Lessons Learned 1, 1&2 (2021)
Submitted: 31.05.2021
Accepted: 17.06.2021
DOI: https://doi.org/10.25369/ll.v1i1/2.24
ISSN: 2749-1293 (Print); 2749-1307 (Online)

Design options for online teaching in the assembly of flexible materials

Y. Kyosev

[1] *Professorship Development and Assembly of Textile Products, Institute of Textile Machinery and High Performance Textile Materials (ITM), Faculty of Mechanical Engineering, TU Dresden*

Abstract

In diesem Beitrag wird ein Erfahrungsbericht über die Umsetzung der Online-Lehre und eine konkrete Aufgabenstellung während des COVID-Semesters in den Jahren 2020 und 2021 vorgestellt. Die Montage von flexiblen Materialien beinhaltet viele manuelle Tätigkeiten, die bisher von den Studierenden während der Praktika selbst durchgeführt werden konnten. Gezeigt werden zwei Aufgaben zur Online-Unterstützung der Lehre durch die Programmierung einer 3D-Visualisierung der Stichtypen und der Dokumentation der Montagevorgänge durch Video oder Bild- und Textreihen. Die Erfahrungen zeigten, dass diese Visualisierungsvarianten den Personalaufwand etwas reduzieren können, aber das Mitführen eines Abspielgerätes (Tablet) von jedem Studenten während des Praktikums erfordern. Die Erfahrungen aus den beiden Aufgaben sollen auch für die Zukunft genutzt werden, um den Studenten mehr eigenständige Aufgaben anzubieten.

This paper presents an experience report on the implementation of online teaching and a concrete task during the COVID semester in 2020 and 2021. The assembly of flexible materials involves many manual operations, which until now could be performed by the students themselves during the practical courses. Shown are two tasks for online support of teaching by programming 3D visualisation of stitch types and documentation of assembly operations by video or series of images and texts. The experience showed that these visualisation variants can reduce the staff input a little, but require carrying a playback device (tablet) from each student during the practical. The experiences from the two tasks will also be used for the future to offer the students more independent tasks.

*Corresponding author: yordan.kyosev@tu-dresden.de

This article was originally submitted in German.

1. Introduction

In the course "Machines and processes of ready-made clothing technology" the students learn the functioning and construction of the machines for joining flexible materials. While the non-initiated of ready-made clothing technology only understand sewing cheap T-shirts, the experts know that the scientific preparation of this subject requires a multidisciplinary deeper knowledge from several subjects. The optimisation of a sewing process for joining components made of high-performance fibres, as well as the automatic sewing of human skin, starts with the kinematic analysis of gears with complex spatial movements. The laws of motion are then only the first step for the analysis of the interaction between the machine elements and the moving viscoelastic one-dimensional material - the sewing thread that is pulled 100 times a second, then bent, kinked, heated by friction and relaxed again at the end.

The design of the textile assembly is also complex - the flexible fabrics must be folded in the right places for individual processes, then brought together as several layers on the machine and then folded over, untwisted, heat-set, etc. Before an engineer begins to robotise or at least partially automate such a process, these steps must first be fully understood. In the pre-Covid days in the presence factory, these skills were taught as practical exercises directly on the sewing and welding machines and the ironing machines. As Aristotle already knew [2] and the pedagogues confirm - the probability of retention in do-it-yourself is 90% because several channels - sight, hearing, touch - are addressed at the same time.

This paper presents some problems encountered in the preparation of individual contents for distance self-learning, which was necessary to keep the attendance times and the number of people in the laboratories within the permissible limits.

2. Typical tasks

One of the tasks of assembly is to learn the thread interlacements (stitch types). Besides the mostly known lockstitch, which runs on household sewing machines and is also predominantly used for joining seams in industry, there are numerous more complex stitch types, divided into several classes. Fig. 1, for example, shows a cover chain stitch, represented in the usual in the books drawing.

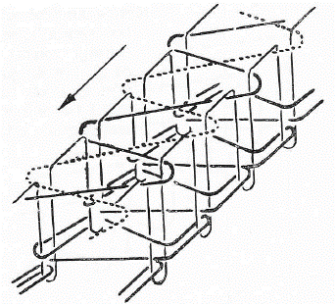

Fig. 1: Cover stitch [1]

If you sit on the sewing machine and create this type of stitch yourself, the movements of the individual organs are clear and the end product is also visible from above and below. The same effect is difficult to achieve with a drawing.

The main task of the practical training is to learn how to sew together a whole product such as a shirt, laptop bag, seat cover or similar. This task requires a longer sequence of spatial movements of both hands with at least 3 fingers each and their interaction with fabrics and machines. This is realised in the presence mode by "show" and "let repeat".

3. Basis for implementation Dokuwiki - the "learning studio"

OPAL is a powerful tool for regulating access to a repository of material and data. At the beginning of the COVID period, the built-in wikis and learning modules were not suitable for serial processing of large quantities of images and materials. In order to still be well prepared in terms of time for the semester of "teaching without a lecture hall", after several weeks of struggle with Opal, the author spontaneously decided to install a second wiki on the professorship's webspace, which runs as a DokuWiki [3], and to design the content there. Thus the "Learning Studio of the Professorship Development and Assembly of Textile Products" was born.

Why Dokuwiki as Wiki? The decision was made internally years ago, based on the Wikimatrix [4] and tests with MediaWiki, TWiki, PhP Wiki, WordPress and Joomla. Reasons for this:

- it is freely accessible and open source
- it is small and fine (3.6 MB installation)
- it only needs PHP and no SQL database, so it runs on the TUD webspace
- it uses plain text files for the contributions, which can still be directly accessed and used in the event of a theoretical crash
- it provides a simple backup of all data
- a simple restore by unpacking the backup from the folder is possible
- it has namespaces (folders) with the possibility of regulating access rights
- it allows the embedding of YouTube videos
- it has a syntax that is easy to learn
- several plug-ins are available
- HTML, Latex also PowerPoint (through VBA script) can be converted into Dokuwiki format by pandoc [5].
- The author already maintains several such wikis and has experience with them. Thus, the creation of teaching materials can be realised quickly.

4. Virtual representation of stitch types

In order to enable the active understanding of the learning material: Crossing of sewing threads, according to the principle "do it yourself", the following task was designed: Each student is given an individual stitch type, and in addition a parametric 3D model is to be created in Python. For the 3D data set visualisation, a freely accessible viewer is provided by the author. At the end of the assignment, the thread lengths are to be calculated. With about 15 students, there were no problems in distributing the individualised tasks, but after the first ZOOM lesson on this topic, it became apparent:

Lesson Learned 1: The students in the 8th semester have "already" programmed (and passed the computer science exam in C#), but they cannot demonstrate proper algorithmic thinking.

Lesson Learned 2: Not much knowledge has been retained from the programming units, in the first semester, as hardly any of the honoured colleagues seem to ask for it or maintain it.

As a result, the following content was prepared as "Step by Step Introduction - Python for Beginners" (Fig.2), "Seam image as 3D projection, the coordinates are described parametrically and coded in Python" in the Learning Studio. An easy-to-install and "low-maintenance" environment "Thonny" [6] was found.

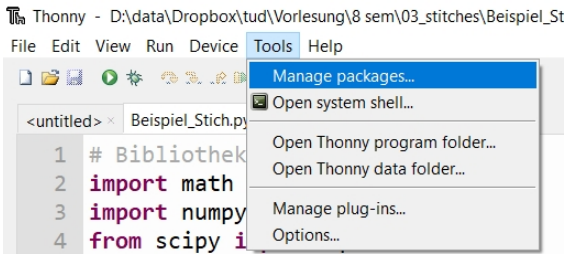

Fig. 2: Picture from the step by step instructions for Thonny

After two sessions of 90 minutes each and an additional demonstration of the step-by-step instructions, the "aha effect" came to the students with the first colourful images as a result, as in Fig. 3.

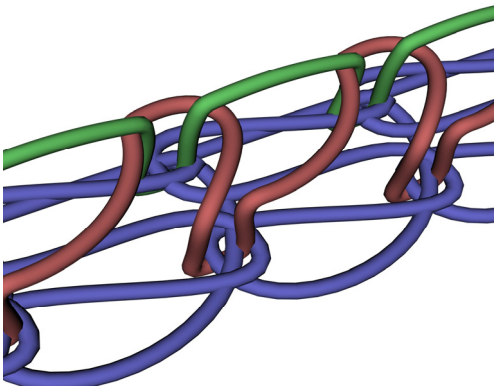

Fig. 3: Generated 3D image based on a parametric model of the student K.H.

The attempt to have the students determine the length of the thread alone failed. Here the hints about numerical integration or Pythagoras in space and "loop" did not really help.

In further Zoom meetings, the algorithms were dealt with, how to go through the coordinates with a loop and how distances are added.

Lesson Learned 3: The generation born with "mobile phones in their pockets" still cannot practically apply what they have learned in mathematics, numerical methods and computer science.

Most students found the wiki content with pictures and detailed explanations (it is an electronic manual) more enjoyable to use than recorded videos because they could go through the content at their own pace.

Lesson Learned 4: Text with explanations is easier to follow, the small amount of data is about 2-3 MB per lesson.

Lesson Learned 5: Resumption of the lecture is nevertheless desired.

Nevertheless, some students have asked to make the recorded content with explanations additionally available via ZOOM. (Amount of data x00 MB per teaching unit)

5. Assembly technology

The technology of assembling individual products in industry is supplied for 4 learned "operators of sewing machines" as a table with machine types and short descriptions of operations, naturally supplemented with pictorial material, as shown in Fig. 4. There, the cross-sections at the joints and the associated seams are shown.

The picture in Fig. 4 shows the "**finished state**" **of** the joints, but not the sequence of hand or machine movements used to bend, guide and sew the soft textiles. To explain more by ZOOM on the basis of this picture is pointless.

An alternative, which excites many people, are the videos on YouTube (Fig. 5). To put it into practice, it means getting or borrowing a sewing machine at home, putting the computer next to it and watching each step, pausing the video and then practically repeating it yourself.

In principle, this proves to be a good solution if one wants to overcome the annoying advertising in YouTube. By using the newly designed Video Campus Saxony [7], this problem is solved and, in addition, the author rights and access are very professionally regulated.

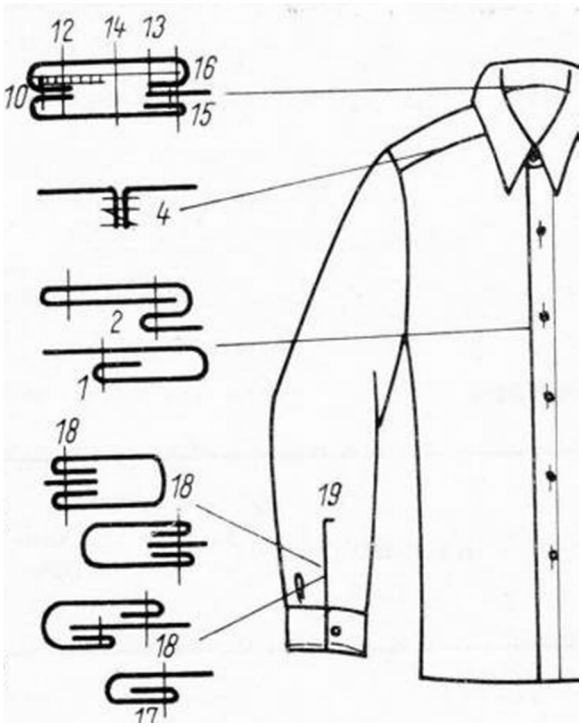

Fig. 4: Excerpt from the sequence for assembling a shirt [1].

Fig 5. YouTube video on how to create a bag
https://www.youtube.com/watch?v=Zx4yKzfRrus

Nevertheless, the videos have some disadvantages as a medium - you can't watch the whole thing clearly in a quick pass and then concentrate on specific passages, and they still require a lot of data volume, a good internet connection and a lot of preparation work in recording and video editing.

For this reason, alternative variants were sought, such as pictorial representation of the individual operations, with some text, as befits a classic book (Fig. 6).

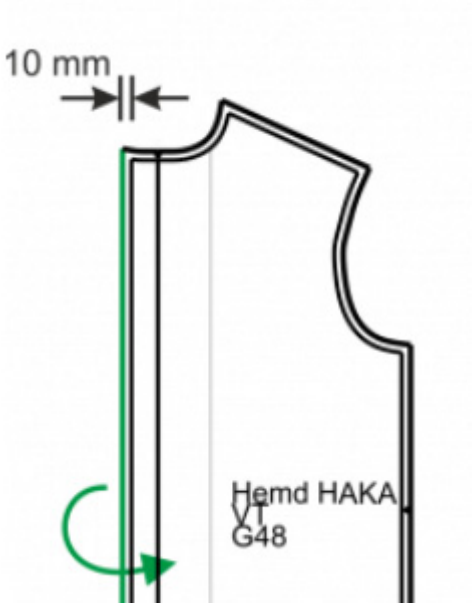

Fig 6. Illustration of an operation during manufacturing

This variant required significantly less storage space, is somewhat clearer than individual cross-section images and allows quick perusal and deepening at individual points. In terms of effort, this variant is not faster than the production of a video - in this case, a member of staff also had to work on the diagrams for a few days with CorelDraw.

The test phase with about 15 students in the first run found this presentation not really helpful. When questioned about the reasons, it was explained that the problem was not with the presentation but with the application - here the students were asked to look at the sequence and practise "dryly" at home (which of course did not happen) in order to move forward with less explanation afterwards during the practical. Like leading Augmented Reality users, one would have to place an AR Glass or at least a tablet or laptop next to the sewing machines here - whether YouTube video or pictures as a series of images - for it to have an effect.

This possibility was also thought of, but the problem turned out to be that:

a) no laptop fits straight next to the machine for reasons of space

b) it makes technological sense for the student to carry their tablet/screen/laptop and look at the next steps.

This last option is being planned and will be tested in the near future, because it allows for a more dynamic design of the practicals even in normal times, where each student can work on the assignments at his or her own pace.

6. Summary

The introduction of 3D seam programming has only partially replaced the practical exercise, but has also resulted in students learning methods for representing seams and later being able to use these representations directly for FEM calculation. This unit will also be continued in post-Covid times.

The presentation of the production technology as a video or series of images with explanations is possible, but its application requires that this content is taken along on a portable tablet right next to the machine. This implementation will also be tested and further developed in the future to optimise the supervision effort and to create more individualisation in the practical units.

Mails like this " I learned a lot and found the tasks super, I enjoyed it. :)" (A.G., 13.08.2020) have confirmed my more than 20 years of teaching experience that the way to design a semester accompanied by individual assignments and to honour them in a way that is relevant to the exam - has been right.

Acknowledgement

Many thanks to Ms Claudia Neumann SG 7.5 and the web support team for the competent advice and quick regulation of the professorship's web space, where the Learning Studio was implemented.

Literature

[1] Endre, N., Ferenc, T., Ruhaipari kezekönyv, Muszak-Könyvkiado, Budaperst, 1979
[2] Knoll, Michael, Vom Aristoteles zu Dewey. Zum Usprung der Maxime "learning by doing", https://www.mi-knoll.de/128401.html
[3] www.dokuwiki.org
[4] www.wikimatrix.org

[5] www.pandoc.org
[6] www.thonny.org
[7] https://videocampus.sachsen.de/