UDK 902
ISSN 1330-0644
VOL 33/2016.
ZAGREB, 2016.

Prilozi

Instituta za arheologiju u Zagrebu

Pril. Inst. arheol. Zagrebu
Str./*Pages* 1-352, Zagreb, 2016.

Pril. Inst. arheol. Zagrebu, 33/2016
Str./*Pages* 1-352, Zagreb, 2016.

Izdavač/*Publisher*
INSTITUT ZA ARHEOLOGIJU
INSTITUTE OF ARCHAEOLOGY

Adresa uredništva/*Address of the editor's office*
Institut za arheologiju/*Institute of archaeology*
HR–10000 Zagreb, Ulica Ljudevita Gaja 32
Hrvatska/*Croatia*
Telefon/Phone ++385/(0)1 61 50 250
Fax ++385(0)1 60 55 806
e-mail: urednistvo.prilozi@iarh.hr
http://www.iarh.hr

Glavni i odgovorni urednik/*Editor in chief*
Marko DIZDAR

Uredništvo/*Editorial board*
Marko DIZDAR, Snježana KARAVANIĆ, Viktória KISS (Budapest, HUN) (prapovijest/Prehistory), Marija BUZOV, Goranka LIPOVAC VRKLJAN (antika/Antiquities), Katarina Katja PREDOVNIK (Ljubljana, SLO), Natascha MEHLER (Wien, AUT), Juraj BELAJ, Tatjana TKALČEC (kasni srednji vijek i novi vijek/Late Middle Ages and Modern era), Predrag NOVAKOVIĆ (Ljubljana, SLO) (metodologija/Methodology)

Izdavački savjet/*Editorial advisory board*
Dunja GLOGOVIĆ (Zagreb), Ivor KARAVANIĆ (Zagreb), Timotej KNIFIC (Ljubljana, SLO), Laszlo KÓVACS (Budapest, HUN), Kornelija MINICHREITER (Zagreb), Mladen RADIĆ (Osijek), Aleksandar RUTTKAY (Nitra, SK), Ivančica SCHRUNK (Minneapolis, USA), Željko TOMIČIĆ (Zagreb), Ante UGLEŠIĆ (Zadar)

Prijevod na engleski/*English translation*
Sanjin MIHELIĆ, Dragan BOŽIČ, Ana ĐUKIĆ, Heidy ETEROVIĆ, Ana GRABUNDŽIJA, Igor KULENOVIĆ, Tamara LEVAK POTREBICA, Marko MARAS, Krešimir MIJIĆ

Prijevod na hrvatski/*Croatian translation*
Sanjin MIHELIĆ

Prijevod na njemački/*German translation*
Mario GAVRANOVIĆ

Lektura/*Language editor*
Ivana MAJER (hrvatski jezik/Croatian)
Sanjin MIHELIĆ, Tamara LEVAK POTREBICA, Marko MARAS, Emily ZAVODNY (engleski jezik/English)
Mario GAVRANOVIĆ (njemački jezik/German)

Korektura/*Proofreads*
Katarina BOTIĆ
Marko DIZDAR

Grafičko oblikovanje/*Graphic design*
Roko BOLANČA

Računalni slog/*Layout*
Hrvoje JAMBREK

Tisak/*Printed by*
Tiskara Zelina d.d., Sv. I. Zelina

Naklada/*Issued*
400 primjeraka/*400 copies*

Pril. Inst. arheol. Zagrebu, 33/2016
Str./*Pages* 1-352, Zagreb, 2016.

Sadržaj

Contents

Izvorni znanstveni radovi

Original scientific papers

Prethodno priopćenje

Preliminary communication

Pregledni rad

Report

Recenzije

Book reviews

Towards Methodological Principles for Experience Textile Archaeology.

Experimental Approach to the Aegean Bronze Age Textile Techniques in the Institute of Archaeology, University of Warsaw

Prilozi metodološkim principima u iskustvenoj tekstilnoj arheologiji.

Eksperimentalni pristup tekstilnim tehnikama brončanog doba Egeje na Institutu za arheologiju Sveučilišta u Varšavi

Pregledni rad
Prapovijesna arheologija

Report
Prehistoric archaeology

UDK/*UDC* 903.04(495)"637"

Primljeno/*Received*: 23. 11. 2015.
Prihvaćeno/*Accepted*: 16. 05. 2016.

AGATA ULANOWSKA
Institute of Archaeology
University of Warsaw
Krakowskie Przedmieście 26/28
Pl-00-927 Warsaw
a.ulanowska@uw.edu.pl

Experimental archaeology is commonly employed in the research on textiles and textile production in prehistory, in order to explain the operational aspects of textile manufacturing and the functionality of textile tools, to investigate fabric wear and decomposition processes, and to reconstruct ancient textiles and costumes. 'Experience textile archaeology' is a term which describes tests and trials of experiential character performed by actors who are not skilled craftspeople in order to get them acquainted with textile production techniques through practice. Although the importance of experience archaeology as a pedagogical tool has already been acknowledged, the experience approach rarely generates analogies that could be further exploited in the academic discourse. However, in the author's opinion, experiential tests and trials, if well scheduled, documented and conducted over a longer period of time, may also contribute to improving the knowledge of textile craft of societies of the past. The methodological principles henceforth suggested for experience activities have been introduced by the author and concern tests conducted with students of archaeology at the University of Warsaw.

Key words: Experimental textile archaeology, experience textile archaeology, textile tools, textile production, textile techniques of Bronze Age Greece, archaeology of Bronze Age Greece

Eksperimentalna arheologija često se koristi u istraživanju tekstila i tekstilne proizvodnje u pretpovijesti s ciljem da se objasne operativni aspekti proizvodnje tekstila i funkcionalnosti alatki za obradu tekstila, za proučavanje procesa oštećenja i propadanja tkanine, kao i za rekonstrukciju drevnih tekstila i odjeće. „Iskustvena tekstilna arheologija" jest termin kojim se opisuju ispitivanja i pokušaji eksperimentalnog karaktera koje provode osobe koje nisu vješti obrtnici kako bi se kroz vlastitu praksu upoznali s tehnikama proizvodnje tekstila. Iako je važnost iskustvene arheologije kao pedagoškog alata već prije prepoznata, iskustveni pristup rijetko stvara analogije koje bi se mogle dalje koristiti u akademskoj raspravi. Međutim, prema mišljenju autorice, iskustveni testovi i pokusi, ako su dobro pripremljeni, zabilježeni i provedeni kroz dulje razdoblje, također mogu doprinijeti povećanju znanja o tekstilnom obrtu prošlih društava. Autorica je predstavila metodološke principe koji se preporučuju za iskustvene aktivnosti, a odnose se na ispitivanja provedena uz pomoć studenata arheologije Sveučilišta u Varšavi.

Ključne riječi: eksperimentalna tekstilna arheologija, iskustvena tekstilna arheologija, tekstilne alatke, proizvodnja tekstila, tekstilne tehnike brončanodobne Grčke, arheologija brončanog doba Grčke

INTRODUCTION

Experimental approach has been an important part of archaeological research since the very beginnings of the discipline and has developed from natural curiosity about past technologies and the function of unearthed finds. In studies on archaeological textiles, experimenting has been crucial in understanding the structure of fabrics and applied techniques, and explaining the complexity of the *chaîne opératoire* of textile manufacturing. Therefore, many of the pioneers of modern textile archaeology, such as Grace M. Crowfoot, Marghrete Hald, Marta Hoffmann, Jill Carington Smith and Elisabeth J. W. Barber have successfully combined academic knowledge of textile techniques with craft skills and practice. Their personal hands-on experiences have facilitated expert analyses on the scraps of textiles and textile tools found in archaeological contexts, and also allowed more comprehensive analogies to traditional textile techniques to be further observed and recorded by ethnographic research.

This paper discusses personal hands-on experience as almost an essential prerequisite for textile studies, as well as the ways in which experience archaeology approach may be used in didactics and academic discourse. It has been argued that experience archaeology, in addition to its acknowledged role as an important pedagogical tool, may also generate analogies of a more scholarly character, provided that the scope of experiential activities is purposefully designed and documented. The suggested methodology of experience tests and the system of their documentation have been developed during the author's five years' practice in university teaching about textile production in Bronze Age Greece, at the Institute of Archaeology, University of Warsaw.

EXPERIMENTAL TEXTILE ARCHAEOLOGY

Experimenting in research on textiles and textile production consists of several integrated practical approaches. Generally, the term 'experimental textile archaeology' applies to those experiments and trials which have been scheduled to answer a specific and previously defined research question, and therefore, which are directed towards testing a hypothesis related to archaeological evidence. There are several systems of classification or categorization of experimental textile archaeology tests and trials, according to their main subject, applied procedures, or the level of scientific verifiability. Probably the most universal one has been suggested by Eva Andersson Strand, who has distinguished three major activities undertaken under the 'experimental archaeology' terminological umbrella: ethnographic studies, experience archaeology, and experimental archaeology understood as a method (Andersson Strand 2010b: 1; 2014: 41–43). This last term refers to a broad scope of different practises, such as: reconstruction of ancient fabrics and costumes, experimenting with raw materials processing, tools testing, time trials and experimenting with physio-chemical decay processes such as mineralization of fibres, degradation of textiles in soil, wear marks, and colour changes (Peacock 2001; 2014). These experiments may therefore be

UVOD

Eksperimentalni pristup već je od najranijih početaka činio bitan dio arheoloških istraživanja, a razvio se iz prirodnog zanimanja za prošle tehnologije i funkciju pronađenih predmeta. U proučavanju arheoloških tekstila, eksperimentiranje je imalo ključnu ulogu za razumijevanje strukture tkanine i primijenjenih tehnika, kao i za objašnjavanje složenosti *lanca operacija* u proizvodnji tekstila. Više je pionira suvremene tekstilne arheologije, kao što su Grace M. Crowfoot, Marghrete Hald, Marta Hoffmann, Jill Carington Smith i Elisabeth J. W. Barber, uspješno kombiniralo akademska znanja o tehnikama tekstila sa zanatskom vještinom i praksom. Njihova su praktična iskustva doprinijela stručnim analizama nalaza tekstila i tekstilnih alatki pronađenih u arheološkom kontekstu, omogućivši da se sveobuhvatnije analogije za tradicionalne tekstilne tehnike prouče i zabilježe kroz etnografska istraživanja.

Ovaj rad donosi raspravu o osobnim praktičnim iskustvima kao gotovo esencijalnom preduvjetu za istraživanje tekstila, kao i o načinima na koje se iskustveni arheološki pristup može koristiti u didaktici i akademskom diskursu. Izneseno je mišljenje da iskustvena arheologija, uz svoju već prihvaćenu ulogu kao važnoga pedagoškog sredstva, može stvoriti i analogije koje su više znanstvene naravi, pod uvjetom da se opseg iskustvenih aktivnosti svjesno isplanira i zabilježi. Predložena metodologija iskustvenih testova i sustav njihova bilježenja razvijeni su tijekom autoričine petogodišnje prakse kao sveučilišnog predavača na temu proizvodnje tekstila u Grčkoj brončanog doba na Institutu za arheologiju Sveučilišta u Varšavi.

EKSPERIMENTALNA TEKSTILNA ARHEOLOGIJA

Pokusi u istraživanju tekstila i tekstilne proizvodnje sastoje se od nekoliko povezanih praktičnih pristupa. Općenito uzevši, sintagma „eksperimentalna tekstilna arheologija" odnosi se na sve one eksperimente i ispitivanja kojima je cilj ponuditi odgovore na točno određena prethodno definirana istraživačka pitanja te su prema tome usmjereni na ispitivanje hipoteza utemeljenih na arheološkim nalazima. Postoji nekoliko sustava klasifikacije ili kategorizacije ispitivanja i pokusa u eksperimentalnoj tekstilnoj arheologiji, koje je moguće podijeliti prema glavnim temama, primijenjenim postupcima ili prema razini znanstvene provjerljivosti. Vjerojatno je najopćenitiji onaj koji je predložila Eva Andersson Strand koja razlikuje tri glavne aktivnosti koje ulaze pod skupni naziv „eksperimentalne arheologije": etnografska istraživanja, iskustvena arheologija te eksperimentalna arheologija kao metoda (Andersson Strand 2010b: 1; 2014: 41–43). Ovaj posljednji termin odnosi se na široku paletu različitih praksi, kao što su rekonstrukcija starih tkanina i nošnji, eksperimentiranje s obradom sirovina, ispitivanje alatki, zatim vremenski pokusi i eksperimenti vezani uz fizikalno-kemijske procese raspadanja poput mineralizacije vlakana, propadanja tkanina u tlu, tragove upotrebe te promjena boje (Peacock 2001; 2014). Ovi se eksperimenti u skladu s time mogu podijeliti u četiri glavne tematske grupe prema

divided, according to their main objectives, into four main thematic groups, such as:

- experiments that explain yarn properties and textile structure and reconstructions of ancient fabrics and costumes;
- experiments that explain the *chaîne opératoire* of textile production with tests that examine processing of raw materials, and functionality and properties of textile tools;
- experiments that explain socio-economic dimensions of textile production, such as time trials in spinning and weaving;
- scientific laboratory tests that explain the physio-chemical processes which influence textiles and yarns, such as degradation of organic materials, dyes or wear marks.

Experience textile archaeology, defined also as 'exploratory experimental archaeology' (Miller 2007: 34–35) or 'experiential activities' (Outram 2008: 3–4), is usually distinguished from experimental approach, because experience tests and trials do not explain any hypothesis related to archaeological evidence and serve as a tool for a personal development rather than a method of a scholarly research.

These tests are performed by actors who wish to gain some hands-on experience in textile techniques, in order to comprehend textile production in a more complete manner. As a result, the actors posses some initial 'body' or kinaesthetic' knowledge of textile craft which, in turn, allows them to incorporate their perspective as a craftsperson in their further research and to refer to their own experiences. Exploratory tests, although less formal than archaeological experiments and not as strictly controlled, have been nevertheless acknowledged as a possible source of new analogies and an important tool in the analysis of past technologies (Miller 2007: 35; Ulanowska 2014). They may also be perceived as a unique instrument which allows the experimenters to engage personally in social interactions that accompany textile craft and to develop their subjective feelings about the work they are practising.

Experimental approach to textile production in the Institute of Archaeology, University of Warsaw

The experimental approach to studies on textiles and textile production, including some hands-on experience of students, became a regular course at the Institute of Archaeology, University of Warsaw in 2011. In these courses, I have focused on teaching about textile production in Bronze Age Greece, choosing weaving techniques as my main subject of lectures and experimenting. Most of the tests and trials undertaken by students are planned as a practical introduction to the craft of weaving, and their main aim is to get the students acquainted with basic textile production terminology and an initial 'body knowledge' of chosen weaving techniques (Ulanowska 2012; 2014).

The programme for experience archaeology tests includes the following experiential activities: modelling clay textile tools as copies of Bronze Age Aegean artefacts, constructing simple looms or heddling implements, weaving

njihovim ključnim ciljevima, a to su:

- eksperimenti koji objašnjavaju svojstva prediva i strukture tekstila te rekonstrukcije starih tekstila i nošnji;
- eksperimenti koji objašnjavaju *lanac operacija* u proizvodnji tekstila temeljem ispitivanja obrade sirovina te funkcionalnosti i svojstava tekstilnih alatki;
- eksperimenti koji objašnjavaju društveno-ekonomske dimenzije proizvodnje tekstila, kao što je mjerenje vremena pri predenju i tkanju;
- znanstvena laboratorijska ispitivanja koja objašnjavaju fizikalno-kemijske procese koji utječu na tkanine i prediva, kao što su propadanje organskih materijala, boja ili tragovi upotrebe.

Iskustvena tekstilna arheologija koju se još naziva i „istraživačko-eksperimentalnom arheologijom" (Miller 2007: 34–35) ili „iskustvenim aktivnostima" (Outram 2008: 3–4), obično se razlikuje od eksperimentalnog pristupa, zato što iskustvena ispitivanja i pokusi ne objašnjavaju hipoteze koje se odnose na arheološke dokaze nego prije služe kao oruđe za stjecanje osobnih iskustava a ne kao znanstveno-istraživačka metoda.

Ove testove provode oni koji žele steći određena praktična iskustva u tekstilnim tehnikama, kako bi stekli dublji i potpuniji uvid u proizvodnju tekstila. Kao posljedicu toga, te osobe stječu jedno inicijalno „tjelesno" odnosno kinestetičko znanje o tekstilnom zanatu, što im pak omogućuje da svoju perspektivu kao zanatlije ugrade u daljnja istraživanja te da se referiraju na svoja vlastita iskustva. Iako manje formalni te ne tako čvrsto kontrolirani poput arheoloških eksperimenata, istraživački testovi svejedno su već prihvaćeni kao moguć izvor novih analogija te kao važno sredstvo u analizi prošlih tehnologija (Miller 2007: 35; Ulanowska 2014). Također ih se može promatrati i kao jedinstveno sredstvo koje omogućuje eksperimentatorima da se osobno uključe u društvene interakcije koje prate tekstilni zanat te razviju vlastite osjećaje prema aktivnostima koje provode.

Eksperimentalni pristup proizvodnji tekstila na Institutu za arheologiju Sveučilišta u Varšavi

Eksperimentalno proučavanje tekstila i tekstilne proizvodnje, uključujući i praktičan rad studenata, 2011. godine uvedeni su kao redoviti nastavni predmet na Institutu za arheologiju Sveučilišta u Varšavi. Na tim sam se satovima fokusirala na učenje o proizvodnji tekstila u brončanodobnoj Grčkoj, odabravši tehnike tkanja kao glavnu temu predavanja i eksperimenata. Najveći dio testova i ispitivanja koje su studenti poduzimali planirani su kao praktični uvod u vještinu tkanja, s glavnim ciljem da studente upoznaju s osnovnom terminologijom tekstilne proizvodnje te im pruže početni korpus znanja o odabranim tehnikama tkanja (Ulanowska 2012; 2014).

Program za iskustvene arheološke testove uključuje sljedeće eksperimentalne aktivnosti: modeliranje glinenih tekstilnih alatki kao kopija brončanodobnih egejskih predmeta, izradu jednostavnih tkalačkih stanova ili naprava s nićanicama, tkanje vrpci „kanica" na tkalačkim stanovima za izradu uskih traka, tkanje početnih rubova i snivanje osnova (tekstila), snivanje osnova i tkanje na vertikalnom tka-

narrow bands on band looms such as rigid heddles and tablets, weaving/warping starting borders, warping and weaving on warp-weighted looms, interlinking in sprang, and finishing the textiles. The activities are scheduled within the 60-hour time-span of a single course, plus approx. 60 hours of students' homework. All activities are first demonstrated and then practised by students as DIY tasks performed individually or, in the case of weaving starting borders and weaving on warp-weighted looms, performed in groups consisting of two to three actors.

TEXTILE PRODUCTION IN BRONZE AGE GREECE AS A REFERENCE

Since textile production in Bronze Age Greece is the main subject of my academic interests, Aegean textile traditions and weaving techniques constituted the focal area of references.

Only a few scanty textile fragments have been preserved from archaeological contexts in Greece. Recently, however, studies on textile production have apparently made progress thanks to the successful combination of technological approach to textile tools and production remains with experimental archaeology, iconographical approach and linguistic/textual analyses of linear B tablets (Cf. Barber 1991; Breniquet, Michel 2014; Burke 2010; Gillis, Nosch 2007; Harlow et al. 2014; Laffineur, Betancourt 1997; Michel, Nosch 2010; Nosch, Laffineur 2012; Tzachili 1997).

As a result of the experimental approach, textile implements, primarily spindle-whorls and loom weights, have been better understood in terms of their functionality and the relationship between their parameters and final products: yarns and fabrics (Andersson, Nosch 2003; Andersson Strand 2010a; 2012; Mårtensson et al. 2005/06; 2006a; 2006b; 2007a; 2007b; Mårtensson et al. 2009), thus constituting a helpful starting point for experience activities with students.

The overall textile tradition in Bronze Age Greece may be roughly defined by:

- the employment of two basic raw materials: wool and flax;
- dropped and supported spindle-spinning techniques with a low spindle-whorl;
- advanced dyeing techniques;
- the widespread use of the warp-weighted loom and most probably band looms;
- plain weaves (although twill may also have been known);
- different techniques of patterned weaving;
- final products of utmost technical quality: fine, diaphanous and multicoloured textiles - high specialisation of the craft (Cf. Barber1991; Carington Smith 1975; Killen 2007; Spantidaki, Moulhérat 2012: 187–194; Tzachili 1997).

However, the Aegean textile tradition cannot be seen as a homogenous "technical system" with similar social organization, although some of abovementioned features were present in all cultures of Bronze Age Greece, as well as in the neighbouring areas. There were certain regional and diac-

lačkom stanu, preplet niti u „jalba" tehnici te dovršavanje tkanine. Aktivnosti su raspoređene na ukupno 60 sati tijekom jednog semestra, uz dodatnih otprilike 60 sati domaće zadaće za studente. Sve su aktivnosti prvo demonstrirane studentima, nakon čega su ih oni izvodili samostalno ili, kao u slučaju tkanja početnih rubova te tkanja na vertikalnom tkalačkom stanu, u grupama od dvije ili tri osobe.

PROIZVODNJA TEKSTILA U BRONČANODOBNOJ GRČKOJ KAO REFERENCA

S obzirom na to da je glavna tema moga akademskog zanimanja proizvodnja tekstila u bronČanodobnoj Grčkoj, ključne polazišne točke bile su mi egejske tekstilne tradicije i tehnike tkanja.

Iz Grčke potječe tek nekoliko sačuvanih ulomaka tekstila iz arheološkog konteksta. Međutim, nedavna istraživanja tekstilne proizvodnje dovela su do pomaka zahvaljujući uspješnom spajanju tehnološkog pristupa tekstilnim alatkama i ostacima proizvodnje s eksperimentalnom arheologijom, ikonografskim pristupom te lingvističkim/tekstualnim analizama linear B pločica (*usp*. Barber 1991; Breniquet, Michel 2014; Burke 2010; Gillis, Nosch 2007; Harlow et al. 2014; Laffineur, Betancourt 1997; Michel, Nosch 2010; Nosch, Laffineur 2012; Tzachili 1997).

Rezultat takvoga eksperimentalnog pristupa jest bolje razumijevanje tekstilnih alatki, prije svega pršljenaka i utega, u smislu njihove funkcionalnosti te odnosa između njihovih parametara i konačnih proizvoda: prediva i tkanine (Andersson, Nosch 2003; Andersson Strand 2010a; 2012; Mårtensson et al. 2005/06; 2006a; 2006b; 2007a; 2007b; Mårtensson et al. 2009), čime je stvorena korisna osnova za iskustvene aktivnosti za studente.

Ukupna tekstilna tradicija u Grčkoj bronČanog doba može se okvirno definirati pomoću sljedećih odrednica:

- upotreba dviju osnovnih sirovina: vune i lana;
- tehnike predenja sa slobodno visećim i oslonjenim vretenom s nisko postavljenim pršljenkom;
- napredne tehnike bojenja;
- raširenо korištenje vertikalnog tkalačkog stana te vjerojatno i tkalačkog stana za izradu vrpci, tzv. „tkanica";
- obična tkanja (iako je keper također možda bio poznat);
- različite tehnike tkanja s uzorcima;
- krajnji proizvodi vrhunske tehničke kvalitete: fine, prozračne i višebojne tkanine – visokospecijalizirani obrt (*usp*. Barber 1991; Carington Smith 1975; Killen 2007; Spantidaki, Moulhérat 2012: 187–194; Tzachili 1997).

Međutim, egejska tekstilna tradicija ne može se smatrati homogenim „tehničkim sustavom" sa sličnom društvenom organizacijom iako su neke od gore spomenutih značajki bile prisutne u svim kulturama bronČanodobne Grčke, kao i u susjednim područjima. Postojale su određene regionalne i dijakronijske razlike između i unutar minojskih, kikladskih i heladskih kultura, poput raznovrsnih uzoraka distribucije pršljenaka i utega za tkalački stan na Kreti te na grčkom kopnu, koji upućuju na razlike i transformacije u organizaciji

hronic differences between and within the Minoan, Cycladic and Helladic cultures, such as diverse patterns of distribution of spindle-whorls and loom weights on Crete and in the Mainland, suggesting differences and transformations in the organization of spinning and weaving in both areas (Burke 2010; Carington Smith 1975; Tzachili 1997). From the point of view of experience archaeology, the most advantageous characteristic of the Aegean textile tradition is the high diversification of textile implements, primarily loom weights, which makes it possible to conduct tangible trials demonstrating the functionality of loom weights and direct effects of their parameters on the quality of fabrics.

Towards the methodology of experience textile archaeology: objectives and tenets of experiential tests

The universal principle of experimental archaeology, formulated by one of its scientific fathers – John Coles (1973; 1979) states, that any replication of an ancient technique should be as close to the past technology as possible. Since experimenting in textile archaeology refers to so many practical actions, methodology of archaeological experiments can be hardly generalized behind this overall statement. Each particular approach requires its own different methods and altered tenets.

The methodological principles of our experience activities have been influenced by principles established for experimental research aimed at investigating the function of textile implements found on archaeological sites in Bronze Age Eastern Mediterranean. The experiments were carried out in 2005 and 2006 as part of the *Tools and Textiles – Texts and Contexts* research programme of the Danish National Research Foundation's Centre for Textile Research (Andersson Strand 2010b: 2; Mårtensson et al. 2005/06: 3; Märtensson et al. 2009: 379). Although some of these tenets cannot be applied to experience activities with students, they have generally inspired our approach to weaving tests, in which copies of loom weights from Bronze Age Greece were used.

The main objective of the experience archaeology approach to textile production teaching is to introduce some craft techniques by practice, in addition to academic readings and lectures, in order to get students/actors acquainted with, otherwise inaccessible, body or kinaesthetic knowledge of a craft (weaving in our tests). In the process of craft teaching the term *chaîne opératoire* is introduced as an analytical tool in studies on technology, and all the tests and trials are planned in the order of consecutive sequences of an operational framework of weaving. Consequently, students become more aware of the complexity of the *chaîne opératoire* of textile manufacturing and the manner in which the operational sequences may be scheduled, more conscious of the functional parameters of textile tools and, hopefully, more focused on textile production in interpreting archaeological finds and artefacts in the future.

The main tenets of experience archaeology trials and tests with students may be described according to the following rules:

- all activities are scheduled according to the *chaîne* predenja i tkanja u oba područja (Burke 2010; Carington Smith 1975; Tzachili 1997). Sa stajališta iskustvene arheologije, najpovoljnija karakteristika egejske tekstilne tradicije jest velika raznovrsnost tekstilnog pribora, prije svega utega za tkalački stan, što nam omogućuje da provedemo konkretne pokuse koji dokazuju funkcionalnost utega te izravne učinke njihovih parametara na kvalitetu tkanine.

Prema metodologiji iskustvene arheologije tekstila: ciljevi i načela iskustvenih pokusa

Opće načelo eksperimentalne arheologije koje je formulirao jedan od njezinih znanstvenih začetnika – John Coles (1973; 1979) – nalaže da bilo kakvo ponavljanje neke drevne tehnike treba biti što je više moguće u skladu s prošlom tehnologijom. Budući da se eksperimentiranje u arheologiji tekstila odnosi na mnoge praktične aktivnosti, metodologija arheoloških eksperimenata teško se može generalizirati prema ovoj općenitoj tvrdnji. Svaki pojedini pristup zahtijeva svoje vlastite metode i izmijenjena načela.

Na metodološke principe naših iskustvenih aktivnosti utjecala su načela postavljena za eksperimentalno istraživanje usmjereno na proučavanje funkcije tekstilnih alatki pronađenih na arheološkim nalazištima na istočnom Sredozemlju tijekom brončanog doba. Eksperimenti su provedeni 2005. i 2006. godine kao dio istraživačkog programa Centra za istraživanje tekstila Danske nacionalne istraživačke zaklade pod nazivom *Alatke i tekstili – tekst i kontekst* (Andersson Strand 2010b: 2; Mårtensson et al. 2005/06: 3; Mårtensson et al. 2009: 379). Iako se neka načela ne mogu primijeniti na iskustvene aktivnosti sa studentima, općenito uzevši, ipak su nadahnula naš pristup tkalačkim pokusima, pri kojima su korištene replike utega za tkalački stan iz Grčke brončanog doba.

Glavni cilj našeg iskustvenoga arheološkog pristupa učenju o proizvodnji tekstila bio je uvesti prakticiranje zanatskih tehnika, uz akademsko čitanje i predavanja, kako bi se studenti/provoditelji upoznali s inače nedostupnim tjelesnim ili kinestetičkim poznavanjem zanata (u našim pokusima riječ je o tkanju). U procesu poučavanja o zanatu, pojam *chaîne opératoire* (lanac operacija) uvodi se kao analitičko oruđe u proučavanju tehnologije, a svi se testovi i pokusi planiraju u uzastopnom nizu jednoga operativnog okvira tkanja. Posljedično, studenti postaju svjesniji složenosti takvog *chaîne opératoire* u proizvodnji tekstila te načina na koji se operativni sljedovi mogu rasporediti, svjesniji funkcionalnih parametara tekstilnih alatki te, nadajmo se, usredotočeniji na proizvodnju tekstila u tumačenju arheoloških nalaza i predmeta u budućnosti.

Glavna načela pokusa i testova iskustvene arheologije sa studentima mogu se opisati u skladu sa sljedećim pravilima:

- sve se aktivnosti raspoređuju prema slijedu *lanca operacija*, kao „uradi sam" zadaci;
- svi testovi i pokusi organiziraju se u skladu s vremenskom organizacijom tkalačkog procesa;
- tkalački stanovi i tehnike tkanja odabiru se na osnovi trenutačnog poznavanja egejskoga brončanodobnog tekstilnog pribora i tkanja;
- svi utezi za tkalački stan, kalemi i pršljenci korišteni u

opératoire sequences, as DIY (do it yourself) tasks;
- all tests and trials are organized in accordance with the temporal organization of the weaving process;
- looms and weaving techniques are selected based on the current knowledge of the Aegean Bronze Age textile implements and weaves;
- all loom weights, spools and spindle-whorls used in experience activities are copies of Bronze Age implements from archaeological sites in Greece;
- students/actors are always informed of negative archaeological evidence, either for operational sequences of weaving, the construction of looms, or certain categories of textile tools;
- students/actors are always informed that the manner in which they proceed is suggested by ethnographic analogies and that there may be more than one manner of execution for each of the tested activities;
- whenever there is a greater number of manners of execution or procedural choices, at least two of them are demonstrated and tested;
- the documentation system covers descriptions and photographs of all operational sequences combined with a card system for documenting pieces of experientially woven textiles and their weaving as the work of an individual;
- students/actors are not skilled craftspeople and their observations on weaving can only be further analysed having in mind this important qualification.

Since textile manufacturing was a highly specialized activity in Aegean cultures, students are also informed of possible differences in scheduling textile production for household needs and in nondomestic workshops. Thanks to personal involvement and the acquired basic body knowledge of weaving, students, aware that their experience has no relation to these two main organization modules, become more responsive to differentiating between task-oriented and continuously run textile production. Furthermore, experiential tests enacted by a group of collaborating students stimulate the experience of collectively of textile manufacturing and enjoyment that could result from working together.

Experiential activities at the University of Warsaw: modelling textile tools

Most of the tool copies imitate loom weights, whereas copies of spindle-whorls are few, because spinning is merely shown and experienced in the form of one-time trials. In order to demonstrate the functionality of loom weights in practice, several types of such implements of different shapes and weights were chosen for the imitation. The range of parameters contained in publications on textile tools was also one of the decisive factors. During the modelling experience a single artefact representing a certain type of loom weights is moulded in several copies. There was only one exception, where the entire set of 17 pyramidal weights from Late Minoan I Palaikastro (Weingarten 2000) was reshaped in February 2015, although not yet tested. The reproduced sets of loom weights consist of eight to 60 tools

iskustvenim aktivnostima replike su brončanodobnog pribora s arheoloških nalazišta u Grčkoj;
- studenti/izvoditelji su uvijek obaviješteni o negativnim arheološkim dokazima, bilo za operativni slijed tkanja, konstrukcije tkalačkog stana, ili određenih kategorija tekstilnih alatki;
- studenti/izvoditelji su uvijek obaviješteni da se način na koji postupaju temelji na etnografskim analogijama te da za svaku od pokusnih aktivnosti može postojati više od jednog načina izvedbe;
- gdje god postoji više mogućih načina da se provedu odabrani postupci, uvijek se demonstriraju i iskušaju barem dva načina;
- sustav dokumentiranja pokriva opise i fotografije svih operativnih sljedova u kombinaciji s kartičnim sustavom za dokumentiranje komada iskustveno istkanih tkanina i njihova tkanja kao rada pojedinca;
- studenti/izvoditelji nisu vješti zanatlije te se njihova opažanja o tkanju mogu dalje analizirati tek ako se vodi računa o toj važnoj činjenici.

S obzirom na to da je proizvodnja tekstila bila visoko specijalizirana aktivnost u egejskim kulturama, studente se obavještava o mogućim razlikama u rasporedu proizvodnje tekstila za potrebe domaćinstva te u radionicama izvan kuće. Zahvaljujući osobnom uključivanju te stečenom temeljnom znanju o tkanju, studenti, svjesni da njihovo iskustvo nije povezano s tim dvjema glavnim organizacijskim modulima, postaju osjetljiviji na razlikovanje između proizvodnje tekstila usmjerene na zadatak te one koja teče u kontinuitetu. Nadalje, iskustveni testovi koje zajednički provodi grupa studenata potiču iskustvo kolektivne proizvodnje tekstila te zadovoljstva koje proizlazi iz zajedničkog rada.

Iskustvene aktivnosti na Sveučilištu u Varšavi: modeliranje tekstilnih alatki

Najveći dio replika alata imitira utege za tkalački stan, dok je tek nekoliko replika pršljenaka, jer je predenje tek prikazano i iskušano u obliku jednokratnih pokusa. Radi demonstracije funkcionalnosti utega za tkalački stan u praksi, za imitaciju je odabrano nekoliko tipova takvih predmeta različitog oblika i težine. Raspon parametara sadržanih u publikacijama o tekstilnim alatkama također je bio jedan od ključnih čimbenika. Za iskustvo modeliranja, pojedini predmet koji predstavlja određeni tip utega oblikuje se u nekoliko primjeraka. Učinjena je samo jedna iznimka gdje je čitav set od 17 piramidalnih utega s nalazišta Palaikastro kasnominojskog I (LMI) vremena (Weingarten 2000) remodeliran u veljači 2015., no još nije testiran. Reproducirani setovi utega za tkalački stan sastoje se od osam do 60 predmeta (u rasponu od najtežih koničnih utega, pri čemu je rekonstruirana težina pojedinog predmeta otprilike 800 g, do malih kalemova težine oko 38–45 g), dok njihov broj ovisi o težini i mogućoj multifunkcionalnosti predmeta. Trenutačno su nam je na raspolaganju sljedeći setovi pečenih i nepečenih replika utega s Krete i kopnene Grčke: diskoidni utezi iz Myrtosa (Warren 1972: 221: uteg 75, sl. 96.75, T. 74A), sferični utezi iz Neistražene vile u Knossosu (Carington Smith 1975: sl. 47, 49), kubični utezi iz Petrasa i Palaikastra (Burke 2006: 292,

(ranging from the heaviest conical weights, with a reconstructed weight of a single implement of c. 800 g, to small spools weighting c. 38–45 g), with their number depending on the weight and possible multi-functionality of implements. We have at present at our disposal the following sets of baked and unbaked copies of loom weights from Crete and Mainland Greece: discoid loom weights from Myrtos (Warren 1972: 221: loom weight 75, Fig. 96.75, Pl. 74A), spherical weights from Unexplored Mansion in Knossos (Carington Smith 1975: Fig. 47, 49), cuboid weights from Petras and Palaikastro (Burke 2006: 292, Fig. 3, 13; Carington Smith 1975: Fig. 51: PK/63/173), pyramidal weights from Palaikastro and cylindrical, crescent-shaped and conical loom weights from Tiryns (Siennicka 2012: 68–71; Pl. XXV e, g, h). In addition, there are three sets of spools based on artefacts from Tiryns (Rahmstorf 2008: 132, 139, 146, 148; T. 26, 28–29; catalogue numbers: T 1550, T 1621, T 1714, T 1690), which were used in the tests as multifunctional textile tools (Siennicka, Ulanowska, forthcoming).

The loom weights were reshaped so as to make them as similar to the original artefacts as possible, paying special attention to their weight (in preliminary tests, the author calculated the weight loss of wet clay in the drying process; sl. 3, 13; Carington Smith 1975: sl. 51: PK/63/173), piramidalni utezi iz Palaikastra te cilindrični, polumjesečasti i konični utezi za razboj iz Tirinta (Siennicka 2012: 68–71;, T. XXV e, g, h). K tomu, postoje i tri seta kalemova izrađenih na osnovi nalaza iz Tirinta (Rahmstorf 2008: 132, 139, 146, 148; T. 26, 28–29; kataloški brojevi: T 1550, T 1621, T 1714, T 1690), korištenih u pokusima kao multifunkcionalne tekstilne alatke (Siennicka, Ulanowska, u pripremi).

Utezi za tkalački stan bili su preoblikovani kako bi što više sličili izvornim predmetima, pri čemu se posebna pozornost pridavala njihovoj težini (u preliminarnim testovima, autorica je izračunala gubitak težine vlažne gline tijekom procesa sušenja; Ulanowska 2012: 245–246) i dimenzijama (sl. 1). Međutim, mi koristimo glinu koja je prethodno pripremljena i kupljena u keramičarskom dućanu, tako da njezin sastav i finoća nemaju veze s kvalitetom gline stvarnih izrađevina.

Jednom smo se okušali u rekonstrukciji načina na koji su izvorno mogli biti oblikovani diskoidni utezi, ponavljajući eksperiment koji je provela i opisala Carol Cheval (Cheval 2008). Studenti su oblikovali tri glinena valjka čiji su promjeri bili slični prosječnom promjeru diskoidnih utega za razboj te su narezali glinu na kriške pomoću uzice (sl. 2). Zatim, ovi su poluproizvodi dalje oblikovani rukom te probušeni na

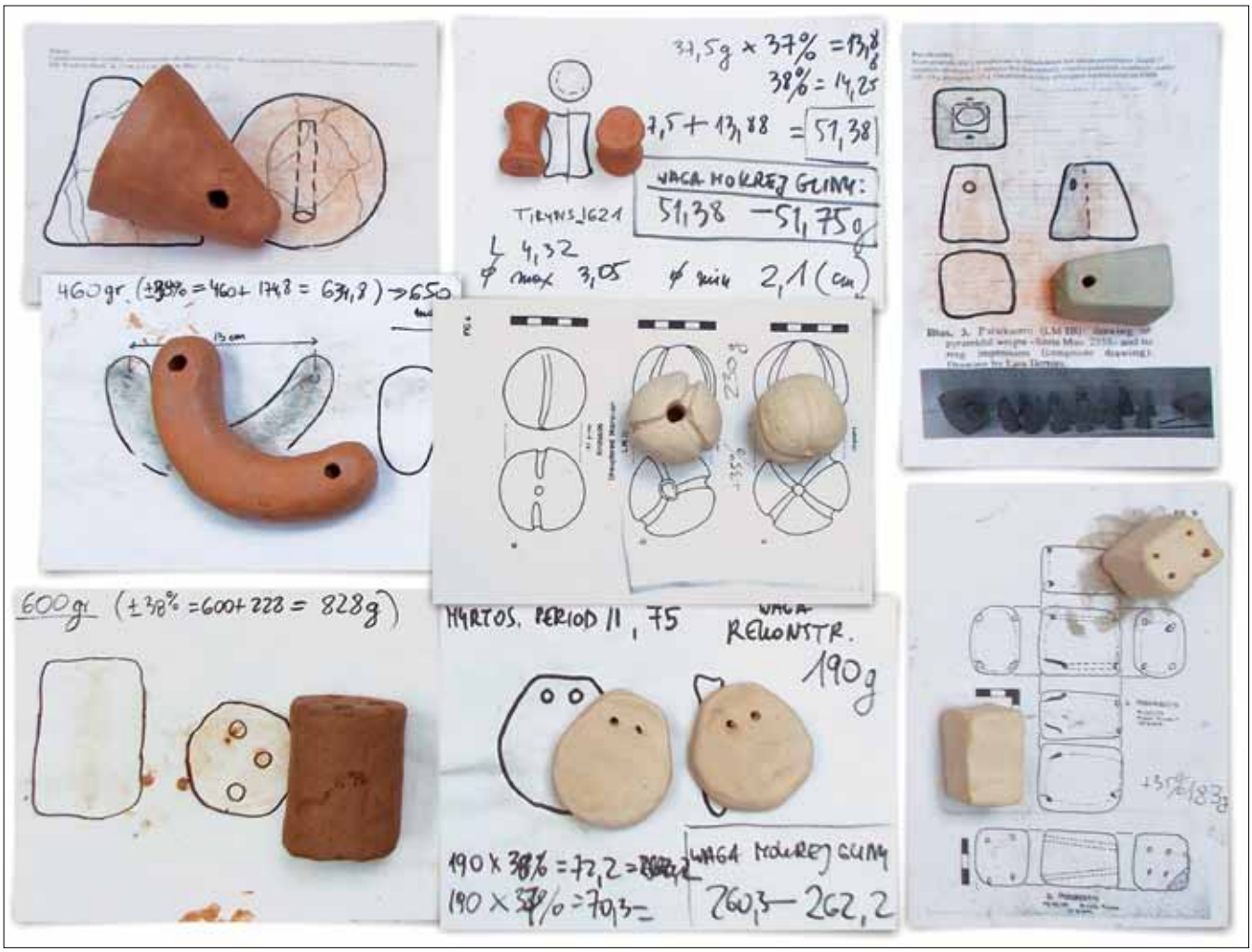

Fig. 1 Copies of loom weights from Bronze Age Greece reconstructed by students of the Institute of Archaeology, University of Warsaw and used in the experiential weaving tests

Sl. 1 Replike utega za tkalački stan iz brončanodobne Grčke, koje su studenti Instituta za arheologiju Sveučilišta u Varšavi rekonstruirali te potom koristili u iskustvenim testovima tkanja

Fig. 2 Modelling discoidal loom weights – re-enactment of Carol Cheval's test. Piercing holes with fingers and sticks. The flattening of the upper edge of the weight appeared while holes were pierced (photo: A. Ulanowska)

Sl. 2 Oblikovanje diskoidnih utega za tkalački stan – uprizorenje testa koji je provela Carol Cheval. Bušenje rupa prstima i štapićima. Tijekom bušenja rupa pojavilo se ravnanje gornjeg ruba utega (foto: A. Ulanowska)

Ulanowska 2012: 245–246) and dimensions (Fig. 1). However, we use clay prepared beforehand and purchased from a ceramic shop, so its composition and finesse have no relation to the quality of clay of the actual artefacts.

We have made one attempt at reconstructing the manner in which the discoid loom weights may have originally been shaped, repeating the experiment performed and already described by Carol Cheval (Cheval 2008). The students modelled three clay rollers with diameters close to an average diameter of discoid loom weights and cut the clay up into slices with a string (Fig. 2). Then, the semi-finished products were further shaped by hand and pierced at the top. Our observations confirmed Cheval's hypothesis that the grooves at the upper edge of some of the discovrhu. Naša su opažanja potvrdila hipotezu Carol Cheval da su utori na gornjem rubu nekih od diskoidnih utega mogli nastati nakon proizvodnje samog utega, što je ovisilo o sili kojom je proizvođač pritiskao vrh utega dok je bušio rupe, kao i o stupnju plastičnosti gline.

Iskustveni arheološki testovi počinju oblikovanjem utega za tkalački stan, jer se glinene alatke ne mogu koristiti odmah nakon što ih se oblikuje – moraju se prvo dobro osušiti prije nego što se mogu peći ili koristiti kao nepečeni predmeti. Količina vremena između trenutka kad ih se oblikuje te kad ih se koristi funkcionalno ovisi o uvjetima sušenja – temperaturi i vlažnosti okoline. Na osnovi našeg iskustva i uvjeta u učionici, to se vrijeme može procijeniti na otprilike tri tjedna. Kao rezultat ovog ograničenja, stu-

id loom weights may have been post-production features which in turn depended on the strength with which the manufacturer flattened the top of the weight while piercing holes, and on the degree of plasticity of the clay.

Experience archaeology tests begin with modelling loom weights, because clay tools cannot be used immediately after being shaped – they need to dry off well before they can be fired or used as unbaked implements. The amount of time between moulding them and using them functionally depends on the drying conditions – the temperature and humidity of the environment. Based on our experience and classroom conditions, said period of time may be estimated at about three weeks. As a result of this limitation, students become more aware of the temporal organization of weaving and, therefore, can gain a better understanding of why, e.g., some of the Cretan-style discoid loom weights, simple and easy-to-make artefacts made of rather coarse fabric, may have been transported to remote areas, most probably as complete sets or templates taken by weavers for making more weights at a new location (Cutler 2012: 150).

WEAVING ON BAND LOOMS

Weaving experience begins with weaving simple, narrow bands on band looms: specifically rigid heddles and tablets, although at first students are familiarized with the general "heddles principle". They also try weaving on heddling devices of no particular construction (Fig. 3).

Narrow bands and braids represented quite an important branch of textile manufacturing, and may have been commonly used as separate items such as belts, bag straps, ties, headbands or even leashes. They may have also been sewn onto cloths to trim them or to reinforce their edges. Small fragments of a delicate band or braid were actually preserved from Late Minoan Chania-Kastelli on Crete (Möller-Wiering 2006: 1–4; Moulhérat, Spantidaki 2009; Spantidaki, Moulhérat 2012: 189).

Moreover, band looms were also used to set up starting borders for textiles woven subsequently on warp-weighted looms. Since woven starting borders have been acknowledged as one of the oldest practices for preparing the warp for the warp-weighted loom (Cf. Barber 1991: 116; Broudy 1979: 31; Carington Smith 1975: 95; Grömer 2013: 73–76; Hoffmann 1974: 152–154; Médard 2012: 371), and since tablets and rigid heddles have been discussed as implements of a certain ancestry (Barber 1991: 116–122; Broudy 1979: 31–33, 90–91; Cheval 2011: 144–145; Collingwood 1982: 11–19; Gleba 2008: 138–139; Gostenčnik 2012: 75; Grömer 2013: 70–72; Hoffmann 1974: 165–166; Ræder Knudsen 2012; Shishlina et al. 2003), both devices are introduced in experience activities, even though there is no direct evidence for either of them in the archaeological contexts of Bronze Age Greece.

However, thanks to indirect evidence provided by the iconography of cloths: mainly costumes edged with bands and "sacred knots" – painted, carved on gems or moulded objects representing elaborately tied narrow fabrics, and by the presence of small, light spools made of clay, recently linked convincingly to tablet weaving (Gleba 2008: 140–141; Ræder Knudsen 2002: 228–229; 2012: 259–260, Fig. 11.11), it is possible to imply that certain types of band looms were denti postaju svjesniji vremenske organizacije u vezi tkanja te, prema tome, mogu bolje razumjeti zašto su, na primjer, neki od diskoidnih utega u kretskom stilu, jednostavni i lako izradivi predmeti razmjerno grube teksture, mogli biti transportirani u daleka područja, najvjerojatnije kao cjeloviti setovi ili uzorci koje su tkalci nosili kako bi izradili više utega na novoj lokaciji (Cutler 2012: 150).

TKANJE NA TKALAČKOM STANU ZA IZRADU VRPCI

Stjecanje tkalačkog iskustva počinje s tkanjem jednostavnih, uskih traka korištenjem tkalačkog stana za izradu vrpci „kanica": konkretno, uz pomoć tkalačkih daščica i pločica, iako se u početku studenti upoznaju s općim „principom nićanica". Također se okušavaju u tkanju na proizvoljnim napravama s nićanicama bez neke posebne konstrukcije (sl. 3).

Uske trake i pletenice činile su jednu vrlo važnu granu tekstilne proizvodnje te su takvi predmeti možda često bili korišteni i zasebno, poput pojaseva, remenja za torbe, spona, ukrasnih traka za glavu ili uzica. Također su mogli biti našiveni na odjeću kako bi je uljepšali ili osnažili rubove. Mali ulomci finih traka ili obruba ostali su očuvani na kasnominojskom nalazištu Chania-Kastelli na Kreti (Möller-Wiering 2006: 1–4; Moulhérat, Spantidaki 2009; Spantidaki, Moulhérat 2012: 189).

Nadalje, tkalački stanovi za tkanje traka korišteni su i za započinjanje inicijalnih rubova za tkanine koje su naknadno istkane na vertikalnom tkalačkom stanu. Budući da je tkanje početnih rubova prepoznato kao jedna od najranijih praksi u pripremanju osnove za okomite tkalačke stanove (*usp*. Barber 1991: 116; Broudy 1979: 31; Carington Smith 1975: 95; Grömer 2013: 73–76; Hoffmann 1974: 152–154; Médard 2012: 371) te s obzirom na to da su tkalačke pločice i tkalačke daščice pribor kojem se pripisuje određena starost (Barber 1991: 116–122; Broudy 1979: 31–33, 90–91; Cheval 2011: 144–145; Collingwood 1982: 11–19; Gleba 2008: 138–139; Gostenčnik 2012: 75; Grömer 2013: 70–72; Hoffmann 1974: 165–166; Ræder Knudsen 2012; Shishlina et al. 2003), obje su naprave uvedene u iskustvene aktivnosti, iako ni za jednu od njih ne postoji izravan dokaz u smislu arheološkog konteksta iz brončanodobne Grčke.

Međutim, zahvaljujući neizravnim dokazima temeljenima na ikonografiji odjeće: ponajviše nošnjama obrubljenim trakama i „svetim čvorovima" – slikanim, izrezbarenim na gemama ili oblikovanim predmetima na kojima su prikazane pažljivo vezane uske tkanine, kao i malim, lakim glinenim kalemovima koji su nedavno uvjerljivo dovedeni u vezu s tkanjem tehnikom tkanja tkalačkim pločicama (Gleba 2008: 140–141; Ræder Knudsen 2002: 228–229; 2012: 259–260, sl. 11.11), moguće je implicirati da su egejske kulture poznavale određene tipove tkalačkih stanova za tkanje traka.

Konačno, tkalačke daščice i pločice jednostavno je konstruirati i njima se koristiti – dakle, može ih se napraviti ručno te ih potom studenti mogu koristiti kod kuće. Konkretno,

known in the Aegean cultures.

Finally, rigid heddles and tablets are easy to construct and handle – they can therefore be hand-made and then used by students at home. Specifically, the simplicity of the rigid heddle seems to be an advantage in introducing the general mechanics of weaving for beginners. Tablet weaving, described by students as a technique relatively more difficult, is shown without threading diagrams – the basic hands-on experience is gained by manipulating sets of four to six tablets carrying two colour threads, turned backward and forward or twisted about an axis (cf. Collingwood 1982). After gaining some practice in weaving narrow bands, students (who usually weave three or four bands during the course) prepare their own starting borders. Thanks to this hands-on experience, the main functions of starting borders are noted, such as: even spacing of warp threads, separating even warp threads from uneven ones nicely, and providing a decorative, and stronger, selvedge for the fabric. Students also become more responsive to the relationship between the structure of the starting border and the structure of the final fabric.

Both looms, rigid heddles and tablets, are tested with different warp tensioning and different working positions (Fig. 4), such as:

jednostavnost tkalačkih daščica čini se kao prednost pri predstavljanju opće mehanike tkanja početnicima. Tkanje tehnikom tkalačkih pločica, koju su studenti opisali kao razmjerno težu metodu, predstavljena je bez dijagrama udijevanja – osnovno praktično iskustvo stječe se rukovanjem setovima od četiri do šest pločica koje nose dvije obojene niti, koje se okreće natrag i naprijed ili ih se vrti oko osi (*usp.* Collingwood 1982). Nakon što steknu određenu praksu u tkanju uskih traka, studenti (koji obično istkaju tri ili četiri trake tijekom semestra) pripremaju svoje vlastite početne rubove. Zahvaljujući ovom praktičnom iskustvu, bilježe se glavne funkcije početnih traka, kao što je pravilan razmak između niti osnove, pri čemu su lijepo odvojene parne niti osnove od neparnih, a omogućuju i ukrasan te čvrsti obrub za tkaninu. Studenti jednako tako postaju zainteresiraniji za odnos između strukture početnog ruba te strukture konačne tkanine.

I tkalački stanovi, daščice i pločice iskušani su s različitim napetostima niti osnove, kao i u različitim radnim položajima (sl. 4), kao što su:

- tkanje u sjedećem položaju s osnovom razvučenom između dvije čvrste točke;

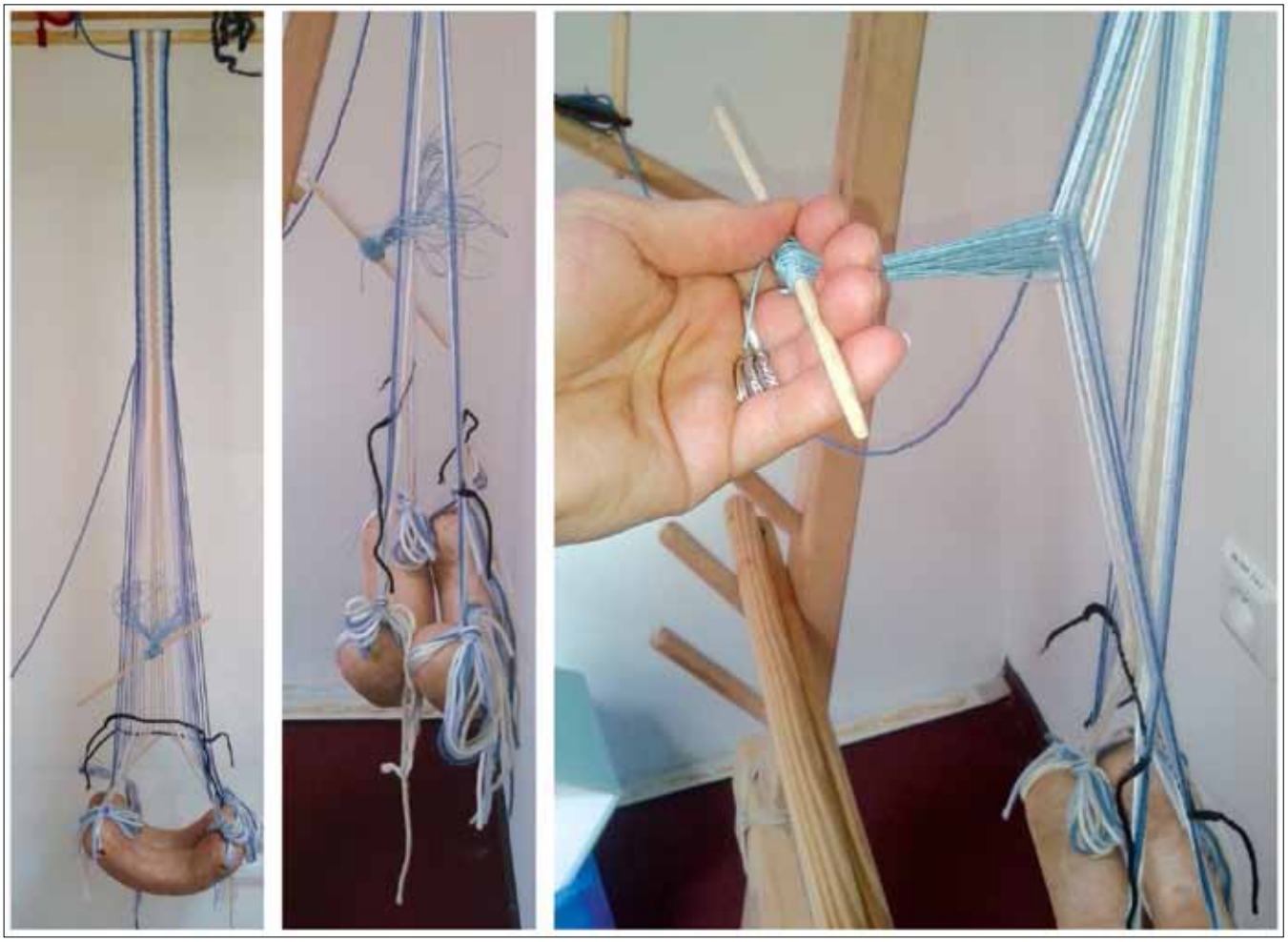

Fig. 3 Weaving bands on a heddling device tensioned by copies of two crescent-shaped loom weights inspired by Karl Schlabow's reconstruction of band weaving (photo: A. Ulanowska)

Sl. 3 Tkanje traka „kanica" pomoću jednostavne konstrukcije s nićanicama napete replikama dvaju polumjesečastih utega, nadahnuto rekonstrukcijom tkanja traka koju je ponudio Karl Schlabow (foto: A. Ulanowska)

Fig. 4 Weaving on rigid heddles and tablets using different methods of warp tensioning (photo: A. Ulanowska, K. Żebrowska)
Sl. 4 Tkanje na tkalačkim daščicama i pločicama korištenjem različitih metoda napinjanja osnove (foto: A. Ulanowska, K. Żebrowska)

- weaving in a sitting position with the warp stretched between two fixed points;
- weaving in a sitting position with the warp tied to the weaver;
- weaving in a standing position with the warp tensioned by weights.

Vertical warp tensioning, recently discussed by Margarita Gleba and Lise Ræder Knudsen for tablet weaving in Prehistoric Italy, was similarly applied to rigid heddles with quite satisfying results: the tension was stable during the entire work, sheds changed gently, and the fabric width was easily controlled. In tablet weaving with the warp tensioned by the use of small spools, wooden spacers may be added in order to protect threads from tangling. This practice may again be traced in pre-Roman Italy (Gleba 2008: 152–153). However, no spacers have been preserved from Bronze Age Greece.

- tkanje u sjedećem položaju s osnovom privezanom za tkalca;
- tkanje u stojećem položaju s osnovom koju napinju utezi.

Okomito napinjanje osnova, o čemu su nedavno diskutirale Margarita Gleba i Lise Ræder Knudsen, za tkanje tehnikom tkalačkih pločica u pretpovijesnoj Italiji, na sličan je način primjenjivano i na ltkalačke daščice sa sasvim zadovoljavajućim rezultatima: napetost je bila stabilna tijekom čitavog rada, zjevovi su se blago mijenjali, a širina tkanine lako je kontrolirana. U tkanju pločicama s osnovom koju su napinjali mali kalemovi, mogle su se umetati drvene razmaknice kako bi se spriječilo zaplitanje niti. Ovu je praksu također moguće pratiti i u predrimskoj Italiji (Gleba 2008: 152–153). Međutim, iz brončanodobne Grčke nisu sačuvane nikakve razmaknice.

WEAVING ON THE WARP-WEIGHTED LOOM

Numerous finds of loom weights, which provide good evidence for the widespread use of the warp-weighted loom in Bronze Age Greece and suggest that textiles of varied quality were manufactured, do not tell us anything about loom construction. Since loom weights have rarely been found *in situ* (Cf. Andersson Strand, Nosch no date: 23; Barber 1991: 93, 102–103; Carington Smith 1975: 302–303; Mauel 2012; Siennicka 2012: 67), it is difficult even to hypothesise whether the Aegean warp-weighted loom was a Scandinavian type of loom, or rather a free-standing construction. Some schematic iconographical references to the warp-weighted loom may be traced in Minoan glyptic on multifaced seals and in logograms of linear A and B scripts (Burke 1997: 418–419; 2010: 43–47, 49; Del Freo, Nosch, Rougemont, 2010: 351–53, Fig. 17.11; Militello 2007: 41; Nosch 2012: 306–307, Fig.1; Petrakis 2012: 78–79; Pl. CXXVI; Ulanowska, forthcoming), but they take the form of symbolic iconic signs designating a cloth or loom, and by no means depict a real implement.

Two warp-weighted looms of the Scandinavian type were constructed for the needs of the experience weaving tests. The author decided to choose this type of loom, because its construction is very simple and the loom is easy to move around. Both looms were built by amateurs, out of materials which might have been used in the Bronze Age Greece (such as wood from deciduous trees and hemp cord) but with the use of modern tools such as the electric drill. We made no attempts at making them look "archaic", nor were they copies of any particular ancient or modern implements. In groups of two or three participants, students enact all the operational sequences of weaving on the warp-weighted loom: they sew a starting border to the cloth beam (other methods of the starting stage of weaving a textile are discussed); they choose loom weights according to the expected parameters of the textile and suspend them directly or indirectly with extra loops; they chain the warp threads (two methods tested), knit the heddles to the heddle bar (other manners discussed); and they weave and finish textiles (several methods tested) (Fig. 5).

Students are informed that the number of weavers operating a single loom in the Bronze Age Aegean is not known, and that it may have been related to the construction of the warp-weighted loom and its shedding devices (Barber 1991: 109–113; 2007, 174; Militello 2007: 41; Tzachili 1990: 386; Ulanowska 2014: 157). Therefore, students try to weave without using heddle bar supports and to operate the loom by one person only. There are fewer textiles woven on the warp-weighted loom than bands because they are made by a pair or a group of actors, it takes noticeably more time to weave on the vertical loom, and it is impossible for students to practise at home: therefore, each group of actors normally weaves one piece of fabric during the course. The fabrics are frequently of poorer quality in comparison to that of bands: textiles commonly narrow down while being made, the weave is uneven and the weft may run at an angle to the cloth beam. All errors are discussed, and the students look for possible relations between the errors and the correctness of the tension were applied, the manner in which the weft is drawn through the sheds, and

TKANJE NA VERTIKALNIM TKALAČKIM STANOVIMA S OSNOVOM NAPETOM UTEZIMA

Brojni nalazi utega za tkalačke stanove koji pružaju odlične dokaze za široko korištenje vertikalnih tkalačkih stanova u brončanodobnoj Grčkoj te upućuju na to da su se proizvodile tkanine raznovrsne kvalitete, ne govore nam ništa o strukturi tkalačkih stanova. S obzirom na to da su utezi za tkalački stan rijetko pronalaženi *in situ* (*usp*. Andersson Strand, Nosch, s.a.: 23; Barber 1991: 93, 102–103; Carington Smith 1975: 302–303; Mauel 2012; Siennicka 2012: 67), teško je čak i pretpostaviti jesu li tkalački stanovi s osnovom koju su napinjali utezi predstavljali skandinavski tip tkalačkog stana, ili je vjerojatnije bila riječ o samostojećoj konstrukciji. Određene shematizirane ikonografske reference na vertikalne tkalačke stanove mogu se pratiti u minojskoj gliptici na pečatima s više lica te u logogramima linear A i linear B pisama (Burke 1997: 418–419; 2010: 43–47, 49; Del Freo, Nosch, Rougemont, 2010: 351–53, sl. 17.11; Militello 2007: 41; Nosch 2012: 306–307, sl. 1; Petrakis 2012: 78–79; T. CXXVI; Ulanowska, u pripremi), no ovi primjeri imaju oblik simboličkih ikoničnih znakova koji označavaju tkaninu ili tkalački stan, a ni u kom slučaju ne predstavljaju stvarnu napravu.

Za iskustvene tkalačke testove sastavljena su dva okomita razboja skandinavskog tipa. Autorica je odlučila odabrati ovaj tip razboja zbog jednostavnosti konstrukcije te lakog prenošenja. Oba tkalačka stana sagradili su nestručnjaci od materijala koji su mogli biti korišteni u brončanodobnoj Grčkoj (poput drva bjelogorica te užadi od konoplje), no korištenjem suvremenih alatki poput električne bušilice. Nismo se trudili da im podarimo „arhaičan" izgled, niti smo kopirali neke određene povijesne ili suvremene naprave. U grupama od po dva ili tri sudionika, studenti izvode sve dijelove lanca operacija za tkanje na okomitom tkalačkom stanu: šiju početni rub na gredu za tkaninu (raspravlja se o drugim metodama početnog stadija tkanja tkanine); odabiru utege za razboj prema očekivanim parametrima tkanine te ih vješaju izravno ili neizravno pomoću dodatnih petlji; lančano opliću niti osnove u pletenicu (isprobavaju se dvije metode), pletu nićanice na gredu (raspravlja se i o drugim metodama); te tkaju i dovršavaju tkanine (iskušava se nekoliko metoda) (sl. 5).

Studenti se upoznaju s činjenicom da nam nije poznat broj tkalaca koji su tijekom brončanog doba Egeje radili na jednom tkalačkom stanu, te da je to moglo biti povezano s konstrukcijom vertikalnog tkalačkog stana i načinima za stvaranje zijeva (Barber 1991: 109–113; 2007, 174; Militello 2007: 41; Tzachili 1990: 386; Ulanowska 2014: 157). Prema tome, studenti pokušavaju tkati bez da koriste potpornje za gornju pomičnu prečku s nićanicama i isprobavaju na tkalačkom stanu raditi samostalno. Manje je tkanina istkanih na tkalačkom stanu s osnovom napetom utezima nego traka, zato što ih izrađuju dvije ili više osoba, za tkanje na okomitom tkalačkom stanu potrebno je osjetno dulje vrijeme te je k tome još studentima nemoguće vježbati kod kuće: shodno tomu, svaka grupa izvođača obično tka jedan ko-

Fig. 5 Operational sequences of weaving: sewing the starting border to the cloth beam, suspending loom weights, warp chaining, weaving, and finishing (photo: A. Ulanowska, K. Żebrowska)

Sl. 5 Operativni slijed tkanja: šivanje početnog ruba na gredu, vješanje utega za tkalački stan, lančano oplitanje niti osnove u pletenicu, tkanje te završavanje (foto: A. Ulanowska, K. Żebrowska)

the strength of beating. In all the techniques experienced, the simple weave prevails, although students try their hand at basic pattern weaving using the weft/warp floating technique and supplementary weft.

mad tkanine tijekom tečaja. Tkanine su često slabije kvalitete u usporedbi s trakama: tkanine se često sužavaju tijekom izrade, tkanje je nejednako, a potka se ponekad nalazi pod kutom u odnosu na gredu. O svim se pogreškama rasprav-

Operational sequences of textile production and textile techniques demonstrated but not experienced

There are some important operational sequences of textile production which are only discussed with students or demonstrated to them and eventually experienced hands-on, in single trials. They are excluded from regular experiential tests, mainly due to the fact that the period of primary apprenticeship is rather long as in the case of spinning, there are no appropriate installations in the classroom as in the case of dyeing, and last but not least, the time-span of the teaching course is limited.

Students are familiarized with the properties of the two main classes of raw materials used in Bronze Age Greece, namely plant and animal fibres. The structure and properties of flax and wool fibres are discussed in detail, as well as differences between the parameters and quality of mechanically- and hand-spun yarns. Moreover, small portions of unwashed and uncombed sheared wool from the *Wrzosówka* sheep, bred on the premises of the Biskupin Archaeological Museum, are manually prepared for spinning. Shorter and longer fibres of flax cultivated on fields located at experimental stations of the Institute of Natural Fibres and Medicinal Plants are also available for spinning tests. Students make an attempt at hand spinning and drop spindle spinning even though spinning is not practised (unless some students should voluntarily decide to do some spinning at home) nor is it documented. Spun yarns are not evaluated in terms of their quality. In experience weaving tests, mechanically spun yarns are used: flax, wool and economical acrylic yarns.

From the broad range of fabrics built of a continuous or a single set of elements, only sprang is discussed, demonstrated and experienced in single trials. Possible knowledge on sprang in Aegean cultures has already been suggested with the reference to women's hair-nets represented on a fresco from Xeste 3 in Akrotiri (Tzachili 1997: 248–250), although nets have been shown as part of female costumes more frequently, pointing to a more widespread skill of linking, looping or interlinking of threads (Cf. Chapin 2008; Shank 2012; for knotted nets see Betancourt 2007).

Students try to warp on simple fixed frames and then make some attempts at Z- and S-twist interlinking (Collingwood 1974); for the most part, however, without completing the fabric.

Documentation system

The system of comparable documentation of individual weaving trials was introduced by the author in 2013 in the form of documentation cards designed to record a textile and the process of its weaving, tailored to each of the tested techniques (Ulanowska 2014). The system is open in character, more questions may be introduced, and more cards may, and actually have been, added.

The cards were inspired by archaeological documentation of stratigraphic units and artefacts, and were designed to facilitate both verifiable recording and the objective comparison of as much data and as many observations as

lja te studenti traže moguće poveznice između grešaka i ispravnosti primijenjene napetosti, načina na koji se potka provlači kroz zjevove, te snage sabijanja. U svim iskušanim tehnikama prevladava jednostavno tkanje, iako se studenti okušavaju u jednostavnim tehnikama izrade uzoraka izvlačenjem, tj. isticanjem niti osnove/potke te izvođenjem dodatnih niti potke.

Slijed operacija u proizvodnji tekstila i tekstilnim tehnikama koje su predstavljane ali ne i iskušane

Postoje neke važne operacije u proizvodnji tekstila o kojima se samo raspravljalo sa studentima ili su im demonstrirane te naposljetku i praktično iskušane, ali u pojedinačnim pokušajima. One nisu uključene u redovite iskustvene testove, uglavnom zbog činjenice da je razdoblje primarnog naukovanja razmjerno dugo kao u slučaju predenja, nema primjerenih instalacija u učionici u slučaju bojenja te konačno, no ne i najmanje bitno, vrijeme trajanja semestra je ograničeno.

Studenti se upoznaju sa svojstvima dvije glavne vrste sirovina korištenih u brončanodobnoj Grčkoj, naime, biljnim i životinjskim vlaknima. Detaljno se raspravlja o strukturi i svojstvima lanenih i vunenih vlakana, kao i o razlikama između parametara i kvalitete mehanički i ručno izrađenih prediva. Nadalje, male količine neoprane i neočešljane ostriženе vune *Wrzosówke* ovce, uzgojene u prostoru Arheološkog muzeja Biskupina, ručno su pripremljene za predenje. Kraća i duža vlakna lana uzgojena na poljima eksperimentalne stanice Instituta za prirodna vlakna i medicinske biljke također su na raspolaganju za pokuse s predenjem. Studenti se okušavaju u ručnom predenju i predenju s vretenom, iako se predenje ne prakticira (osim u slučaju da studenti dragovoljno odluče prakticirati predenje kod kuće), niti se dokumentira. Izrađena pređa ne ocjenjuje se u smislu kvalitete. U iskustvenim testovima tkanja koristi se strojno izrađena pređa: lanena, vunena i akrilična pređa.

Između široke palete tkanina izrađenih od kontinuiranog ili jednog seta elemenata, razmatra se jedino jalba, koja se demonstrira i iskušava u jednom pokušaju. Na moguće znanje o jalbi u egejskim kulturama već je bilo upozoreno referencom na ženske mreže za kosu, prikazane na freski iz zgrade Xeste 3 u naselju Akrotiri (Tzachili 1997: 248–250), iako su mreže češće bile prikazane kao dio ženske nošnje, upućujući na širu rasprostranjenost vještina pletenja sa i bez čvorova te prepleta niti (jalba tehnika) (*usp.* Chapin 2008; Shank 2012; za mreže s čvorovima vidi Betancourt 2007).

Studenti pokušavaju fiksirati niti osnove na jednostavne učvršćene okvire te potom isprobavaju z i s preplet (Collingwood 1974); doduše, u većini slučajeva ne uspjevaju dovršiti tekstil.

Dokumentacijski sustav

Sustav usporedive dokumentacije pojedinih pokušaja tkanja autorica je uvela 2013. godine u obliku dokumentacijskih kartica sastavljenih kako bi se zabilježili podaci o tkanini i procesu tkanja te prilagođenih svakoj od isprobanih

possible. Each card contains six main information components, although the recorded data may differ in each of the components, according to the operational sequences and specific nature of the particular weaving technique. Said components are as follows:

- the weaver's personal data, the date and the consecutive number of the textile made using a specific technique;
- threading and patterning scheme;
- parameters of the textile, including its thread count, dimensions and weight;
- parameters of the loom and the loom set-up, including the manner of tensioning, the tension applied, and the working position;
- working time registered for consecutive operational sequences, as well as the overall working time;
- subjective description of the work recorded with reference to the level of attention required: high, middle or low, in each of the operational sequences, the comfort of work, and personal satisfaction.

At present, four card layouts are being used in documenting, as follows: bands woven on a rigid heddle (Fig. 6), bands woven on a rigid heddle using the warp-floating technique, bands woven on tablets, and textiles woven on a warp-weighted loom.

tehnika (Ulanowska 2014). Sustav je otvorenog karaktera, mogu se pridodati i nova pitanja, a također se mogu te uistinu i jesu dodale dodatne kartice.

Kartice su nadahnute arheološkom dokumentacijom stratigrafskih jedinica i predmeta te su dizajnirane da omoguće kako provjerljive zapise tako i objektivno uspoređivanje što je moguće više podataka i opažanja. Svaka kartica sadrži šest glavnih informacijskih stavki, iako se zabilježeni podaci mogu razlikovati u svakoj stavki, u skladu s lancem operacija i specifičnom prirodom pojedine tkalačke tehnike. Riječ je o sljedećim stavkama:

- osobni podaci o tkalcu, datum i redni broj tkanine izrađene specifičnom tehnikom;
- shema uvođenja niti i stvaranja uzoraka;
- parametri tkanine, uključujući broj niti, dimenzije te težinu;
- parametri tkalačkog stana i postava tkalačkog stana, uključujući način napinjanja, primijenjenu napetost te radni položaj;
- radno vrijeme zabilježeno za susljedne radnje u lancu operacija, kao i ukupno vrijeme trajanja rada;
- bilješka o subjektivnom opisu rada s referencom na razinu potrebne pozornosti: visoka, umjerena ili niska, za svaku od operativnih sekvenci, ugodnost rada te osobno zadovoljstvo.

Department of Aegean Archaeology, Institute of Archaeology UW
BAND WOVEN ON A LOOM WITH A RIGID HEDDLE - DOCUMENTATION CARD

Name and surname	Band no.	Date

SCHEME OF THREADING

BAND PARAMETERS:		LOOM PARAMETERS:			TIME OF WORK:
Fibres:		Loom width in cm:			Time of designing the pattern in min:
Thread diameter in mm:		Shed height in cm:			
Threads / 1 cm^2:		Loom setting:			Time of warping the loom in min:
WA:	WE:	backstrap	vertical	horizontal	
Weight of band:		Warp setting:			Weaving time in min:
		vertical	horizontal	diagonal	
Fabric dimensions in cm (without finishing):		Warp tension, if possible to determine:			Finishing time in min:
L:	W:	Total in g:		1 thread/g:	
Finishing:		Length of working area in cm:			Total working time in min:

DESCRIPTION OF WORK:

Required level of attention:				General comfort of work:	Satisfaction from work:
warping	high	medium	low	high	high
weaving	high	medium	low	medium	medium
finishing	high	medium	low	low	low

OTHER OBSERVATIONS AND A DESCRIPTION OF WORK:

Picture overleaf

Fig. 6 Documentation card for a band woven on a rigid heddle
Sl. 6 Dokumentacijska kartica za traku istkanu pomoću tkalačke daščice

The cards are available for download in English and Polish (http://www.archeo.uw.edu.pl/szablon.php?id=275; http://www.archeo.uw.edu.pl/szablon.php?id=1207).

The card system can be transferred to an electronic database and is, therefore, easily searchable and available for statistical analysis. The system may also be converted into electronic forms and uploaded on the Internet to be filled online. A similar way of recording the weaving experience may also be employed in tests performed by skilled craftspeople and textile technicians.

ACADEMIC VALUE OF EXPERIENCE ARCHAEOLOGY EXPERIMENTS

The most important and anticipated outcome of experience archaeology experiments is primarily didactic in character. However, the students' academic approach to hands-on activities combined with recurring documented tests, a longer period of observation, a relatively large number of the participating actors (approx. ten each year), and, finally, the author's own interests, encouraged an inquiry into more scholarly conclusions as well.

The observations recorded so far point to areas in which experience archaeology may possibly be used in a more scholarly-oriented discourse. The collected records facilitate or make it possible to:

- objectively compare the work of different people with different skill levels;
- document personal progress in acquiring the weaving skill;
- compare the amount of time required to accomplish the consecutive operational sequences of weaving such as designing the fabric, warping the loom, weaving and finishing for different looms and different weaving techniques;
- compare subjective observations and feelings about the working position, evaluate the (dis)comfort of work, the level of attention required and the satisfaction gained from work;
- assess which of the operational sequences and techniques are perceived as being relatively easier to perform (requiring less attention) and which, therefore, may have been combined with other daily chores such as childcare or food preparation.
- compare different techniques and methods of pattern weaving in terms of their relative difficulty and efficiency (Ulanowska 2014).

The data discussed below was gathered in the academic year 2013/2014, and all of it refers to the experience of weaving bands on a rigid heddle. In all the documented experience tests, weaving appeared to be the most time-consuming part of band-making, whereas threading and setting up the loom were ranked second on the operational time-consumption scale. The finishing took third place, and designing took the last, fourth, place (Fig. 7).

The relation between the overall weaving time and the length of the fabric was in many cases less clear, likely because the actors' skill level was generally low and there were noticeable differences in their efficiency (Fig. 8). The efficiency of the entire weaving process was calculated per one hour of work using two variables: the size of the fabric

Za sada se u dokumentiranju koriste četiri tipa kartica: trake, tj. kanice tkane na tkalačkoj daščici, trake tkane na tkalačkoj daščici tehnikom izrade uzorka izvlačenjem, tj. isticanjem niti osnove, trake tkane tkalačkim pločicama, tekstili, tj. tkanine tkane na vertikalnom tkalačkom stanu.

Kartice su dostupne za preuzimanje na engleskom i poljskom jeziku: http://www.archeo.uw.edu.pl/szablon.php?id=275; http://www.archeo.uw.edu.pl/szablon.php?id=1207).

Sustav kartica može se prebaciti u elektroničku bazu podataka te je prema tome lako pretraživ i pogodan za statističku analizu. Ovaj se sustav može prebaciti u elektronički oblik i prenijeti na internet kako bi se ondje popunjavao. Sličan se način bilježenja tkalačkih iskustava može primijeniti i u pokusima vještih zanatlija i tkalačkih tehničara.

AKADEMSKA VRIJEDNOST EKSPERIMENATA ISKUSTVENE ARHEOLOGIJE

Najvažniji i predviđeni ishod eksperimenata iskustvene arheologije ponajprije se tiče njihove didaktičke naravi. Međutim, akademski pristup studenata praktičnim aktivnostima u kombinaciji s ponavljajućim dokumentiranim testovima, zatim dulje razdoblje opažanja, razmjerno velik broj sudionika (približno deset svake godine) te, napokon, autoričin vlastiti interes, doprinijeli su tomu da zaključci sadrže i znanstvenu komponentu.

Dosad zabilježena opažanja upućuju na područja u kojima bi se iskustvena arheologija mogla rabiti u nešto znanstvenijem diskursu. Prikupljene bilješke olakšavaju ili omogućuju da se:

- objektivno usporedi rad različitih ljudi s različitim razinama vještina;
- dokumentira osobni napredak u stjecanju vještine tkanja;
- usporedi količina vremena potrebna za obavljanje susljednih aktivnosti u procesu tkanja, poput dizajna tkanine, pripreme osnove, tkanja i završavanja na različitim tkalačkim stanovima i korištenjem različitih tehnika tkanja;
- usporede subjektivna opažanja i osjećaji u vezi radnog položaja, procjene (ne)ugodnosti radnog procesa, razina potrebne pozornosti te zadovoljstvo koje rad donosi;
- procijeni koji se dijelovi operativnog niza i tehnike smatraju razmjerno lakšima za izvođenje (zahtijevaju manje pozornosti) te koji se, shodno tomu, mogu kombinirati s drugim dnevnim poslovima, poput brige o djeci ili priprave hrane;
- usporede različite tehnike i metode izrade uzorkovanih tkanina u smislu njihove relativne težine i učinkovitosti (Ulanowska 2014).

Podaci o kojima se raspravlja u nastavku teksta prikupljeni su tijekom akademske godine 2013./14., a svi se odnose na iskustvo tkanja traka pomoću tkalačkih daščica. U svim dokumentiranim iskustvenim testovima, tkanje se iskazalo vremenski najzahtjevnijim dijelom procesa izrade traka, dok su uvođenje niti te postavljanje tkalačkog stana stavljeni na drugo mjesto na ljestvici zadataka koji oduzimaju najviše vremena. Završavanje je stavljeno na treće mjesto, dok je dizajniranje zauzelo posljednje, četvrto mjesto (sl. 7).

Odnos između ukupnog vremena tkanja te dužine tkanine u mnogim je slučajevima bio manje jasan, vjerojatno

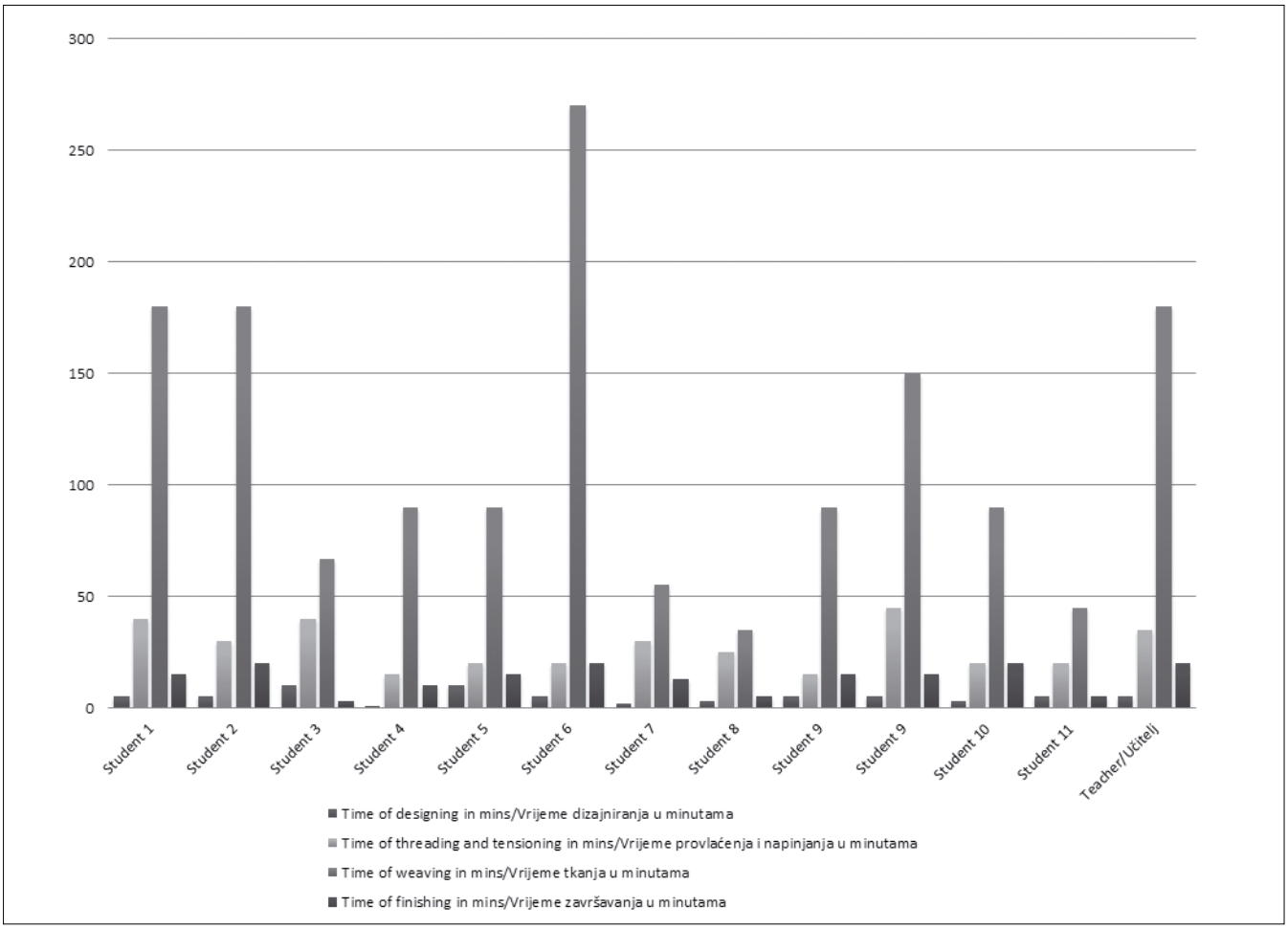

Fig. 7 Band weaving time registered according to the operational sequences of weaving
Sl. 7 Vrijeme trajanja tkanja traka zabilježeno prema operativnom slijedu tkanja

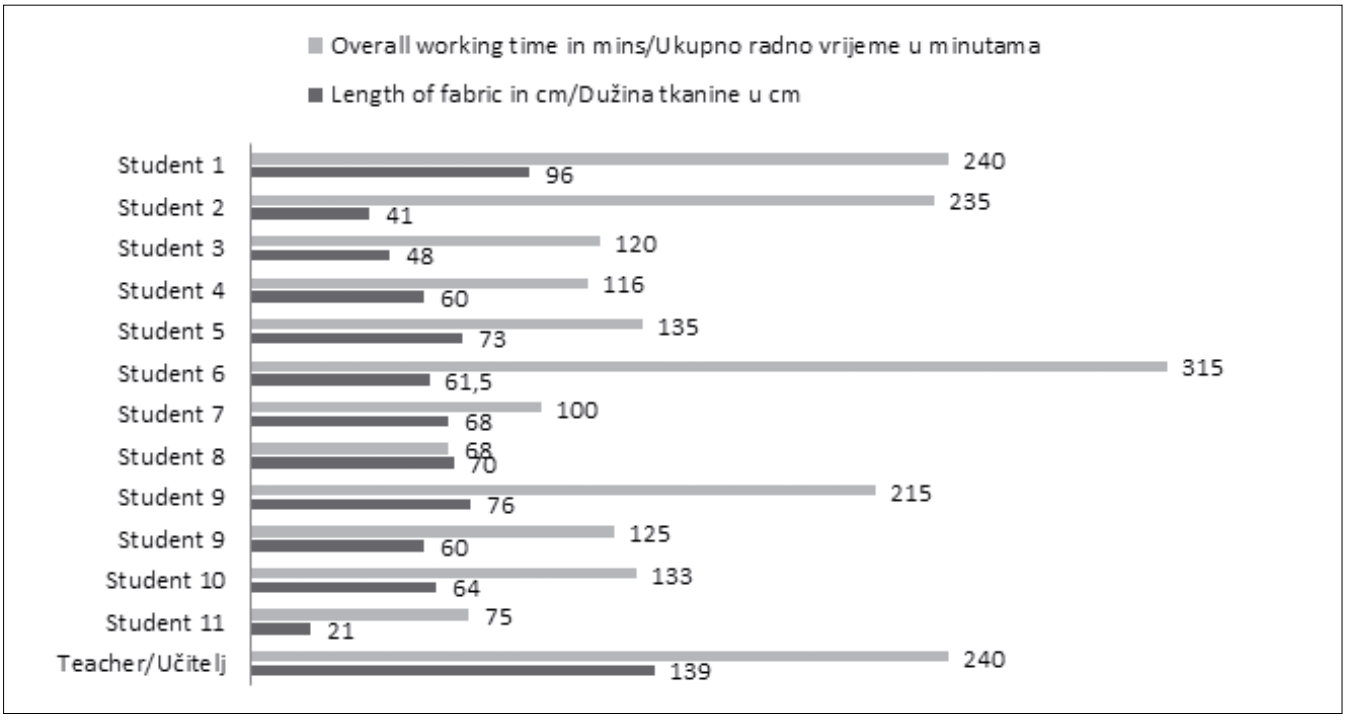

Fig. 8 The comparison between the individual's overall weaving time and the final length of the same fabric
Sl. 8 Usporedba ukupnog trajanja tkanja pojedinog sudionika te konačne dužine istkane tkanine

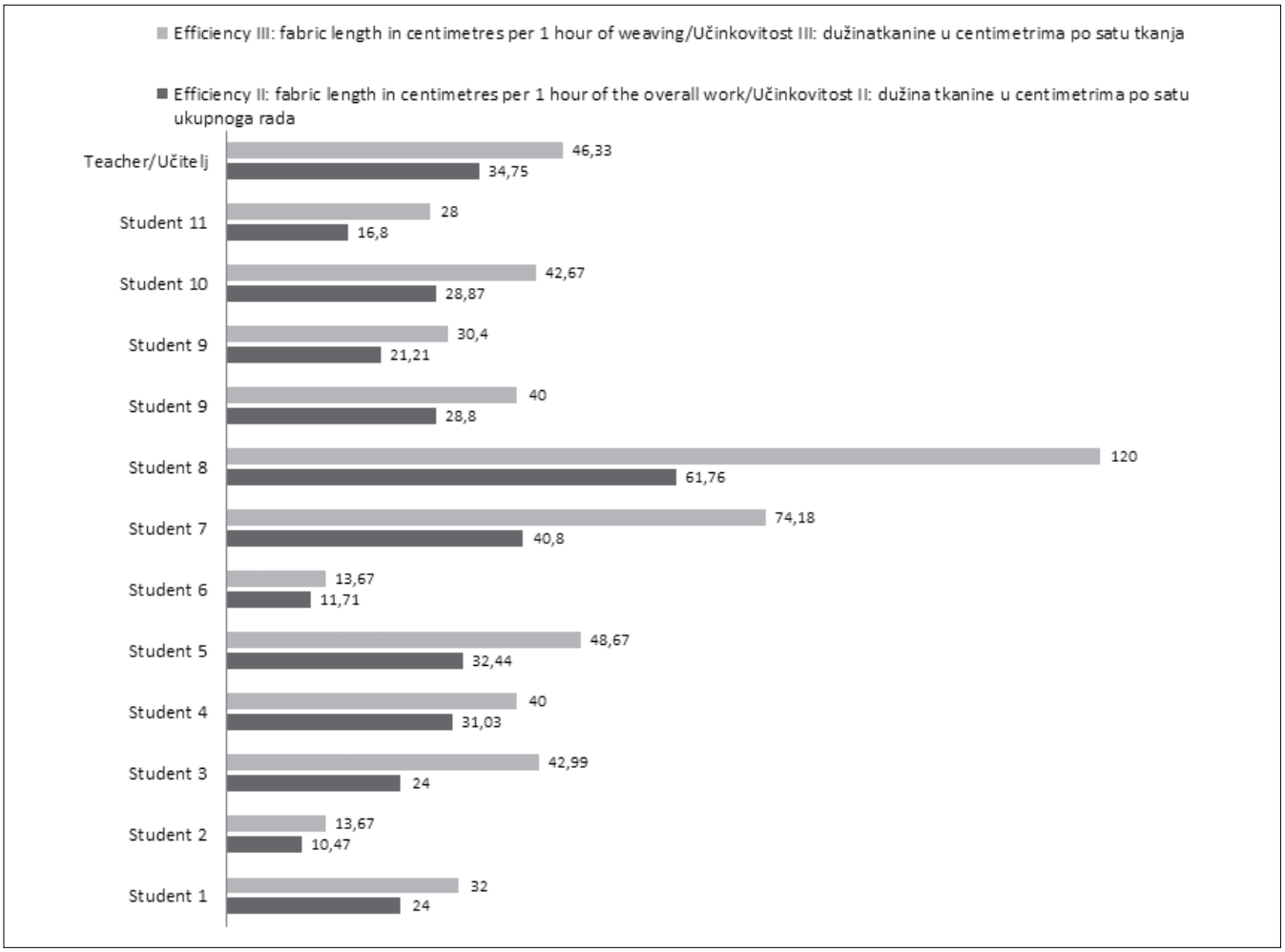

Fig. 9 The comparison of the individual efficiency of the overall weaving process with the efficiency of the sequence of sole weaving, calculated per one hour of work

Sl. 9 Usporedba pojedinačne učinkovitosti ukupnog procesa tkanja s učinkovitošću slijeda samog tkanja, izračunata prema jednom satu rada

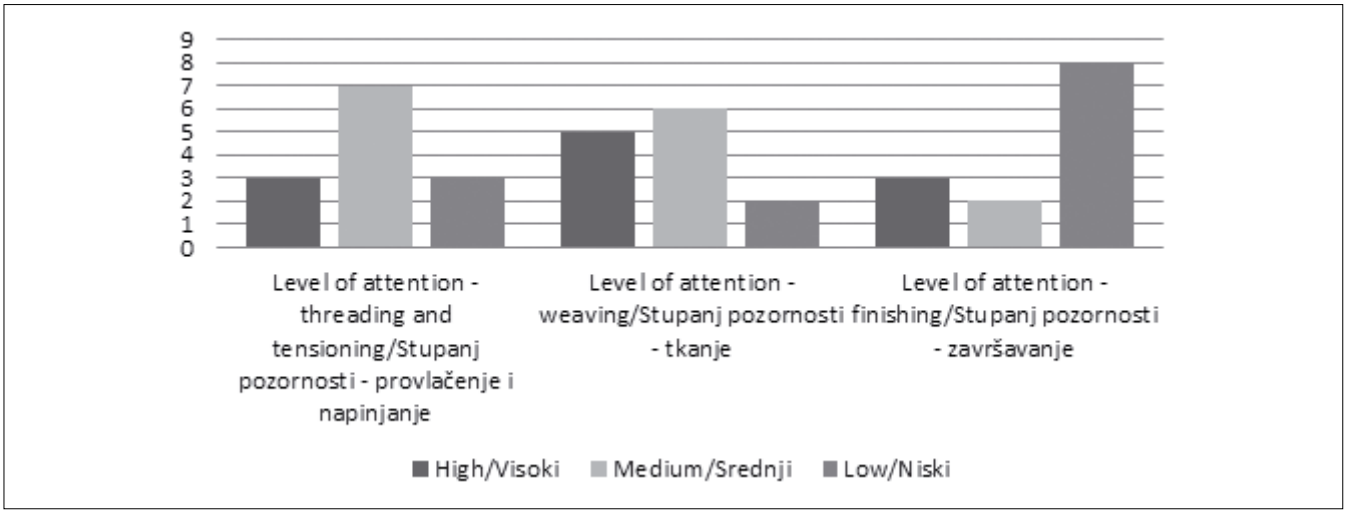

Fig. 10 The level of attention required for the operational sequences of weaving translated into numerical values: 1 – low level of attention, 3 – medium level of attention, 6 – high level of attention. The numbers on the horizontal axis reflect the number of respondents to each question

Sl. 10 Razina pozornosti neophodne za operativni slijed tkanja pretvorena u brojevne vrijednosti: 1 – niska razina pozornosti, 3 – srednja razina pozornosti, 6 – visoka razina pozornosti. Brojevi na vodoravnoj osi predstavljaju broj ispitanika za svako pitanje

in square centimetres and the length of the fabric in centimetres. Additionally, the efficiency of a single weaving phase was calculated separately (Fig. 9).

The students' efficiency was related to the manual skills of an individual rather than to an actor's craft skill and, as it may be expected, the weaving phase appeared to be the key variable affecting the overall efficiency of work. At the same time, weaving was evaluated as work that required most attention from the greatest number of students (five respondents), whereas the least attention was required for finishing fabrics (eight respondents) (Fig. 10). No correlation was observed between working position recorded as loom/warp tensioning and the efficiency of work, nor between the efficiency and the general level of comfort.

Finally, the level of satisfaction with work, as a variable dependent predominantly on the personality of the weaver, appears to be unrelated to the overall time of work, its efficiency or comfort. In general, students were fairly satisfied with their hand-made fabrics, with only two respondents describing the level of satisfaction from their work as "low".

By analysing the recorded time of work in relative terms such as a longer or shorter phase, it is possible to suggest that the operational sequences of weaving were similarly spread out over time in the past. These observations, combined with the assessment of the amount of attention required for the subsequent weaving sequences, may point to how weaving was organized in households and where it may have fit in amongst other daily duties such as childcare and food preparation.

Moreover, there are some additional questions concerning weaving as a skill, its organization and the functionality of the textile tools used, formulated before the beginning of each course. In the academic year 2011/2012, research was mainly concentrated on measuring the time necessary for learning the basic skill in experienced weaving techniques (Ulanowska 2012) along with the issue of the relative time of work and the evaluation of weaving in terms of the required level of attention and satisfaction from work, which was further pursued during the 2012/2013 course (Ulanowska 2014). Last year, we were focused on the functionality of small clay spools (Siennicka, Ulanowska forthcoming), whereas the potential multi-functionality of different types of loom weights such as crescent-shaped, cylindrical and cuboid weights, is the main topic of investigation during the current course.

Some of the results of the experiments designed to answer previously formulated questions seem to be less dependent on the level of the craft skill of their actors. Measuring the potential yarn capacity of copies of Late Helladic small spools from Tiryns, or applying crescent-shaped and cylindrical weights for band weaving purposes, was quite successfully performed by inexperienced students.

CONCLUSIONS

Experience archaeology is a useful and effective didactic tool in teaching about ancient textiles and textile production in societies of the past. By gaining as little as the initial body knowledge of the textile craft, students participating

zbog toga što je razina vještine izvođača uglavnom bila niska te su postojale primjetne razlike u njihovoj učinkovitosti (sl. 8). Učinkovitost čitavog procesa tkanja izračunata je po satu rada pomoću dvije varijable: veličine tkanine u kvadratnim centimetrima te dužine tkanine u centimetrima. K tomu, zasebno je izračunavana učinkovitost pojedine faze tkanja (sl. 9).

Učinkovitost studenata ovisila je o manualnoj vještini pojedinca više nego o zanatskoj vještini izvođača te, kao što se moglo i očekivati, pojedina faza tkanja predstavljala je ključnu varijablu koja je utjecala na ukupnu učinkovitost rada. Istodobno, tkanje je procijenjeno kao posao koji je zahtijevao najviše pozornosti od najvećeg broja studenata (pet odgovora), dok je najmanje pozornosti zahtijevalo dovršavanje tkanine (osam odgovora) (sl. 10). Nije opažena korelacija između radnog položaja, zabilježenog kao napinjanje stana/osnove te učinkovitosti rada, niti između učinkovitosti i opće razine ugodnosti.

Na kraju, čini se da razina zadovoljstva poslom, kao varijable koja prije svega ovisi o osobnosti tkalca, nije bila povezana s ukupnim vremenom rada, učinkovitošću ili ugodom. Općenito uzevši, studenti su bili prilično zadovoljni svojim ručno izrađenim tkaninama, s obzirom na to da je tek dvoje njih opisalo razinu svoga zadovoljstva obavljenim poslom kao „nisku".

Analizirajući zabilježeno vrijeme rada u relativnom smislu kao dulju ili kraću fazu, moguće je sugerirati da su susljedne operacije u procesu tkanja bile slično raspoređene i u prošlosti. Ova opažanja, u kombinaciji s procjenom količine pozornosti potrebne za susljedne radnje u procesu tkanja, mogu uputiti na to kako je tkanje organizirano u kućanstvima te gdje se moglo smjestiti u okviru ostalih dnevnih zaduženja, poput skrbi o djeci te pripravi hrane.

Nadalje, postoje i neka dodatna pitanja u vezi tkanja kao vještine, zatim organizacije tkanja te funkcionalnosti korištenih tekstilnih alatki, koja su formulirana prije početka svakog semestra. Tijekom akademske godine 2011./12. istraživanje je uglavnom bilo usmjereno na mjerenje vremena potrebnog za stjecanje osnovnih vještina u iskustvenim tehnikama tkanja (Ulanowska 2012), zajedno s pitanjem relativnog vremena rada te evaluacijom tkanja u smislu potrebne razine pozornosti i zadovoljstva poslom, što je zatim nastavljeno i tijekom 2012./13. godine (Ulanowska 2014). Prethodne smo se godine fokusirali na funkcionalnost malih glinenih kalemova (Siennicka, Ulanowska, u pripremi), dok je moguća multifunkcionalnost različitih tipova utega za tkalački stan, poput polumjesečastih, cilindričnih te kockastih, glavna istraživačka tema tijekom tekućeg semestra.

Neki od rezultata eksperimenata osmišljenih da ponude odgovor na prethodno formulirana pitanja čini se da manje ovise o razini zanatske vještine njihovih izvođača. Zadaci poput mjerenja potencijalnog kapaciteta za namatanje prediva za kopije malih kasnoheladskih kalemova iz Tirinta, kao i korištenje polumjesečastih i cilindričnih utega u tkanju traka, sasvim su uspješno izveli neiskusni studenti.

ZAKLJUČCI

Iskustvena arheologija jest korisno i učinkovito didaktičko sredstvo za učenje o drevnim o drevnim tekstilima i njihovoj proizvodnji među (pra)povijesnim zajednicama. Stjecanjem već maloga početnog fonda znanja o izradi tekstila, studenti koji sudjeluju u iskustvenim testovima

in experience tests are better prepared to understand the high level of social involvement and economic effort required by textile manufacturing, the complexity of its *chaîne opératoire*, and the interlinking of technological sequences with the cultural, social and economic environment. By using copies of archaeological artefacts, the actors become more aware of the functionality of textile tools and, therefore, may more easily perceive the relationship between the parameters of the preserved tools and the quality of the usually perished fabrics. Finally, students' hands-on experience with handling copies of archaeological artefacts will hopefully contribute to a more technology-focused approach to their archaeological research in the future.

Experience archaeology tests, if properly documented and analysed, may also serve as a source of analogies in academic research on textile production, especially in research on textile manufacturing in households and its organization, as well as textile tools analyses. Such analogies may also be useful in studies aiming to investigate the organization of apprenticeship in societies of the past.

Although experience tests are less controlled and less reliable than archaeological experiments, their possible advantage may be seen in introducing a greater number of enactment modes or procedural choices for operational sequences of textile production. Another benefit may be connected to the higher number of participants, especially in comparison with experimental tests, which require participation of skilled and, therefore, fewer textile experts. Methodological principles for experience archaeology should be formulated with the emphasis on limitations resulting from the shortage of archaeological evidence, low skill level of actors and discrepancy between materials and tools applied in tests and the ones used in the past. Accordingly, the methodological principles should primarily formulate objectives of tests, tenets of their enactment, and a system of documentation.

The social relations established between the participants of the experience archaeology tests in weaving form part of intangible results. However, the overall pleasure derived from cognitive apprenticeship and the collectively of the enacted tasks and trials, as well as the ultimate satisfaction from work felt by a majority of students may offer a glimpse of how the job of weaving may have been perceived by workers in prehistory, not necessarily in Bronze Age Greece.[1]

postaju bolje pripremljeni za razumijevanje visoke razine društvene uključenosti i ekonomskog ulaganja koju zahtijeva proizvodnja tekstila, o složenosti lanca operacija, kao i povezanosti tehnoloških sljedova s kulturnim, društvenim i gospodarskim okolišem. Korištenjem replika arheoloških predmeta, sudionici postaju svjesniji funkcionalnosti tekstilnih alatki te u skladu s tim mogu lakše uvidjeti odnose između parametara sačuvanih alatki i kvalitete najvećim dijelom nesačuvanih tkanina. Naposljetku, praktično iskustvo koje studenti stječu rukovanjem replikama arheoloških predmeta će, nadajmo se, doprinijeti da u svojim budućim arheološkim istraživanjima usvoje pristup koji pridaje više pozornosti tehnološkim aspektima.

Ako se dokumentiraju i analiziraju na ispravan način, iskustveni arheološki testovi mogu također poslužiti i kao izvor za analogije u akademskim istraživanjima o proizvodnji tekstila, pogotovo u istraživanju o proizvodnji i organizaciji proizvodnje tekstila u kućanstvima, kao i u analizama tekstilnih alatki. Takve analogije mogu također biti korisne u studijama kojima je cilj proučiti organizaciju naukovanja u prošlim društvima.

Iako su iskustveni testovi slabije kontrolirani i manje pouzdani od arheoloških eksperimenata, kao njihovu moguću prednost može se istaknuti uvođenje većeg broja načina provedbe ili proceduralnih mogućnosti za faze operativnog slijeda proizvodnje tekstila. Druga korist može se povezati s većim brojem sudionika, naročito u usporedbi s eksperimentalnim testovima koji zahtijevaju sudjelovanje izvježbanih te, samim time, rjeđih stručnjaka. Metodološka načela za iskustvenu arheologiju trebala bi se formulirati s naglaskom na ograničenja koja proizlaze iz nedostatka arheoloških dokaza, niske razine vještine sudionika te proturječnosti između materijala i alatki korištenih u testovima te onih korištenih u prošlosti. U skladu s tim, metodološka načela bi prije svega trebala postaviti ciljeve za testove, načela njihove provedbe, kao i sustav dokumentiranja.

Društveni odnosi uspostavljeni između sudionika iskustvenih arheoloških testova u tkanju čine dio nematerijalnih učinaka. Međutim, ukupno zadovoljstvo koje je proizašlo iz kognitivnog naukovanja te provedenih zadataka i pokusa, kao i krajnje zadovoljstvo radom prisutno kod većine studenata može nam ponuditi uvid u to kako su posao tkanja mogli doživljavati radnici u pretpovijesti, iako ne nužno i u brončanodobnoj Grčkoj.[1]

Translation and Proofreading / *Prijevod i lektura*
Sanjin Mihelić

1 Students of the Institute of Archaeology, University of Warsaw, who took part in experience archaeology tests in years 2011–2014, in alphabetical order: M. Barańska, K. Bijalski, K. Bonio, A. Charycka, K. Cichecka, N. Dmitruk, E. Gorzko, M. Jędrzejewska, A. Kaliszewska, P. Klimaszewski, K. Kopańska, D. Kossowska, A. Kraszewska, W. Krzemień, I. Krzyszczak, A. Łada, N. Łuszczyk, A. Mech, E. Mińko, M. Miśnicki, J. Nurczyk, A. Pawlikowska, Ł. and M. Piasecki, M. Piątkowska, M. Politowska, A. Romaniuk, S. Ronisz, K. Sadurska, K. Seiler, A. Skolimowska, K. Stach, K. Supeł, D. Trzos, Z. Uszyńska, M. Wesołowska, J. Witulska, P. Zabost, A. Zydler, K. Żebrowska, A. Ziemecka, I. Żołędziowska.

1 Studenti Instituta za arheologiju Sveučilišta u Varšavi koji su sudjelovali u iskustvenim arheološkim testovima između 2011. i 2014. godine, abecednim redom: M. Barańska, K. Bijalski, K. Bonio, A. Charycka, K. Cichecka, N. Dmitruk, E. Gorzko, M. Jędrzejewska, A. Kaliszewska, P. Klimaszewski, K. Kopańska, D. Kossowska, A. Kraszewska, W. Krzemień, I. Krzyszczak, A. Łada, N. Łuszczyk, A. Mech, E. Mińko, M. Miśnicki, J. Nurczyk, A. Pawlikowska, Ł. and M. Piasecki, M. Piątkowska, M. Politowska, A. Romaniuk, S. Ronisz, K. Sadurska, K. Seiler, A. Skolimowska, K. Stach, K. Supeł, D. Trzos, Z. Uszyńska, M. Wesołowska, J. Witulska, P. Zabost, A. Zydler, K. Żebrowska, A. Ziemecka, I. Żołędziowska.

BIBLIOGRAPHY / LITERATURA

Andersson Strand, E. 2010a, The basics of textile tools and textile technology: From fibre to fabric, in: *Textile Terminologies in the Ancient Near East and the Mediterranean from the 3rd to the 1st Millennia BC,* Michel C., Nosch M.-L. (eds.), Ancient Textiles Series vol. 8, Oxbow Books, Oxford–Oakville, 10–22.

Andersson Strand, E. 2010b, The experimental textile archaeology, in: *North European Symposium for Archaeological Textiles X,* Andersson Strand E., Gleba M., Mannering U., Munkholt C., Ringgaard M. (eds.), Ancient Textiles Series vol. 5, Oxbow Books, Oxford–Oakville, 1–3.

Andersson Strand, E. 2012, From spindle whorls and loom weights to fabrics in the Bronze Age Aegean and Eastern Mediterranean, in: *KOSMOS. Jewellery, Adornment, and Textiles in the Aegean Bronze Age. Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010,* Nosch M.-L., Laffineur R. (eds.), Aegaeum 23, Peeters, Leuven–Liège, 207–213.

Andresson Strand, E. 2014, Sheep, wool and textile production, An interdisciplinary approach to the complexity of wool working, in: *Wool Economy in the Ancient Near East and the Aegean. From the Beginnings of Sheep Husbandry to Institutional Textile Industry*, Breniquet C., Michel C. (eds.), Ancient Textiles Series vol. 17, Oxbow Books, Oxford–Philadelphia, 41–51.

Andersson, E., Nosch, M.-L. 2003, With a little help from my friends: Investigating Mycenaean textiles with help from Scandinavian experimental archaeology, in: *METRON. Measuring the Aegean Bronze Age. Proceedings of the 9th International Aegean Conference, New Heaven, Yale University, 18-19 April 2002,* Foster K. P., Laffineur R. (eds.), Aegaeum 24, Liège–Austin, 199–203.

Andersson Strand, E., Nosch, M.-L. s.a., Technical textile tools report for Khania, Crete, http://ctr.hum.ku.dk/tools/toolsreports/Khania_Technical_Textile_Tools_Report.pdf (13. 3. 2015.), 23.

Barber, E. J. W. 1991, *Prehistoric Textiles. The Development of Cloth in the Neolithic and Bronze Ages with Special Reference to Aegean,* Princeton University Press, Princeton.

Barber, E. J. W. 2007, Weaving the social fabric, in: *Ancient Textiles, Production, Craft and Society, Proceedings of the First International Conference in Ancient Textiles, held at Lund Sweden and Copenhagen, Denmark, on March 19-23, 2003*, Gillis C., Nosch M.-L. B. (eds.), Ancient Textiles Series vol. 1, Oxbow Books, Oxford, 173–178.

Betancourt, P. 2007, Textile production at Pseira: The knotted net, in: *Ancient Textiles, Production, Craft and Society, Proceedings of the First International Conference in Ancient Textiles, held at Lund Sweden and Copenhagen, Denmark, on March 19-23, 2003*, Gillis C., Nosch M.-L. B. (eds.), Ancient Textiles Series vol. 1, Oxbow Books, Oxford, 185–189.

Breniquet, C., Michel, C. (eds.), 2014, *Wool Economy in the Ancient Near East and the Aegean. From the Beginnings of Sheep Husbandry to Institutional Textile Industry*, Ancient Textiles Series vol. 17, Oxbow Books, Oxford–Philadelphia.

Broudy, E. 1979, *The Book of Looms. A History of the Handloom from Ancient Times to the Present,* University Press of New England, Hanover–London.

Burke, B. 1997, The organization of textile production on Bronze Age Crete, in: *TEXNH, Craftsmen, Craftswomen and Craftsmanship in the Aegean Bronze Age, Proceedings of the 6th International Aegean Conference Philadelphia, Temple University, 18-21 April 1996*, Laffineur R., Betancourt P. (eds.), Aegaeum 16, Liège–Austin, 413–422.

Burke, B. 2006, Textile production at Petras: The evidence from House II, in: *Πεπραγμένα Θ' Διεθνούς Κρητολογικού Συνεδρίου, Ελούντα, 1-6 Οκτωβρίου 2001,* Tampakaki E., Kaloutsakis E. A. (eds.), vol. A1, Εταιρία Κρητικών Ιστορικών Μελετών, Ηράκλειο, 279–295.

Burke, B. 2010, *From Minos to Midas, Ancient Cloth Production in the Aegean and in Anatolia,* Ancient Textiles Series vol. 7, Oxbow Books, Oxford–Oakville.

Carington Smith, J. 1975, Spinning Weaving and Textile Manufacture in Prehistoric Greece – from the beginning of the Neolithic to the end of the Mycenaean Ages; with particular reference to the evidence found on archaeological excavations, PhD thesis, University of Tasmania, Hobart.

Chapin, C. 2008, The Lady of the Landscape: Investigation of Aegean costuming and the Xeste 3 frescoes, in: *Reading a Dynamic Canvas: Adornment in the Ancient Mediterranean,* Colburn C. S., Heyn M. K. (eds.), Cambridge Scholars Publishing, Newcastle, 48–83.

Cheval, C. 2008, Protohistoric weaving, the Minoan loom-weights: a first approach, in: *Purpureae Vestes II. Textiles and Dyes in Antiquity.Vestidios, Textiles y Tintes. Estudios sobre la producción de bienes de consumo en la Antigüedad. Actas del II Symposium Internacional sobre Textiles y Tintes del Mediterráneo en el mundo antiguo (Atenas, 24 al 26 de noviembre, 2005)*, Alfaro C., Karali L. (eds.), Universitat de València,València, 19–24.

Cheval, C. 2011, Le travail de l'os au service de l'artisanat textile: l'exemple de Pompei, in: *Purpureae Vestes III. Textiles and Dyes in Antiquity. Textiles y Tintes en la ciduad antigua. Tissus et Teintures dans la cité antique. Tesuti e Tenture a la città antica. Actas del III Symposium Internacional sobre Textiles y Tintes del Mediterráneo en el mundo antiguo (Nápoles, 13 al 15 de noviembre, 2008),* Alfaro C., Brun J.-P., Borgard Ph., Pierobon Benoit R. (eds.), Universitat de València, Centre Jean Bérard (CNRS-EFR) Naples, València–Naples, 143–147.

Coles, J. M. 1973, *Archaeology by Experiment*, Hutchinson, London.

Coles, J. M. 1979, *Experimental archaeology*, Academic Press, London.

Collingwood, P. 1974, *The Techniques of Sprang, Plaiting on Stretched Threads,* Faber and Faber Limited, London.

Collingwood, P. 1982, *The Techniques of Tablet Weaving,* Faber and Faber Limited, London.

Cutler, J. 2012, Ariadne's thread: the adoption of Cretan weaving technology in the wider southern Aegean in the mid-second millennium B. C., in: *KOSMOS. Jewellery, Adornment, and Textiles in the Aegean Bronze Age. Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010,* Nosch M.-L., Laffineur R. (eds.), Aegaeum 23, Peeters, Leuven–Liège, 145–154.

Del Freo, M., Nosch, M.-L., Rougemont, F. 2010, The terminology of textiles in the Linear B tablets, including some considerations on Linear A logograms and abbreviations, in: *Textile Terminologies in the Ancient Near East and the Mediterranean from the 3rd to the 1st Millennia BC*, Michel C., Nosch M.-L. (eds.), Ancient Textiles Series vol. 8, Oxbow Books, Oxford–Oakville, 338–373.

Gillis, C., Nosch, M.-L. B. (eds.), 2007, *Ancient Textiles, Production, Craft and Society, Proceedings of the First International Conference in Ancient Textiles, held at Lund Sweden and Copenhagen, Denmark, on March 19-23, 2003*, Ancient Textiles Series vol. 1, Oxbow Books, Oxford.

Gleba, M. 2008, *Textile Production in Pre-Roman Italy*, Ancient Textile Series vol. 4, Oxbow Books, Oxford.

Gostenčnik, K. 2012, Austria: Roman Period, in: *Textiles and Textile Production in Europe: From Prehistory to AD 400*, Gleba M., Mannering U. (eds.), Ancient Textile Series vol. 12, Oxbow Books, Oxford–Oakville, 65–88.

Grömer, K. 2013, Kapitel 3: Tradition, Kreativität und Innovation – Textiltechnologische Entwicklung von der Bronzezeit zur Hallstattzeit / Chapter 3: Tradition, creativity and innovation – The development of textile expertise from the Bronze Age to the Hallstatt Period, in: *Textiles from Hallstatt. Weaving Culture in Bronze Age and Iron Age Salt Mines / Textilien aus Hallstatt. Gewebte Kultur aus dem bronze- und eisenzeitlichen Salzbergwerk*, Grömer K., Kern A., Reschreiter H., Rösel-Mautendorfer H. (eds.), Archaeolingua 29, Archaeolingua Alapítvány, Budapest, 53–97.

Harlow, M., Michel, C., Nosch, M.-L. (eds.), 2014, *Prehistoric, Ancient Near Eastern and Aegean Textiles and Dress. An Interdisciplinary Anthology,* Ancient Textiles Series vol. 18, Oxbow Books, Oxford–Philadelphia.

Hoffmann, M. 1974, *The Warp-Weighted Loom, Studies in the History and Technology of an Ancient Implement,* Universitetsforlaget, Oslo–Bergen–Tromsø.

Killen, J. T. 2007, Cloth production in Late Bronze Age Greece: the documentary evidence, in: *Ancient Textiles, Production, Craft and Society, Proceedings of the First International Conference in Ancient Textiles, held at Lund Sweden and Copenhagen, Denmark, on March 19-23, 2003*, Gillis C., Nosch M.-L. B. (eds.), Ancient Textiles Series vol. 1, Oxbow Books, Oxford, 50–58.

Laffineur, R., Betancourt, P. (eds.), 1997, *TEXNH, Craftsmen, Craftswomen*

and Craftsmanship in the Aegean Bronze Age, Proceedings of the 6th International Aegean Conference Philadelphia, Temple University, 18-21 April 1996, Aegaeum 16, Liège–Austin.

Mårtensson, L., Andersson, E., Nosch, M.-L., Batzer, A. 2005/06, *Technical Report. Experimental Archaeology Part 1, 2005-2006, Tools and Textiles – Texts and Contexts Research Programme, The Danish National Research Foundation's Centre for Textile Research (CTR) University of Copenhagen*, http://ctr.hum.ku.dk/tools/Technical_report_1_experimental_archaeology.pdf/ (13. 3 2015.).

Mårtensson, L., Andersson, E., Nosch, M.-L., Batzer, A. 2006a, *Technical Report. Experimental Archaeology Part 2.1 flax, Tools and Textiles – Texts and Contexts Research Programme, The Danish National Research Foundation's Centre for Textile Research (CTR) University of Copenhagen*, http://ctr.hum.ku.dk/tools/Technical_report_2-1_experimental_archaeology.pdf/ (13. 3. 2015.).

Mårtensson, L., Andersson, E., Nosch, M.-L., Batzer, A. 2006b, *Technical Report. Experimental Archaeology Part 2.2 Whorl or Bead?, Tools and Textiles – Texts and Contexts Research Programme, The Danish National Research Foundation's Centre for Textile Research (CTR) University of Copenhagen*, http://ctr.hum.ku.dk/tools/Technical_report_2-2__experimental_arcaheology.PDF/ (13. 3. 2015.).

Mårtensson, L., Andersson, E., Nosch, M.-L., Batzer, A. 2007a, *Technical Report. Experimental Archaeology Part 3 Loom weights, Tools and Textiles – Texts and Contexts Research Programme, The Danish National Research Foundation's Centre for Textile Research (CTR) University of Copenhagen*, http://ctr.hum.ku.dk/tools/Technical_report_3__experimental_archaeology.PDF/ (13. 3. 2015.).

Mårtensson, L., Andersson, E., Nosch, M.-L., Batzer, A. 2007b, *Technical Report. Experimental Archaeology Part 4 Spools, Tools and Textiles – Texts and Contexts Research Programme, The Danish National Research Foundation's Centre for Textile Research (CTR) University of Copenhagen*, http://ctr.hum.ku.dk/tools/Technical_report_4__experimental_archaeology.PDF/ (13. 3. 2015.).

Mårtensson, L., Nosch, M.-L., Andersson Strand, E. 2009, Shape of things: understanding a loom weight, *Oxford Journal of Archaeology*, Vol. 28, No. 4, 373–398.

Mauel, S. 2012, Textile tools from the Bronze Age settlement of Kastanas, in: *KOSMOS. Jewellery, Adornment, and Textiles in the Aegean Bronze Age. Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010,* Nosch M.-L., Laffineur R. (eds.), Aegaeum 23, Peeters, Leuven–Liège, 139–44.

Médard, F. 2012, Switzerland: Neolithic period, in: *Textiles and Textile Production in Europe: From Prehistory to AD 400*, Gleba M., Mannering U. (eds.), Ancient Textile Series vol. 12, Oxbow Books, Oxford–Oakville, 367–377.

Michel, C., Nosch, M.-L. (eds.), 2010, *Textile Terminologies in the Ancient Near East and the Mediterranean from the 3rd to the 1st Millennia BC*, Ancient Textiles Series vol. 8, Oxbow Books, Oxford–Oakville.

Militello, P. 2007, Textile industry and Minoan palaces, in: *Ancient Textiles, Production, Craft and Society, Proceedings of the First International Conference in Ancient Textiles, held at Lund Sweden and Copenhagen, Denmark, on March 19-23, 2003*, Gillis C., Nosch M.-L. B. (eds.), Ancient Textiles Series vol. 1, Oxbow Books, Oxford, 36–45.

Miller, H. M. L. 2007, *Archaeological Approaches to Technology,* Academic Press Elsevier, London-Amsterdam et al..

Möller-Wiering, S. 2006, *Tools and Textiles – Texts and Contexts. Bronze Age textiles found in Crete*, http://ctr.hum.ku.dk/tools/Bronze_Age_textiles_found_in_Crete.PDF/ (13. 3. 2015.).

Moulhérat, C., Spantidaki, Y. 2009, Cloth from Kastelli, Chania, in: *Archane. Occasional Publication for the History of Costume and Textiles in the Aegean and Eastern Mediterranean*, Vol. 3, 8–15.

Nosch, M.-L. B. 2012, The textile logograms in the Linear B tablets: Les idéogrammes archéologiques du textile, *Biblioteca di Pasiphae*, Vol. 6, 305–46

Nosch, M.-L., Laffineur, R. (eds.), 2012, *KOSMOS. Jewellery, Adornment, and Textiles in the Aegean Bronze Age. Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010*, Aegaeum 23, Peeters, Leuven–Liège.

Outram, A. K. 2008, Introduction to experimental archaeology, *World Archaeology*, Vol. 40.1, 1–6.

Peacock, E. 2001, The contribution of experimental archaeology to the research of ancient textiles, in: *The Roman Textile Industry and its Influence. A Birthday tribute to John Peter Wild*, Walton Rogers P., Bender Jørgensen L., Rast-Eicher, A. (eds.), Oxbow Books, Exeter, 181–192.

Peacock, E. 2014, Experimental soil burial studies for archaeological textile preservation and research – a review, in: *A Stitch in Time: Essays in Honour of Lise Bender Jørgensen*, Bergerbrant S., Fossøy S. H. (eds.), GOTARC SERIES A. Gothenburg Archaeological Studies 4, University of Gothenburg, Gothenburg, 1–22.

Petrakis, V. P. 2012, 'Minoan' to 'Mycenaean': thoughts on the emergence of the Knossian textile industry, in: *KOSMOS. Jewellery, Adornment, and Textiles in the Aegean Bronze Age. Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010,* Nosch M.-L., Laffineur R. (eds.), Aegaeum 23, Peeters, Leuven–Liège, 77–86.

Ræder Knudsen, L. 2002, La tessitura con le tavolette nella tomba 89, in: *Guerriero e sacerdote. Autorità e comunità nell'età del ferro a Verrucchio. La tomba del trono,* von Eles P. (ed.), All'Insegna del Giglio in Firenze, Firenze, 230–243.

Ræder Knudsen, L. 2012, Case study: the tablet woven borders of Verucchio, in: *Textiles and Textile Production in Europe: From Prehistory to AD 400*, Gleba M., Mannering U. (eds.), Ancient Textile Series vol. 12, Oxbow Books, Oxford–Oakville, 254–263.

Rahmstorf, L. 2008, *Kleinfunde aus Tiryns. Terrakotta, Stein, Bein und Glas/ Fayence vornehmlich aus der Spätbronzezeit,* Tiryns. Forschungen und Berichte, Band 16, Dr. Ludwig Reichert Verlag, Wiesbaden.

Shank, E. 2012, The jewellery worn by the procession of mature women from Xeste 5, Akrotiri, in: *KOSMOS. Jewellery, Adornment, and Textiles in the Aegean Bronze Age. Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010,* Nosch M.-L., Laffineur R. (eds.), Aegaeum 23, Peeters, Leuven–Liège, 559–65.

Shishlina, N. I., Orfinskaya O. V., Golikov, V. P. 2003, Bronze Age textiles from the north Caucasus: new evidence of fourth millennium B.C. fibres and fabrics, *Oxford Journal of Archaeology*, Vol. 22, No. 4, 331–334.

Siennicka, M. 2012, Textile production in Early Helladic Tiryns, in: *KOSMOS. Jewellery, Adornment, and Textiles in the Aegean Bronze Age. Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010,* Nosch M.-L., Laffineur R. (eds.), Aegaeum 23, Peeters, Leuven–Liège, 65–74.

Siennicka, M., Ulanowska, A. (forthcoming), So simple yet universal. Experimental approach to clay spools from Bronze Age Greece, in: *Textiles and Dyes in the Mediterranean World. Vth Purpureae Vestes International Symposium. Textiles and Dyes in the Mediterranean World, Abbey of Montserrat 20-23. 03. 2014,* Alfaro Giner C. et al. (eds.).

Spantidaki, Y., Moulhérat, Ch. 2012, Greece, in: *Textiles and Textile Production in Europe: From Prehistory to AD 400*, Gleba M., Mannering U. (eds.), Ancient Textile Series vol. 12, Oxbow Books, Oxford–Oakville, 185–200.

Tzachili, I. 1990, All important yet elusive: looking for evidence of cloth-making at Akrotiri, in: *Thera and the Aegean World III. Proceedings of the Third International Congress, Santorini, Greece, 3-9 September 1989*, Hardy D. A., Doumas C. G., Sakellarakis J. A., Warren P. M. (eds.), Vol. 1 Archaeology, The Thera Foundation, London, 380–389.

Tzachili, I. 1997, *Υφαντική και υφάντρες στο Προϊστορικό Αιγαίο,* Πανεπιστημιακές Εκδόσεις Κρήτης. 'Ιδρυμα Τεχνολογίας και 'Ερευνας, Ηράκλειο, Αθήνα.

Ulanowska, A. 2012, Odtwarzanie dawnych technik tkackich w Instytucie Archeologii Uniwersytetu Warszawskiego poprzez archeologię doświadczalną, in: *Ricerche e attività del corso internazionalizzato di archeologia. Catania, Varsavia, Konya 2009–2012,* Militello P., Camera M. (eds.), Syndesmoi 3, Officina di Studi Medievali, Palermo, 239–262.

Ulanowska, A. 2014, The economics of weaving – aspects of labour in the Bronze Age Aegean, in: *Textile Trade and Distribution in Antiquity,* Droß-Krüpe K. (ed.), Philippika 73, Harrassowitz Verlag, Wiesbaden, 151–159.

Ulanowska, A. (forthcoming), Representations of textile tools in Aegean glyptic. Cuboid seal from the Tholos Tomb A in Aghia Triada, in:

Syndesmoi, Militello P., Żebrowska K. (eds.).

Warren, P. 1972, *Myrtos: an Early Bronze Age Settlement in Crete,* British School of Athens Supplementary vol. 7, Thames and Huston, British School of Archaeology at Athens, London.

Weingarten, J. 2000, Some seal-impressed weights from eastern Crete, in: *Πεπραγμένα Η' Διεθνούς Κρητολογικού Συνεδρίου, Ηράκλειο, 9-14 Σεπτεμβρίου 1996,* Karetsou A., Detorakis T., Kalokairinos A. (eds.), vol. A1.2, Εταιρία Κρητικών Ιστορικών Μελετών, Ηράκλειο, 485–495.