

# The Lab: A Practice Space for Pedagogical Debugging

## Audience and Usage

This practice space is designed to take place as an orientation activity for new lab assistants, ideally after they have had the chance to become familiar with the equipment in the lab. The potential lab assistants will have the chance to take on the role of working with students on a lab bench before students arrive, allowing them to work through the nuances of what can be a complex social and technical interaction. The practice space especially targets new lab assistants who possess technical skills but not much teaching experience, a common situation in lab classes who recruit their teaching assistants from former students.

## Learning Objective

The primary objective of the practice space is for players to experience the hectic environment of a lab setting, learning to balance their teaching goals with the realities of the situation. These realities range from time constraints to cognitive load to obstinate students. For a would-be teacher coming from a strictly technical background, many of these realities are unexpected, and experiencing them for the first time in a controlled and reflection-filled environment is invaluable. A particular skill related to this objective is hands-off debugging, where teachers refrain from directly fixing code or equipment set-ups for the student. Doing the experiment for the student is often the first response of a new lab assistant faced with a time crunch, and the practice space is deliberately designed to discourage this and similar strategies.

A secondary objective is for players to develop the practical teaching skill of eliciting learner knowledge. As discussed in the context of the ELK practice space by Wong (2017), eliciting learner knowledge is the process of discovering student misconceptions through conversation and observation. ELK focuses on finding misconceptions through direct conversation with a student, but in the context of lab classes, observation is often more important, because students lack the vocabulary to discuss what they do and do not know.

Finally, as in Reich et. al (2018), this practice space aims to provide useful insights for the player roleplaying the student in the game. The student in the game is designed to have a reasonable point of view, and the reflection stage of the practice space specifically asks the player of the student to make suggestions to the player of the teacher, informed by the new student perspective. However, as many potential users are students themselves, this component of the space may be less essential in some cases.

## Design Goals

Following Grossman (2009), this practice space is designed to serve primarily as an approximation of teaching practice, rather than a decomposition or representation. Approximations allow students to repeatedly practice potentially stressful and complex tasks in a safe environment. Here, the use of a practice space allows teaching assistants to experiment with different ways of interacting with students without needing to worry about damaging relationships with students or taking up valuable class time. Additionally, approximation can make situations more playful and fun for practice. As found by Reich et. al. (2018), playful practice spaces often are more motivating and engaging for learners.

This practice space is designed to use role-playing as a central mechanic. However, because this is an active practice space featuring more than just conversation, the role-playing is designed to arise naturally from the game mechanics given to the teacher and student role respectively. By attempting to win the game, players will fall naturally into the teacher and student roles and personalities without having to devote mental resources to consciously maintaining a roleplay persona.

In order to operate successfully, the practice space must be difficult enough to surface the sorts of problems and conflicting priorities that a teacher would experience within the actual lab setting. The practice space is most successful when the player in the teacher role finds themselves getting frustrated or overwhelmed, as this is when they practice the skill of calming the situation and asserting control over the conversation. If the player does not have prior experience in these areas, the timescale of the game is unlikely to allow them time to iterate on their strategies. Instead, a reflection stage at the end of gameplay should point towards the process of improving these methods.

One of the central features of difficulty that the practice space should implement is the complexity of the tasks involved, placing this practice space in the category of “complex assemblages” described by Reich et. al. (2018). Because this practice space is targeted towards new teachers that possess all the individual technical skills needed to operate the lab equipment, the thing that needs to be practiced is the process of integrating multiple skills. The practice space should carefully approximate the hectic and high-load environment of a lab so that the player can start to become used to this environment.

## Design Implementation

The central mechanic of the practice space is based around the emerging genre of “cooperative shouting” games, such as Spaceteam or Keep Talking and Nobody Explodes. In this genre, players must give instructions to each other in high-pressure environments, and are expressly forbidden to bypass the other players in order to carry out their own instructions. This genre,

then, bears many resemblances to the lab scenario that the practice space is trying to replicate, especially the aspects of difficulty, frustration, and complexity. The use of real lab equipment

Many behaviors that a classic “cooperative shouting” game encourages, such as shouting, are undesirable in a classroom environment, so the practice space structure modifies the goals of the teacher player. The student is still operating in the world of time pressure, justified by a short lab period and in line with real student behavior, but the teacher is focused on promoting learning rather than moving quickly. These attitudes are reinforced in scenario sheets provided to each player, providing a jumping off point for role-playing.

The scoring system rewards successfully playing one’s role by connecting this directly to winning the game. The student wins by moving through steps quickly, but the teacher wins by identifying student misconceptions. The only way to achieve these goals is to take control of the chaotic situation and defend one’s point of view. This difference in goals between teacher and student organically develops ways of generating conflict and resolving through roleplaying.

Student misconceptions are represented in a way that minimizes the amount of work that the student player has to put into remembering what their misconceptions are supposed to be. The student and teacher each receive an apparatus sheet that details what they think they know about the lab equipment - what different parts are called, how to use buttons and plugs, and so forth. The student’s misconceptions are represented by differences in the two apparatus sheets. By observing the student’s behavior closely and asking the student to perform tasks or answer questions, the teacher can identify these misconceptions. Additionally, because the player of the student does not know the contents of the teacher’s apparatus sheet, they can build empathy with a student who does not think of themselves as having misconceptions.

A reflection stage, with an invitation for the student and teacher players to trade roles, takes place at the end of the practice space. The reflection is prompted by the scoring system, letting players begin with a sense of how well they did in the space. Now that the hectic environment of the game has passed, players have the chance to look back on the strategies that they used and plan for future experiences. Additionally, a final step of both players working together to look for compromises between teachers and students helps to dispel any competitive tensions that might be lingering after a game that playfully pits teachers against students.

## Prototype

A copy of the prototype can be found in the accompanying folder. In an actual playtest, there is also a physical set of lab equipment matching the images on the apparatus sheets, which players use to carry out the tasks on the protocol sheet.

## References

Grossman, P., Compton, C., Igra, D., Ronfeldt, M., Shahan, E., & Williamson, P. (2009). Teaching practice: A cross-professional perspective. *Teachers College Record*, 111(9), 2055-2100.

Reich, J., Kim, Y. J., Robinson, K., Roy, D., & Thompson, M. (2018). Teacher Practice Spaces: Examples and Design Considerations. In J. Kay & R. Luckin (Eds.), 13th International Conference of the Learning Sciences (pp. 648–655). London, UK.

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