CTHCI – Study Protocol
Mini HCI Experiment

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Context

In current times where online learning is emerging, learning through MOOCs and YouTube are becoming a major part of every curriculum [1, 2, 4, 7]. As MOOCs often use intermediate quizzes in between the video lectures, little is known if they actually help the user to better understand and remember the content or it is just extra efforts by content creators in hope of making the online courses useful [3, 5, 6]. The goal of this study is to investigate the influence of intermediate coding challenges and quizzes on the ability of users to learn programming more efficiently. The results should help to better understand the effect of intermediate tasks in online learning.

Aim

This study aims to investigate the effects of intermediate coding challenges and quizzes on the ability of users to learn programming more efficiently. In particular the study aims to answer the following research questions:

1. What is the effect of coding challenges in-between a learning video on the users' ability to successfully solve a final project question while learning to code?
2. What is the effect of quizzes in-between a learning video on the users' ability to successfully solve a final project question while learning to code?
3. Do intermediate tasks help users to learn to code more efficiently?

Hypotheses

1. Coding challenges in-between a learning video help to learn more efficiently than intermediate questions.
2. Intermediate questions in a learning video help to learn more efficiently than just watching the video without any interaction.

Independent Variables

- Knowledge Reinforcement Method
  - Manipulation by direct intervention
  - Levels:
    - Nothing (Only video sessions)
    - Quizzes (Intermediate quizzes between video sessions)
    - CodingChallenge (Intermediate Coding Challenges between video sessions)
- Survey questions

- Manipulation by selection
- Levels:
  - QUESTION TYPE 1: (OPEN-ENDED TEXT QUESTIONS)
  - QUESTION TYPE 2: (5-POINT LIKERT SCALE QUESTIONS)
  - QUESTION TYPE 3: (MULTIPLE CHOICE)

Dependent Variables

- Time needed to complete the final challenge measured in minutes (Includes the time taken for rewatching videos)
- Difference between answers in start and end surveys

Task

1. Each study begins with the user watching a short 2-min long video that introduces him to SQL.
2. The user is asked to answer a quiz after the video that tests their knowledge. After the user has chosen an answer of the multiple choice questions the answer is evaluated by the system. In the case that the user answered wrong, he has to make a new choice and can only then proceed to the next step. We measure after each confirmed choice whether the user has chosen right or wrong. At any time the user can go back and repeat step 1. We measure how often the user has taken a step back.
3. This questions and quiz cycle is repeated for a total of 3 times. Each cycle builds on the previous one and introduces a new concept with new interactive questions.
4. After that a larger coding challenge is displayed, which the user has to answer. This builds on the previous concepts.

The steps above describe the exact procedure of the QUIZZES variant. In the NOTHING variant, step 2 is omitted and all videos are directly displayed in a sequence. At the end, the participant has to edit the coding challenge. In the CODINGCHALLENGE variant, interactive coding challenges are displayed to the user instead of a quiz, similar to the final project which the user has to work on at the end of the study. However, these are much smaller and exactly tailored to the previously presented small concept videos and can be evaluated interactively. Quiz answers are just evaluated. For example, the user receives an error message if the syntax is incorrect.

Participants

Because of our IV the ideal number of users should be divisible by three and the users shouldn't have any previous knowledge of SQL. That is why we decided to conduct the study with six participants.

Experimental Design

As learning is involved in evaluation of this study and we always present the same set of learning material, we have to use a between-group design. That means each user will only do one trail of those three: NOTHING / QUIZZES / CODINGCHALLENGE. As we have only one IV we don't need any counterbalancing. The experiment will take between 30 minutes and 1 hour.

Apparatus

- Learning videos and coding challenges provided by Khan Academy about SQL are used [8]
- Conducting our study via the Internet using video conferencing software Zoom that allows to give participants access to the researcher's screen.
- Recording users while they watch and perform tasks using the standard recording software deployed in Mac OS X
- Custom web page showing YouTube videos of Khan Academy's introduction to SQL (https://www.khanacademy.org/computing/computer-programming/sql/sql-basics/v/welcome-to-sql) and custom made interactive questions
- The before and after surveys are created using Google Forms (https://docs.google.com/forms/d/1OxsJL-cAlkVjH6JskIFLW5IZA1owW9wCRmk6Q2gZYVs/edit?usp=sharing)

Experiment Procedure

1. Introduction to the aim and purpose of study, i.e. the effects of online learning techniques such as interactive questions or coding challenges on someone's ability to learn basic computer science concepts.
2. General information how the study is conducted and the assigned learning technique.
3. Information about steps for tasks that need to be performed including the breaks between them. Each step of the participants is gone through in detail and it is ensured that the participant understands and agrees with them. If the participant does not agree (not likely) we continue with step 8.
4. The participant is asked to answer a preliminary survey to check the initial knowledge.
5. Since we are conducting our study via the Internet using video conferencing software, we briefly explain to the participant that we do not film his face at any time, only his interaction. After the explanation we give him access to move the mouse on our screen so that he can interact with our system.
6. Participant performs the tasks in our online learning system.
7. The participant is asked to answer a final survey to check the knowledge after learning with different methods.
8. We thank the participant and wish him a nice day before we leave the video conference room.

Data Analysis

For all dependent variables except the start and end surveys we will calculate average, mean and standard deviation. The survey will consist of Likert scale and open questions, we will calculate average for Likert scale and we will analyse open questions manually.

For significance testing, we will use One-way ANOVA as our data is normally distributed. For post hoc analysis we use Tukey HSD test.

Descriptive statistics and graphical representation is used as the survey.

References

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Informed Consent

Evaluating Memory Reinforcement in Online Learning

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PURPOSE OF THE STUDY:
The goal of this study is to find out how Online learning can be designed to help learn programming faster. You will be asked to complete a short lesson on the basics of programming and after that fill out a survey to check how much you learned. We will analyze the difference of knowledge before and after the lesson.

PROCEDURE:
You will be asked to fill out online survey measuring your SQL knowledge, then you will be asked to complete the lesson in our online learning course and after that you will be asked to again fill out the online survey to measure how much you have learned.

BENEFITS:
The results of this study will be useful for the creation of more effective learning courses online.

ALTERNATIVES TO PARTICIPATION:
Participation in this study is voluntary. You are free to withdraw or discontinue participation.

COST AND COMPENSATION:
Participation in this study will involve no cost to you.

CONFIDENTIALITY:
All information collected during the study period will be kept strictly confidential. You will be identified through identification numbers. No publications or reports from this project will include identifying information on any participant. If you agree to join this study, please sign your name below.

☐ I have read and understood the information on this form.

☐ I have had the information on this form explained to me.

_____   _____
Participant's Name   Principal Investigator

_____   _____
Participant's Signature   Date

_____
Date

If you have any questions regarding this study, please contact (PI name) at (PI number) email: (PI email)