

Instructional and Technical Approach

About the Object

We will teach non-engineering undergraduate students how a pin tumbler lock works. Pin tumbler mechanisms are used in cylinder locks, common in most residential and commercial doors. A common way to open groups of pin tumbler locks in residential buildings is by using a “change key” - one used by individual tenants in a building - and a “master key” - which is held by the landlord of the building.

A misconception we are addressing includes peoples’ false perception that the lock opens because its shape matches the key - instead of the key ridges pushing up the pins to align along the shear line.

Target Audience

Our target audience is non-engineering undergraduate students and we expect them to already know how to use a key to open pin tumbler locks. We also expect them to know that a basic spring can be stretched and compressed.

Since they are non-engineering students, we will give them step-by-step instructions as to how the pins exert appropriate pressure on the springs through the shafts connecting the components in the plug to the case, allowing the lock to open.

Instruction and Interaction Design

We will use guided discovery (invent-then-tell) for our instruction and interaction design. We will first show students the inner part of the lock without giving explanations, then ask them to tell how a pin tumbler lock works in the pretest via labeling concepts and self-explanation, give them feedback, and then they will watch instructional videos to verify their hypotheses or correct their misconceptions.

There will be both summative and formative assessments with both corrective and explanatory feedback in our design. We will provide only corrective feedback in the pretest to reduce students’ cognitive load. Formative assessments will enhance students’ memory of the knowledge and provide students with an opportunity to pace their own learning.

We will allow students to continue through the lesson at their own pace (asynchronous, self-directed learning), so that students with knowledge of how pin tumbler locks work can move quickly through the lesson.

Technical Approach

- 1) We will use a pin tumbler lock and videotape its inner parts as we unlock it. We will also draw and create prototypes and use them to explain the lock system in the instructional video. The student will have to visualize the lock and actively engage in understanding the pin tumbler system.
 - Benefits
 - We have reduced extraneous information to focus on the pin tumbler lock mechanism and nothing else.
 - Guided discovery includes performing tasks - high behavioral activity and optionally high psychological activity. Students troubleshoot components of the lock and pay close attention to the shear line mechanism, which is key to unlocking pin tumbler lock-operated doors.
 - Drawbacks
 - We do not have a simulation where a student can use a key to open and watch the tumbler pins of a lock operate; however, college students have reached the cognitive level of abstract thinking. As a result, they should be able to understand the concept by watching the 3D model.
 - We are unable to customize instruction. However, students are given the navigation menu initially and Back/Continue buttons throughout the instructional modules.

- 2) We will develop an interactive website to provide instruction, assessments, and feedback.
 - Students will learn by watching an instructional video.
 - Students will have a chance to perform learning by doing.
 - Students will be able to navigate a video and still use the interactive component.
 - Benefits
 - We increase student engagement and create an active learning environment.
 - Students will receive timely feedback and regulate their own learning.
 - Drawbacks
 - Students may find the practice too challenging and lose motivation.
 - Students may misjudge their abilities and skip crucial instructional components.
 - We don't have an in-person, cross-sectional model of a lock for the student to test their knowledge in a real-world setting.

Bibliography

3D cross sections of the pin tumbler lock were presented in our instructional videos. Portions of this material were clipped from a video originally created by Jared Owen, a 3D animator on YouTube. This video can be found at: <https://www.youtube.com/watch?v=smlIdInCQ-kU>