Reconstructing fabrics used in the clothing of "Kukruse Woman" from the late 12th century: A craftsperson's perspective

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Abstract

This article focuses on the reconstruction of fabrics based on archaeological finds. When a woman's grave from the late twelfth century AD (Kukruse Burial VI) was unearthed at Kukruse in eastern Estonia, archaeologists involved experts from various fields in studying the materials that were found in the grave – from natural scientists to textile researchers. A set of clothing was reproduced from what was found in the grave of the "Kukruse Woman".

The grave that served as the basis for this study featured plentiful amounts of jewellery and bronze embellishments, but textile remains were extremely scarce. It was for this reason that, when it came to weaving the fabrics, other archaeological textile finds that date back to the same period had to be relied on to a degree. The aim was to achieve a visual resemblance to the historic fabric. When weaving the woollen fabrics, the yarn used was from the wool of an ancient Estonian sheep breed, the native Kihnu type, which was spun in a way that is customary for contemporary woollen mills. In order to obtain the required shade of blue, synthetic dyes were used on the yarn. The tools used met the needs of a modern weaver and increased the efficiency of the work. This article interprets handicraft skills on the basis of the crafter's personal experience, primarily from a weaver's perspective. Reconstructing an ancient fabric includes not only reproducing the item itself, but also the process of studying and recreating inherited skills that had since been lost.

Keywords: woollen fabric, reconstructing clothing, archaeological textile finds, weaving

Introduction

In the late autumn of 2009, during highway construction in Kukruse in eastern Estonia, a late Iron Age cemetery was discovered with approximately 50

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Photo 1. Full reconstruction of the attire of "Kukruse woman". *Photo by Jaana Ratas.*

Photo 2. Fragment of Pudivere (AI 4194) 2/2 broken chevron twill fabric. *Photo by Riina Rammo.*

Photo 3. Fragment of Pudivere (AI 4194) 2/2 twill fabric. *Photo by Riina Rammo.*

burials from the 12th–13th centuries, which are now preserved at University of Tartu (Lõhmus *et al.* 2011). One of them – Kukruse VI burial – was designated to be part of a new permanent exhibition at the Estonian National Museum. Based on the finds, a couple of years of work went into making a reconstruction (Photo 1). The team behind the outfit of the "Kukruse Woman" comprises archaeologists and artisans who produced the reconstruction: concept – Riina Rammo, Jaana Ratas and Mari Tõrv; textiles – Astri Kaljus; spiral tube decorations – Jaana Ratas; jewellery, belt and items hanging from the belt – Indrek Jets, Edvards Puciriuss and Jaana Ratas; tools – Edvards Puciriuss, glass beads – Laura Šmideberga; leather footwear – Jaak Mäll.

In the present article, I will look more closely at one aspect of the reconstructed attire – the textiles. The purpose of the reconstruction was to produce fabrics which would visually resemble the fabrics used at the time. How similar could a fabric woven today be to one worn 700 years ago? Archaeological textile finds give some information about the characteristics of the fabrics used, but the actual result is very much based on guesswork, and the whole reconstruction process is rather my interpretation. This article interprets handicraft skills on the basis of the crafter's personal experience, primarily from a weaver's perspective. Which materials, tools, practices and finishing should be chosen nowadays to achieve a result which looks like the materials in the find? Which are the main problems encountered in the course of weaving this fabric? What in the reconstruction process can be considered a success, what was rather a failure, and what could have been done differently?

In Estonia, not much has been written about reconstructing the weaving process based on archaeological finds. This is due to the small number of qualified weavers who specialize in archaeological issues. The Siksälä cemetery textile finds have been the most published (Laul, Valk 2007; Valk, Laul 2014). An

article by Ave Matsin about the reconstruction of the Siksälä shawl has been published in the collection *Muinasaja teadus 21* (*Research into Ancient Times*) in 2010. While working on the Siksälä woman's garment, Ave Matsin published the article *Kangakudumine keskaegses külas Siksälä kalme leidude põhjal* (*Fabric Weaving in a Medieval Village based on finds from Siksälä Tomb*) in co-operation with Riina Rammo in 2014. An article by Astri Kaljus, *Rekonstruktsiooni valmistamine Paistu vaipseelikust* (*Reconstructing the Paistu Wrap Skirt*), about reconstructing an old clothing item dating from a later period, was published in the Yearbook of the Estonian National Museum in 2008.

I reconstructed fabrics for the following items of clothing: an apron worn in front, a peplos dress, a shirt-like coat, leg wrappings, decorative strips on the leg wrappings and a kerchief. The last item is made of linen, and the rest are made of woollen yarn. In addition to fabrics, I also made socks using nålbinding, braided faceted bands and made tablet-woven bands and belt.

The Kukruse VI burial (TÜ 1777) was rich in jewellery and bronze decorations but less so in textiles – only two types of fabric remnants were discovered near the knife sheath. Estonian archaeological textile heritage is very fragmentary: no complete textile items, fabrics or technical means for weaving have been preserved. Only small fragments have been preserved, based on which hypotheses and conclusions can be made and items reconstructed. As my main task was the practical reconstruction of the textiles, Riina Rammo advised me on the source materials. The point of departure was textile finds dating from the 12th–13th centuries. One of the main sources to draw from was the Pudivere hoard from the 12th century (AI 4194: see images 2 and 3; Luik 1999: 143). The Lõhavere box from the 13th century (AI 4133: 2274; Laul, Tamla 2014: 50–55) was of much help on the issue of braided and tablet-woven bands.

Materials and tools used for the reconstruction

The yarn

The fabric was woven using Kihnu native sheep wool. The choice was supported by the conviction that sheep with similar characteristics were most probably bred in the Estonian territory at the time. The sheep have lived here for approximately 4500 years, and they are well-adapted to local conditions and are resistant to diseases, fertile and undemanding (Saarma 2009: 15). The native sheep are considered the heritage breed of the region. The Estonian native breeds are the Kihnu, Ruhnu, Saare and Hiiu native sheep (Saarma 2009: 14). The Kihnu native sheep are the most widespread (Ärmpalu-Idvand 2009: 6; VM Kaljus 2015: Uus). The main feature of the native sheep is a double-coated fleece with a finer inner coat and coarser outer coat. This is underlined by wool fibers of

different colour and length. (Ärmpalu-Idvand 2009: 8; VM Kaljus 2015: Uus). In her doctoral thesis, Riina Rammo (2015: 59) compares urban and country textiles in the pre-historic era and in the Middle Ages and shows that country textile samples are made of wool from double-coated sheep.

It proved complicated to find yarn with features resembling those used for ancient fabrics. The recovered fragments, which for me served as a basis for the reconstruction, had been made with yarn spun from combed wool. Combs were used to prepare the wool before wool cards, which only reached the Estonian territory in the 17th century (Matsin 2002: 13). The purpose of combing or carding is to separate the wool fibres and prepare them for spinning. Combed wool necessitates wool with relatively long fibres (minimum 7–8 cm). Combed wool is smooth, resistant and lustrous (Luhamaa, Roos 2012: 15). Carding is a better solution for making yarn with shorter fibres. The small wool mills of Estonia that mostly spin carded wool only accept wool with short fibres. This was confirmed by Made Uus, who breeds Kihnu native sheep and does not let the wool in her flock grow too long (VM Kaljus 2015: Uus).

Other important properties of yarn are the twist and twist direction. In the case of the fabric fragments that I studied, the two-ply S-twist warp consisted of two single-ply Z-twisted yarns (Photo 4). This two-ply warp is fine with a dense twist and is very even, a result that can be achieved only by an accomplished spinner.

A spindle had been used for spinning, as spinning wheels became more common in Estonia only in the 18th century (Rammo, Matsin 2014: 340). The single-ply weft was spun with Z twist, is comparably fine and of high quality. I took into account that the yarns of the recovered fragments had lost their original appearance, so they cannot be copied scrupulously.

Photo 4. Microscopic image of the warp of the Pudivere textile fragment (AI 4194). *Photo by Riina Rammo.*

As far as the warp was concerned, I struck a compromise and replaced the two-ply S-twisted yarn with a single-ply Z-twisted yarn.

The breeders of the Estonian native sheep have their yarns processed in small wool mills because they accept small quantities of wool (VM Kaljus 2015: Uus). In small wool mills such as Süvahavva, Kabala or Äksi, the diameter of single-ply yarn is comparable to that of two-ply yarns of the past. It is made with Z twist, which suited the warp to reconstruct the recovered material. The quality of spinning can be uneven as a result of using old machines, as I noticed in the case of yarns from the Kabala wool mill, which is approximately one hundred years old. The settings of old-fashioned spinning machines cannot be changed to get a thinner yarn, and the only feature that can be changed is the amount of twist (VM Kaljus 2015: Uus). The twist of single-ply warps has to be tighter to facilitate weaving. Yarn with a slack twist may yield to the weft tension or snap as a result of suffering friction from the reed or heddles and thus slow down the weaving process. I used the wool of Kihnu native sheep raised at Paabo and Uue-Taatsi farms. Liis Luhamaa spun the yarn for the bands on a spinning wheel. For making the linen scarf, I used single-ply linen thread with Z twist bought from an antique shop.

Dyeing the yarn

The woollen textile fragments recovered from the archaeological excavations had been dyed, most often blue. The blue colour had been dyed with indigo which is a colourfast vat dye. There are two basic sources of natural indigo: true indigo (*Indigofera tinctoria*) in more southern regions and woad (*Isatis tinctoria*) in Europe (Peets 1998: 30; Pastoureau 2013: 18). In the 12th–13th centuries, indigo-dyed yarn or wool was probably dyed with woad obtained through trade (Peets 1998: 32). Today, a large spectrum of blue shades can be achieved by using indigotine for dyeing (Prideaux 2003: 15).

I weighed dyeing with natural indigo against using modern artificial dyes. Using indigo as a vat dye would have been a more complex and time-consuming process, especially bearing in mind the amount of yarn (ca 6 kg), as opposed to using water-soluble yarn dyes. Also, I lack the know-how of handling indigo. As I have more long-term experience in dyeing with synthetic dyes, and I have mostly used blue, I decided to use synthetic dyes. I mixed several synthetic pigments and compared them to yarns coloured with indigo. I dyed each of the yarns for different fabrics with a different shade of blue. I used two different shades of blue for the peplos dress and the shirt-like coat (cf Photo 5). It is simpler to dye a smaller quantity, but also I had noticed a difference in the shades of the archaeological textile materials, including in the shades of the warp and weft yarns.

Photo 5. Yarn from Kihnu native sheep for the shirt-like coat fabric dyed with contemporary synthetic dyes. *Photo by Astri Kaljus.*

Tools

In the last centuries of the prehistoric era, weaving on the eastern shores of the Baltic Sea was traditionally done on a vertical loom (Rammo, Matsin 2014: 342). Tubular selvedges and starting with a tablet-woven band are typical of weaving with vertical looms. I excluded using the warp-weighted loom for reconstruction. Firstly, I do not have enough practice, and secondly, it is not known which type of vertical loom was used in this region. The tradition of the warp-weighted loom, for example, is supported only by a few finds of weights, which can imply that weights from some other, perished materials may have been used. Jüri Peets (1992: 57) thinks that some other types of looms may have been used here instead of the vertical loom with weights. Finnish looms enable one to use weaving techniques characteristic to vertical looms. Therefore, my decision to weave on the Finnish looms to which I am accustomed and which are more efficient was reasonable. I have mostly made woollen fabrics. I used my personal Finnish looms, the particularities of which I had been familiar with for 30 years.

Weaving the fabric

Sett and winding the warp

The fabrics that I wove had different setts. The sett of the fabrics that were taken as the basis for the reconstruction was between 8 to 11 warps per one centimetre. In case of the garment fabric, the sett depends mostly on the thickness of the yarn: the thicker the yarn, the fewer warps per centimetre, and vice versa. I picked yarns of different thickness and different setts for different fabrics to serve as material for comparison in the future (Table 1).

Fabric width

The width and sett of a fabric woven on the Finnish looms is determined by the reed number, which shows how many dents there are per 10 or 1 cm (Kelpman 1998: 13). For example, a no. 90 reed has 90 dents or 90 warps per 10 cm and 9 dents or 9 warps per 1 cm. In the course of weaving and after removing the fabric from the loom, the width of the fabric decreases. Depending on the sett, the fabric width and the finishing process, the fabric may shrink up to 4–8%.

A fabric woven with a reed with more dents shrinks less in the course of weaving as well as after washing or fulling. I also took into account that a fabric with a tubular selvedge has to be woven without a temple, which may in turn have an impact on shrinkage. The purpose in finishing was not to boil the fabric but rather to wash it a little in order to even the warp and weft differences that are the result of weaving. Thus, I expected the width shrinkage to be 4–6%.

Clothing item / Fabric measurements /Quantity of textiles	Fabric	Sett / Reed dents	Warp amount / Length	Density	Material / Wool factory (Wp – warp) (Wf – weft)
Apron 46x70 cm	2/2 twill	10 warps per cm / 100	500 warps 150 cm	9 yarns per cm	Woollen, single ply, Z-twist Süvahavva (Wp, Wf)
Decorative strips on leg wrappings 2 pc	2/2 broken chevron twill	11 warps per cm / 110	222 warps 190 cm	10 yarns per cm	Woollen, single ply, Z-twist Kabala (Wf) Süvahavva (Wp)
Leg wrappings 10.5x250 cm 2 pc	2/2 twill	9 warps per cm / 90	120 warps 650 cm	8 yarns per cm	Woollen, single ply, uneven, Z-twist, Kabala (Wp, Wf)
Peplos dress 70x110 2 pc	2/2 twill	8 warps per cm / 80	576 warps 330 cm	9 yarns per cm	Woollen, single ply, Z-twist Kabala (Wf) Süvahavva (Wp)
Shirt-like coat 60x480	2/2 twill	9 warps per cm / 90	576 warps 550 cm	8 yarns per cm	Woollen, single ply, Z-twist Kabala (Wf) Süvahavva (Wp)
Kerchief 80x80	plain	12 warps per cm/ 120	1032 warps 150 cm	9 yarns per cm	Linen, single ply, Z-twist, antique shop, handspun

Table 1. Technical description of the reconstructed fabrics and materials.

Photo 6. Warping with a warping paddle. *Photo by Astri Kaljus.*

Fabric length

Weaving manuals indicate that 10% shrinkage must be calculated into the fabric length. My personal experience has shown that woollen fabrics actually shrink more than this. One of the reasons is that the warp expands under tension. For this reason, I added 15% to the warp length. I have noticed that warp shrinkage occurs to a greater degree in the case of fulled fabrics. I used a warping paddle to wind the warps (Photo 6).

Using a warping paddle accelerates the whole process because more warps can be wound at a time. Personally, I am used to winding 6 warps at a time. In the case of the woollen fabrics, I wound all of the warps at once and put them up in one warp chain; in the case of the linen fabric, I divided the warps into two chains because of the quantity of the warp threads.

Warping the loom

I warped the fabrics to be reconstructed as follows: I distributed the warps in the raddle, wound the warps onto the warp-beam with the help of an assistant, put the lease sticks through the cross and continued with threading the heddles (Photo 7). Threading was carried out according to the threading draft. I then sleyed the reed (Photo 8) and attached the warps to the apron rod in small (12-warp) bundles (Photo 9).

The last step before beginning to weave was the tie-up (Photo 10). In case of most of the fabrics, except the shirt-like coat and the kerchief, two patterns were placed on the same weaving draft. I used the twill draft for the woollen fabrics because this has been the most common tie-up used for weaving in the Estonian territory (Peets 1993: 216). For the apron, peplos dress and leg wrappings, I used 2/2 twill, and for the edges, I used the tubular fabric draft (Figure 1). For the decorative strips, I used the 2/2 broken chevron twill, and for the fabric edges, I used the tubular fabric draft (Figure 2). The shirt-like

Photo 9. Attaching the warps to the apron rod.
Photo by Astri Kaljus.

Photo 7. Warp threading.
Photo by Astri Kaljus.

Photo 8. Sleying with the help of the reed hook. Photo by *Astri Kaljus.*

Photo 10. The tie-up.
Photo by Astri Kaljus.

coat was woven according to the 2/2 twill draft and the linen kerchief according to the plain weave draft.

Weaving

In order to produce fabrics resembling the ancient ones, it is important to weave tubular selvedges (Photo 11), to keep the fabric even and to properly measure the density.

As opposed to weaving on the vertical loom, weaving with the help of a reed leaves more widely spaced warp on the selvedges. A reed is not used with a vertical loom, so the edge warps are more densely packed together, not only in the tubular edge, but also for several centimetres into the fabric. For example, in the case of the Parisselja shirt-like coat (ERM 19506), the edges were denser to the extent of 7 centimetres at both edges. In order to get the same result with a reed, I did not use a temple. Usually, I use a temple to keep the width uniform along the entire length of the fabric.

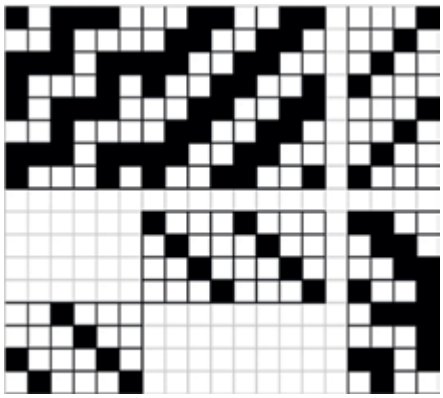

Figure 1. 2/2 twill and tubular selvedge draft. *Drawing by Astri Kaljus.*

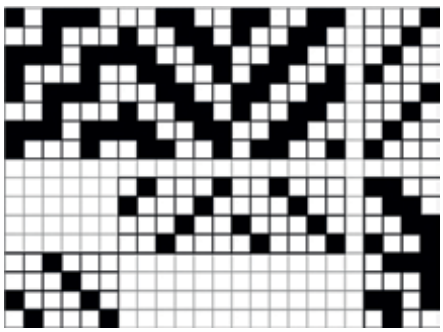

Figure 2. 2/2 broken chevron twill and tubular selvedge draft. *Drawing by Astri Kaljus.*

Weaving the edges of narrower fabrics worked well (Photo 13). I made the 10 cm wide leg wrappings using a thicker yarn (6/1) from the Kabala wool factory and a no. 90 reed. The proportion of the width, reed number and yarn turned out to be most appropriate. I am even more satisfied with the decorative strips. I added extra warps to the edges and sleyed the tubular selvedges more densely (Photo 12). The fabric was more densely woven (no. 110 reed) and the yarn finer (8/1).

The selvedges of the wider fabrics meant for the peplos dress and the apron did not turn out quite as expected. The reason may have been an incorrect balance between the fabric width, the density of reed dents and the thickness of the yarn used. If the gaps between the warps are too wide, i.e., the warps are not together tightly enough, the fabric will shrink more.

As a result of this, the opposite occurs, and the edge warps are more loosely spaced than in the middle of the fabric. To

Photo 11. Tubular selvedge.
Photo by Astri Kaljus.

Photo 12. Densely sleyed tubular selvedge.
Photo by Astri Kaljus.

Photo 13. Weaving the decorative strips.
Photo by Astri Kaljus.

avoid that, I should have used a denser reed for the tubular selvedge fabric and inserted double warps through the dents.

Following precise measurements of the fabrics for the apron and decorative strips was very important. Jaana Ratas made bronze spiral tubes specially for those items and attached them to the fabric. The measurements of the fabrics and the decorations matched. Although we planned a 45 cm wide apron fabric, it was expanded later to 47 cm. According to Jaana Ratas, it is easier for the weaver to take into consideration the more complicated bronze decoration than it would be the other way around.

The fabric for the peplos dress was, in the end, 10 cm narrower than originally planned. In my opinion, the main reason was the too widely spaced dents of the reed (no. 80) and too thin yarn. As the material was in short supply, I could not afford to use a denser reed. More warps would have helped to maintain the planned width of the fabric.

Finishing

The fabrics were meant to look as if they were made of combed wool so that the structure of the fabric is visible. The wefts of handwoven fabrics fresh off the loom may appear uneven, but this can be smoothed out by soaking the fibres. To begin with, I immersed the raw fabrics in water to soak the fibres. If the fabric is not entirely soaked, the gaps between warps and wefts may still remain. I washed the fabrics gently with water and wool detergent. I used lukewarm water because hot water may start to full the carded wool. I dried the lengthier fabrics on a roll in order to avoid folding lines. When the fabrics were half dry, I ironed them with the proper temperature on the right side and left them to lie on a horizontal surface for 24 hours. Finally, I trimmed the nap of the fabric with a razor blade.

Most of the fabrics had a tablet-woven band attached to each end. Attaching a tablet-woven band to the beginning of the fabric is one of the characteristic features of textiles woven on a vertical loom. The wefts of the band, which is woven with tablets or rigid heddles (*tihv*), usually function as the warps of the fabric (Matsin 2002: 63). The Lõhavere box contained 12 fragments of blue tablet-woven bands, one of which has 10 mm of fringed edge (Laul, Tamla 2014: 54). It could be meant for the edge of a fabric. It is quite complicated to start a fabric with tablet-woven bands on a horizontal loom, and considering the features of the loom, there is no need for this, although such an experiment cannot be excluded in the future. As it was technically not possible to begin weaving the fabric in the same manner as on a vertical loom, I attached the bands to each end of the fabric after I had taken the fabric off the loom. The warps of the fabric are woven into the tablet-woven band as wefts (Ratio 1991: 26). I wove the warps into the shed that appeared between the tablets when they were turned away from the fabric. I put a new warp into the next shed and the previous warp towards the fabric. Thus, there are two crossing warps in every shed. For the tablet-woven band, I used 14/2 yarn and wove the weft of the band (the warp of the fabric) single or double, according to the density of the fabric. I had to be careful that the fabric edge would neither slouch nor shrink.

Conclusions

I had to produce six different fabrics, and this turned out to be a real challenge. I achieved visual resemblance to the source materials to the extent possible with the materials and tools available at present. The similitude of the woollen fabrics is a approximate – we do not know exactly how the original fabrics from the end of the 12th century looked. Working on the reconstructions has definitely contributed to my experience and courage in further attempts.

I hope to be able to experiment with more suitable yarns in the future. At present, it is not possible to obtain materials similar to the originals in Estonia. I have been making reconstructions and copies of fabrics for museums since 2008, and the choice of raw materials has definitely become wider over time. Hopefully, it will be possible to produce quality yarns at the wool mill of the UT Viljandi Culture Academy that are close to the originals. The only option to produce proper yarn for the reconstruction would have been hand-processing and spinning by an accomplished artisan, for which we lacked resources and, taking into consideration the objectives set, also need. The yarns that Liis Luhamaa spun for the bands had an important role in the success of the whole project.

Dyeing with synthetic colours was a success in terms of shades as well as even application of colour, except in the case of the shirt-like coat, in which the yarns had not taken the colour on well. Fortunately, it was hardly noticeable in the finished fabric.

Making the reconstruction demonstrated that the success of weaving depends largely on the material used. There has to be a an ample, not a minimal, quantity of yarn, as the case of the peplos dress showed. Weaving according to the measurements was impossible due to shortage of material. In other cases, following the measurements was successful. The yarns did not snap too often, only when the warp was sleyed too densely in the reed. The warps suffered friction against the reed dents and wore through. Experimenting with different fabrics contributes to better results and avoiding mistakes in the future. At the same time, this gave me the idea to experiment with adapting the existing Finnish loom. What kind of impact would excluding a part of the loom, e.g. the reed, have on the fabric? It would make the weaving process more like weaving on a vertical loom.

A reconstruction of an ancient fabric is by nature an endeavour of recreating via conjecture, and reproducing the exact original dating back several centuries is not possible. The present article reflects on the process of recreation, including successful as well as less successful attempts, from the weaver's perspective. As the objective was to attain only visual resemblance of the fabrics to those from the 12th century, I made the fabrics using contemporary materials, tools and methods.

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Item sources

AI 4133: 2274 – Lõhavere box
ERM 19506 – Parisselja bog find
TÜ 1777 – Kukruse cemetery finds
AI 4194 – Pudivere hoard

Author's fieldwork

VM Kaljus 2015: Uus = An interview by Astri Kaljus with a keeper of Kihnu native sheep, Made Uus, in the autumn of 2015 at Paabo farm, Naelavere village, Alatskivi parish. The transcript of the conversation is in the possession of the author.

Abbreviations

AI – Tallinn University research collection of archaeology
ERM – the collection of artefacts of the Estonian National Museum
TÜ – the archaeological collection of the Department of Archaeology of University of Tartu

Astri Kaljus (b 1974) graduated from the University of Tartu Viljandi Culture Academy in 2008, specializing in Estonian native textiles. In 2017, she completed her MA studies in the field of native crafts. Her areas of specialization are woollen fabrics, techniques of weaving based on archaeological finds from the 11th–15th centuries and reconstruction of fabrics. She has produced copies and reconstructions of fabrics and historical garments for several Estonian museums. She also works as the head of the VCA textile workshop and as a lecturer of weaving.

Photo by Pille Kannimäe.