Report: Pedagogy and skill acquisition in lithic knapping

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Abstract:

This article explores a unique pedagogical approach for teaching lithic knapping, an essential aspect of experimental archaeology that focuses on the accurate replication of stone tools. The authors describe the establishment of the Flint Knapping Club (FKC) at Loyola University Chicago, where a diverse group of undergraduate students is introduced to the art of lithic knapping and trained using the pedagogical approach presented here.

This methodology is based on a combination of published literature, common practices in contemporary academic and non-academic knapping groups, and the experience of the instructor. The presented pedagogical method can be completed in an average of 10 hours and comprises a seven-component workflow, including: (1) theory of the fundamental dynamics and physics of knapping, (2) hard hammer percussion, (3) soft hammer percussion, and (4) pressure flaking. A particular emphasis is given to archaeologically accurate tools, raw materials, and knapping methods. Each component is designed to build on the skills and knowledge learned in the previous steps. Students are also given the opportunity to complete replication projects of stone tools such as a unidirectional pebble chopper, bifacially worked hand axes, a projectile point, and a hafted end scraper.

The presented approach aims to provide a comprehensive understanding of lithic knapping, showcasing the advanced degree of skill acquisition irrespective of prior experience in lithic knapping. The success of the pedagogical approach is demonstrated by two case studies, where students produced a set of six projectile points based on cultural traditions from Southern Illinois and a collection of eccentric lithics inspired by Mayan artifacts.

Our pedagogical approach is a valuable resource for teaching lithic knapping and challenges traditional stereotypes based on gender and age within the field. It is easy to implement, requires limited resources, and has been shown to be effective. With this training, it is possible to develop the

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appropriate skills to carry out independent and complex projects that traditionally would have been considered achievable only for knappers with far more experience.

Keywords: knapping; experimental archaeology; pedagogy; teaching; skill acquisition; lithic technology

1. Introduction

One main field of research within experimental archaeology concerns the study and replication of stone tools. Terms used for this practice vary depending on geography, with “knapping” being the most common term across European, North American or British settings (Andrefsky 2005; Waldorf 2006) and “chipping" being sporadically used in North American settings (Hayden 2022). This field includes the methods of production of stone objects (knapping, grinding or other forms of manipulation) and the tools used to make them. The process used to shape rock into tools, also called lithic knapping or flint knapping, can be defined as the deliberate process of carefully removing material using a variety of tools made from rock, bone, antler, metal, and more. This practice has been used by our human ancestors for over 3.3 million years (Harmand *et al.* 2015), originating in Africa and spreading throughout the world among various populations and cultures. Knapped or chipped stone tools have been critical to human evolution, playing a significant role in shaping who we are today.

2. Flint Knapping Club, Loyola University Chicago

In October 2022 authors JNC and EYH inaugurated a new Flint Knapping Club (FKC) within the Department of Anthropology at Loyola University Chicago (LUC). As part of this club, undergraduate students meet on a weekly basis to learn the basics of lithic knapping and the creation of archaeological replicas. So far, members have successfully reproduced tools including Acheulean tools, hafted end scrapers, and basic projectile points. In the future, FKC members will continue to hone their knapping skills and will create replicas of the most important stone tool traditions from all over the world, including Native American projectile points, Levallois flakes, European Paleolithic bladelets, and Mayan eccentric flints.

A total of 36 members have actively participated in the club thus far, with over 60 members registered to begin in Spring 2024. All members are undergraduate students at LUC, majoring or minoring in Anthropology, Biology, Classics, Philosophy, Art History, Political Science, Communications, Fine Arts and more. Of all the members 90.9% identify as women. This statistic is a welcome addition to the field of knapping and lithic analysis as both are historically overrepresented by men. None of the student members were previously acquainted or had any experience with experimental archaeology and lithic knapping.

3. Pedagogical approach

An original pedagogical approach was introduced to all students at the start of their training as FKC members. This approach took inspiration from a multitude of sources, including:

1. Published literature (Hayden 2022; Waldorf 2006; Whittaker 1994),
2. common practices in contemporary non-academic knapping circles (Whittaker 2004), and
3. experience of the instructor (JNC, >10 years knapping experience). The following approach requires limited access to knapping tools and raw materials (Figure 1).

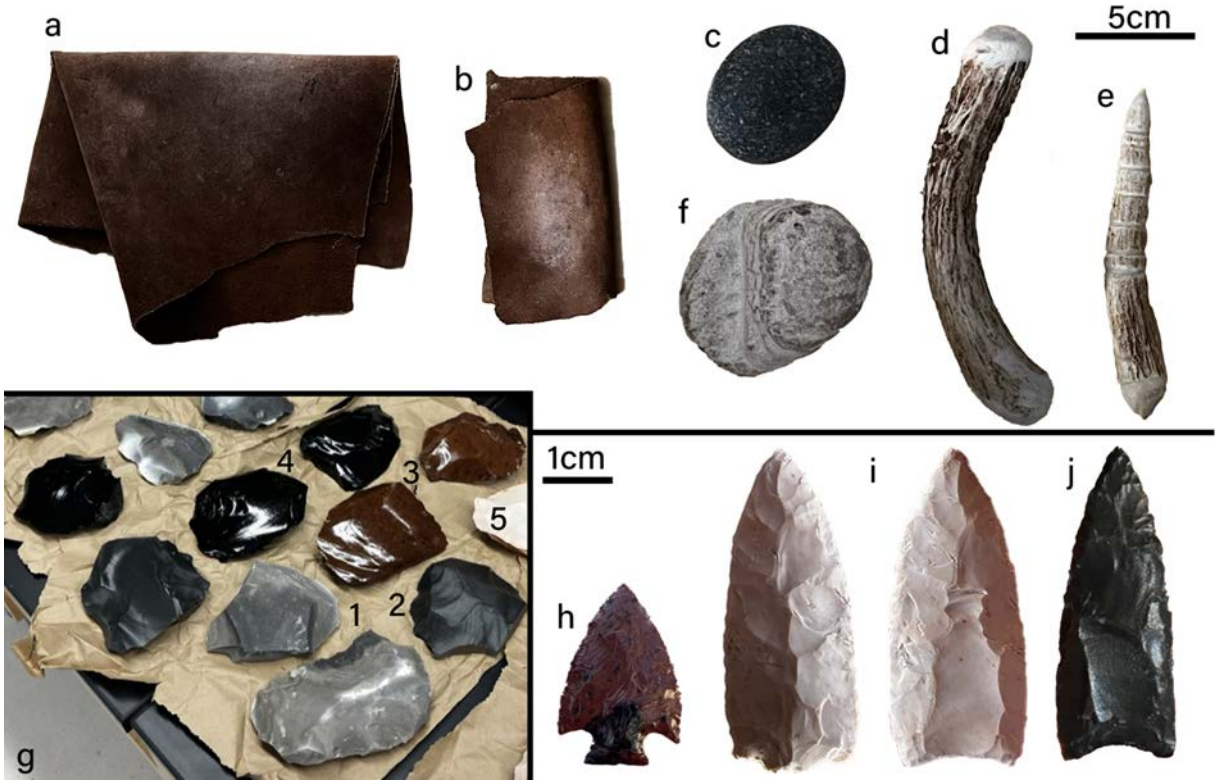

Figure 1. Individual tool set (a-leg pad, b-hand pad, c-hammerstone, d-antler billet, e-antler tip, f-abrader; protective gear not shown but present in kit) and raw materials (g: 1-georgetown flint, 2-4 obsidian variations from different sources, 5-heat-treated Keokuk chert) used for knapping training. In addition, three examples of knapped replicas using this kit were included (h-notched arrow point, i-j Clovis points; replicas by JNC).

The method presented in this project consists of a seven-component process with extra replication projects. The replication projects include a unidirectional pebble chopper (A), a notched projectile point (Project B), and a hafted end scraper (Project C). The complete workflow and required materials are presented in Table 1 and Figure 2; including the required tools, size and type of raw material, and knapping methods covered during training (Table 2).

Table 1. Seven component pedagogical workflow used for flintknapping training.

Knapping pedagogical workflow	Tools required	Raw material	Time (minutes)
Component 1: Theory of the fundamental dynamics and physics of knapping	None	None	15
Component 2: Introduction to pressure flaking	Pressure flaker; Abrader; Hand leather pad	2-3 flakes (length: 3-5 cm)	60-120
Component 3: Introduction to hard hammer percussion	Medium cobble; Abrader; Leg leather pad	2 flat faced cobbles or spalls (length: 20 cm)	60
Component 4: Continuation with pressure flaking	Pressure flaker; Abrader; Hand leather pad	2-3 flakes (length: 3-5 cm)	90
Component 5: Introduction to soft hammer percussion	Small antler billet; Abrader; Leg leather pad	Spall (length: 10 cm)	30
Component 6: Continuation with soft hammer percussion	Small antler billet; Abrader; Leg leather pad	Bifacially worked oval spall (length: 20-30 cm)	60
Component 7: Combination of hard hammer - soft hammer - pressure flaking	All of the above	2 cobbles or spalls (length: 20 cm)	120

Table 2. List of tools and raw materials required for completing the entire pedagogical workflow.

Tools	Raw materials	Raw materials size	Raw materials quantity
Hand leather pad	Flakes	3-5 cm	4-6
Leg leather pad	Flat faced cobbles or spalls	20 cm	2
Abrader (*e.g.*, natural sandstone, synthetic silicon carbide)	Standard spall	10 cm	1
Pressure flaker (*e.g.,* antler tip, copper tipped wooden handle)	Bifacially worked oval spall	20-30 cm	1
Small antler billet	Standard spalls	20 cm	2
Medium cobble or hammestone			

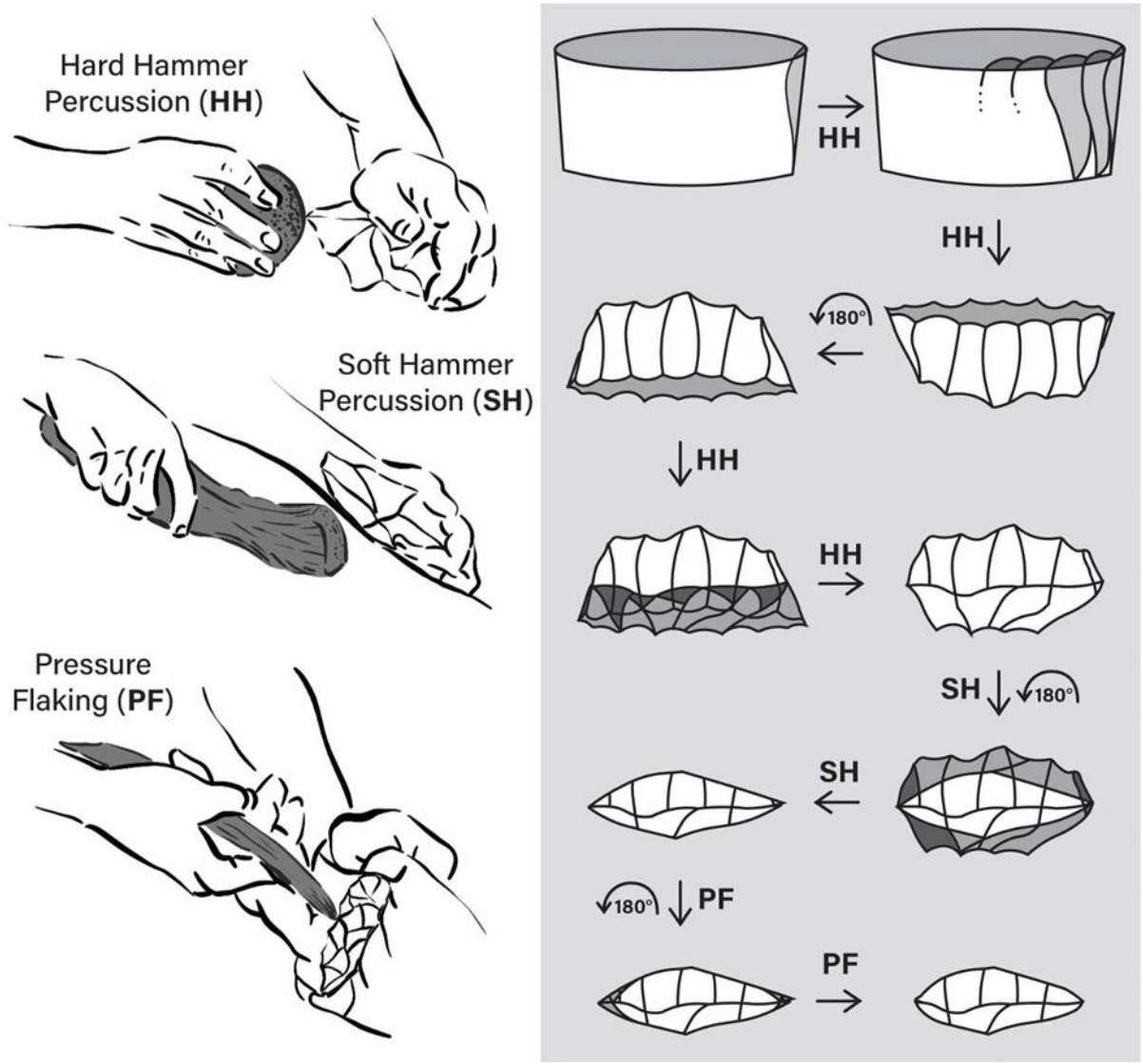

Figure 2. Knapping methods used (left), and complete workflow (right) with pedagogical components in italics with its relevant knapping method. The overall workflow is a step-by-step breakdown of Component 7, with percussion platforms in dark gray and flaked material in light gray.

Component 1 is dedicated to the physical properties of knappable stone, and the dynamics required to intentionally knap (Figure 3). General stone tool definitions are also presented and involve the description of flakes, cores, blades, and knapping tools. Components 2 and 3 introduce the first physical contact to knapping (Figure 2). Unlike other pedagogical approaches, we have found that starting with pressure flaking provides a less steep learning curve. Pressure flaking is less susceptible to inexperienced user error due to its higher degree of control compared to hard hammer percussion. Furthermore, pressure flaking is cost efficient, as it requires less materials.

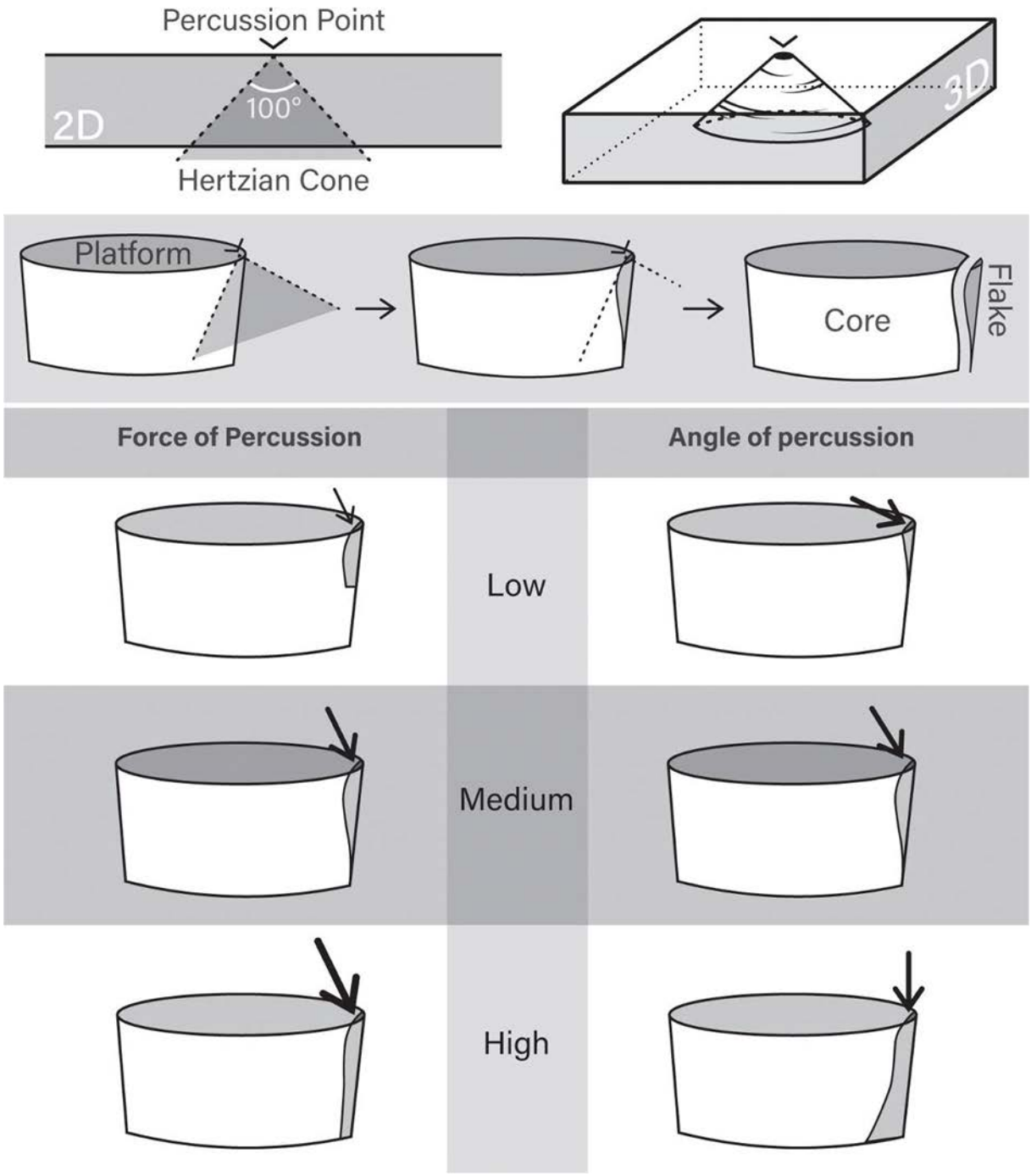

Figure 3. Physical properties and basic dynamics taught during Component 1. They include: Hertzian cone, platform percussion, core and flake technology, angle of percussion, and force of percussion. The latter two dynamics are presented with variable force and angle, from low to high degree.

Component 3 follows a similar structure, where the basic physical properties of knapping are repeated (Figure 2) and applied to the removal of recurrent flakes from a unidirectional core. Once flakes are knapped with good feathering, the first replication project is carried out. Project A uses hard hammer percussion on a cobble to create a unidirectional pebble chopper. The same technique is then used to create a complete worked perimetral edge, followed by bidirectional removal of flakes using the previous scars as platforms. During this step the concepts of removal sequences (unifacial *vs.* bifacial, recurrent *vs.* preferential) are presented.

The removal of bifacial flakes is followed by the description of symmetry and edge alignment, where the final shape and edge of the produced biface is achieved into hand axes.

Components 4-7 constitute practice with different tools, angles and forces of percussion to better understand flake removal and its predictability. Thinning is presented as new conceptual information during Component 6. Two replicas are knapped at the end of this pedagogical workflow involving the thinning and shaping of a flake into a notched projectile point (Project B), and the invasive retouch and notching of an end scraper and its hafting with artificial sinew and pine resin pitch (Project C, examples displayed in Figure 4).

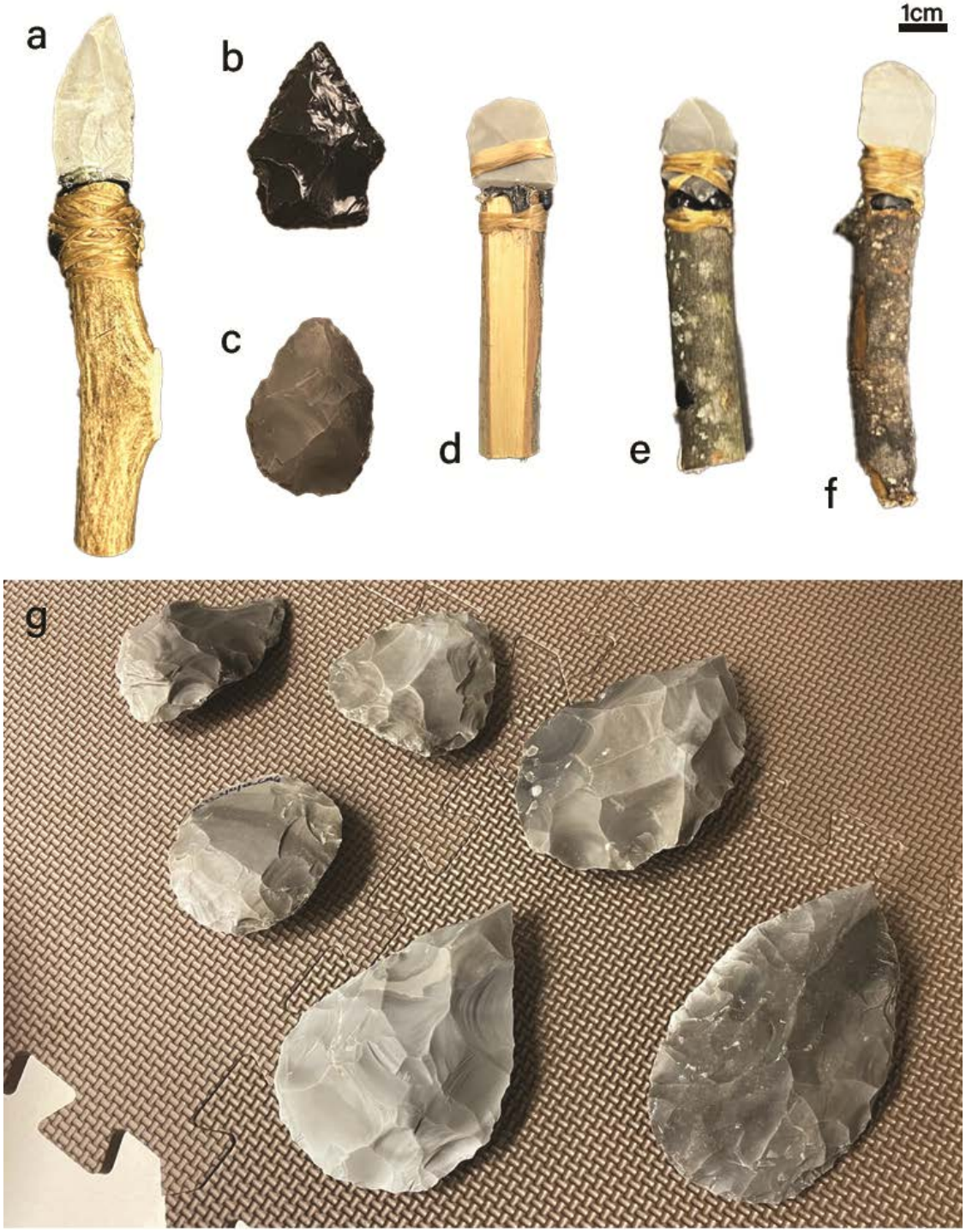

Figure 4. Examples of lithic tools produced by FKC student members. They include a hafted blade (a), bifaces (b-c), hafted end scrapers (d-f) and hand axes (g; not to scale).

By following this workflow, all components can be completed in an average time of 7 hours and 45 minutes. Including extra time for the completion of the replication projects, a conservative time of 10 hours is suggested for the completion of the entire workflow. As a qualitative comparison with reference to bifacial reduction, members were able to reach Callahan's "Learning Phases" C to D (Callahan 1979: 37-38), depending on the student personal predispositions, and preform stage 3 (Callahan 1979: 36). Overall, the knapping outcomes and time estimations presented in this report are in agreement with Callahan's time estimations for the mentioned learning stages, albeit reaching them through a different pedagogical approach.

4. Case studies

Following training, two members of the Flint Knapping Club carried out personal projects as part of their undergraduate studies (Figure 5). Their work has been summarized as case studies of the potential success of the pedagogical approach presented here.

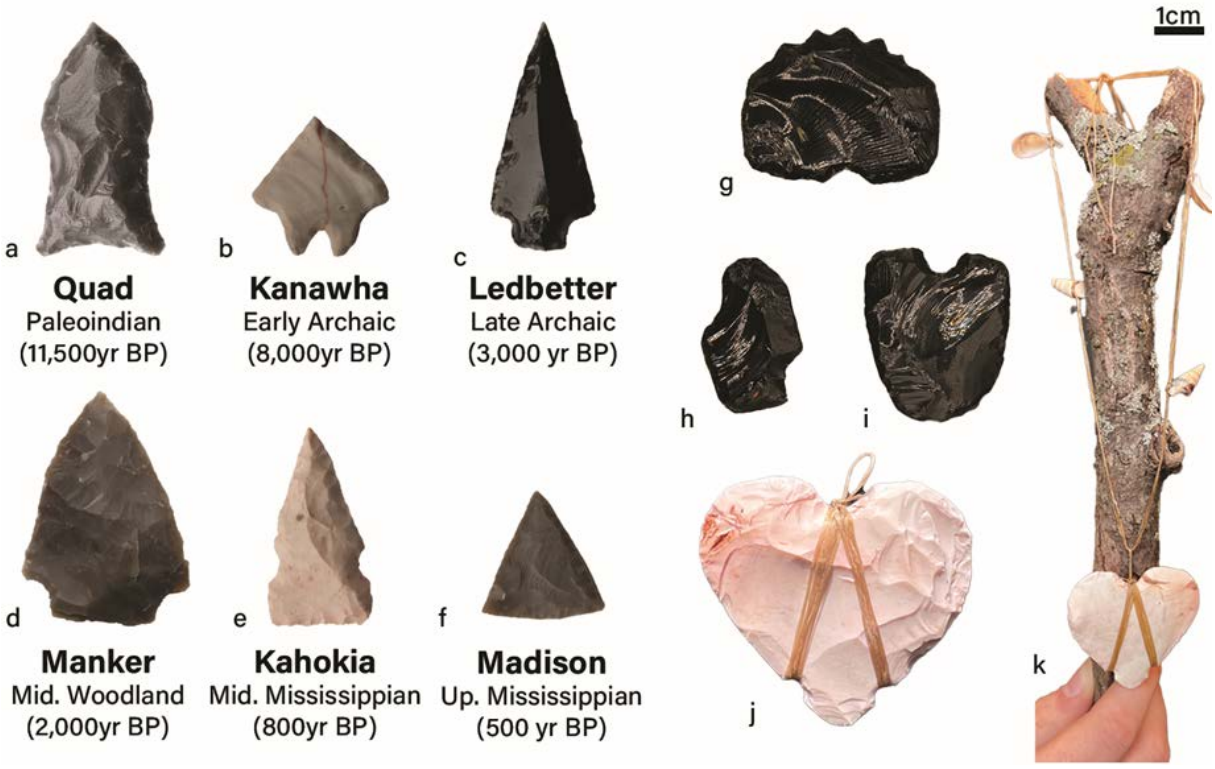

Figure 5. Lithic projectile points produced by CMG (a-f) and KME (g-k; k not to scale).

4.1. Southern Illinois projectile points (CMG)

This project aimed to create a set of six projectile points based on cultural traditions from Southern Illinois (Figure 5). Each projectile point derives from a different time period of the Illinoian archaeological record, from Paleoindian to Upper Mississippian (Reber *et al.* 2017). A secondary objective of this project was to highlight the possibility that stone tools could have been made by anyone, no matter the level of knapping competence, with only a limited amount of instruction.

4.2. Mayan eccentric and shell beads (KME)

This project aimed to create a set of eccentric lithics that explored the artistic side of lithic knapping, including pieces inspired by Ancient Mayan eccentric lithics that were used

for personal adornment, religious practices, or artistic appreciation (Sullivan 2017). Non-functional features such as denticulate edges, curved lines, negative spaces and shell beads were showcased for the purpose of eccentric pieces and pressure flaked jewelry.

5. Conclusion

As proven by the members of LUC's Flint Knapping Club, completing this pedagogical workflow results in the acquisition of basic and more advanced lithic knapping procedures. This can be interpreted as a demonstrable in-depth understanding of lithic knapping and the basic methods of stone tool production. With this training, students were able to complete and carry out independent and complex projects that traditionally would have been considered achievable only for knappers with far more experience.

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Informe: Pedagogía y adquisición de habilidades en talla lítica

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Resumen:

Uno de los principales campos de investigación de la arqueología experimental es el estudio y la reproducción de herramientas líticas por talla lítica. Los términos ingleses utilizados para referirse a la talla lítica varían en función de la geografía, siendo "knapping" el término más común en los entornos europeos, norteamericanos o británicos y "chipping" relativamente común en los entornos norteamericanos. El proceso utilizado para dar forma a la roca y convertirla en herramientas puede definirse como el proceso deliberado de extraer material cuidadosamente utilizando una variedad de herramientas hechas de roca, hueso, asta, metal y otros materiales. Esta práctica ha sido utilizada por nuestros antepasados humanos desde hace más de 3,3 millones de años, se originó en África y se extendió por todo el mundo entre diversas poblaciones y culturas. Las herramientas de piedra tallada han sido fundamentales para la evolución humana y han desempeñado un papel importante en la formación de lo que somos hoy en día.

En este artículo, exploramos un enfoque pedagógico para la enseñanza de la talla lítica, un aspecto esencial de la arqueología experimental que se centra en la reproducción exacta de herramientas de piedra. Los autores describen la creación del Flint Knapping Club (FKC) en Loyola University Chicago, donde un grupo diverso de estudiantes universitarios es introducido en el arte de la talla lítica y entrenado utilizando el enfoque pedagógico que aquí se presenta.

Esta metodología se basa en una combinación de literatura publicada, prácticas comunes en grupos contemporáneos de talla académicos y no académicos, y la experiencia del instructor. El método pedagógico presentado puede ser completado en un promedio de 10 horas y comprende un flujo de trabajo de siete componentes, incluyendo: (1) teoría de la dinámica fundamental y física de la talla, (2) introducción a la percusión directa, (3) introducción a la percusión con percutor duro, (4) continuación con percusión directa, (5) introducción a la percusión con percutor blando, (6) continuación con percusión con percutor blando, y (7) combinación de percusión con percutor duro, percutor blando y percusión directa. Se hace especial hincapié en la precisión arqueológica de las herramientas, las materias primas y los métodos de talla. Cada componente está diseñado para

construir sobre las habilidades y conocimientos aprendidos en los pasos anteriores. Los estudiantes también tienen la oportunidad de completar proyectos de réplica de herramientas lítica como un picador de guijarros unidireccional, un bifaz achelense, una punta de proyectil y un raspador con empuñadura.

El enfoque presentado tiene como objetivo proporcionar una comprensión global de la talla lítica, mostrando el alto grado de adquisición de habilidades, independientemente de la experiencia previa en la talla lítica. El éxito del enfoque pedagógico queda demostrado por dos estudios de caso. En el primero, un alumno elaboró un conjunto de seis puntas de flecha, cada una de las cuales correspondía a un período diferente del registro arqueológico Illinoian (Estados Unidos) desde el Paleoindio hasta el Mississippiano superior. Para el segundo estudio de caso, un estudiante creó un conjunto de líticos excéntricos que exploran el lado artístico de la talla lítica, incluyendo piezas talladas inspiradas en los líticos excéntricos de los antiguos mayas que se utilizaban para el adorno personal, las prácticas religiosas o la apreciación artística.

Nuestro enfoque pedagógico es un recurso valioso para la enseñanza de la talla lítica y desafía los estereotipos tradicionales basados en el género y la edad dentro de este campo. Es fácil de aplicar, requiere recursos limitados y ha demostrado su eficacia. Con esta formación, es posible desarrollar las habilidades apropiadas para llevar a cabo proyectos independientes y complejos que tradicionalmente se habrían considerado alcanzables sólo para tallistas con mucha más experiencia.

Palabras clave: talla lítica; arqueología experimental; pedagogía; adquisición de habilidades; tecnología lítica