.eu/portal/ . The course derives from the need to prepare textile creatives within the new digitization trend of the industry. The course includes state-of-the-art knowledge, based on three pillars: e-learning, design software, and e-textiles. This course will be validated within the second project's year 2022 by three Intensive Study Programs. Our previous experience with classroom / virtual learning and support of e-learning depicts a viable solution for complementary education during pandemic restrictions. The course content will be adapted to the specific target group of students and professionals in textiles. Limitations are related to the course's relatively high level of knowledge when approaching the target group. Applications of the course are promising, since knowledge of software for textile design offers substantial competitive advantages within the world-of-work. Future work will be related to educational performance evaluation of the additionally tailored e-learning instruments for these specific materials: the e-learning instrument and the glossary of terms – available on www.optimtex.eu .

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