THE ASYMPTOTE PROJECT: DEVELOPING A SYSTEM FOR ADAPTIVE AND SYNCHRONOUS ONLINE LEARNING

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Abstract. Within the ASYMPTOTE project, a system of the same name has been developed to prepare, conduct, and evaluate mathematics lessons online. It consists of three components, namely a web portal, a mobile app, and the Digital Classroom feature. In the web portal, teachers can select available or create own learning contents. These learning contents can be downloaded by the students to their smartphones by entering a related code in the app. Within the Digital Classroom feature, synchronous mathematics lessons can be carried out – it offers a monitoring tool allowing teacher to retrace students' working processes. In addition, a chat function is integrated for a direct teacher-student interaction. In the workshop, the participants get to know the ASYMPTOTE system and explore it from the student's and teacher's side. In the following, the ASYMPTOTE web portal and app are briefly introduced. In addition, the Erasmus+ project's outputs are presented.

Key words: ASYMPTOTE, mobile learning, online education.

THE ASYMPTOTE PROJECT

The Covid-19-induced school lockdowns all over the world in Spring 2020 led to a phase of *Emergency Remote Teaching* (ERT). The term describes the urgent and overwhelming installment of new ways to teach and to learn due to the distance situation (Hodges et al., 2020)*.* Based on these experiences and on theoretical considerations on online teaching and learning, the ASYMPTOTE project has been started. It aims at the development of a low-barrier and adaptive learning environment for synchronous mathematics education.

The system with its three components, namely the web portal, the app and the Digital Classroom feature, are presented in the following. For more information on the theoretical background of ASYMPTOTE, we refer to Barlovits et al. (2022).

THE ASYMPTOTE SYSTEM

First Component: The web portal

The web portal (available at https://asymptote-project.eu/en/portal/) serves as a working environment for teachers to select and/or create ASYMPTOTE learning content in the form of adaptive learning graphs. These learning graphs are composed of mathematical tasks that are created in the web portal, too. An exemplary learning graph is presented in Figure 1. By working on the mandatory main tasks (yellow), the students should get a good overview of the entirety of the respective topic. The optional challenge tasks (purple) extend the main tasks with more demanding questions for the quick and particularly motivated students. In addition, support tasks (green) can be attached to each main task to give students easier step-by-step tasks. The students can access them if needed. By this structure, the learning graph concept offers a micro-adaptive learning environment and simultaneously respect the

value of autonomous learning, since students must take responsibility for their learning process (cf. Barlovits et al., 2022).

Each task consists of a problem definition, an answer format (e.g., exact values, fill-in-the-blanks, or multiple choice), a sample solution and up to three stepped hints. In addition, a picture can be given. All of these task components allow students in the follow-up to work on the task independently and with automatic answer validation in the ASYMPTOTE app (cf. "Second Component"). The web portal also offers the possibility of publishing tasks and learning graphs to make them available to the ASYMPTOTE community. Hereby, it is mandatory to receive a review. In return, teachers can take advantage of the constantly growing collection of high-quality tasks. Even more, they can benefit from high-quality content from other European countries, as both tasks and learning graphs are translatable. In course of one of the intellectual outputs of the Erasmus+ project ASYMPTOTE, a solid foundation of theme-based learning graphs has been predesigned, iteratively reviewed and translated into all partner languages, which serve as a good starting point for new users.
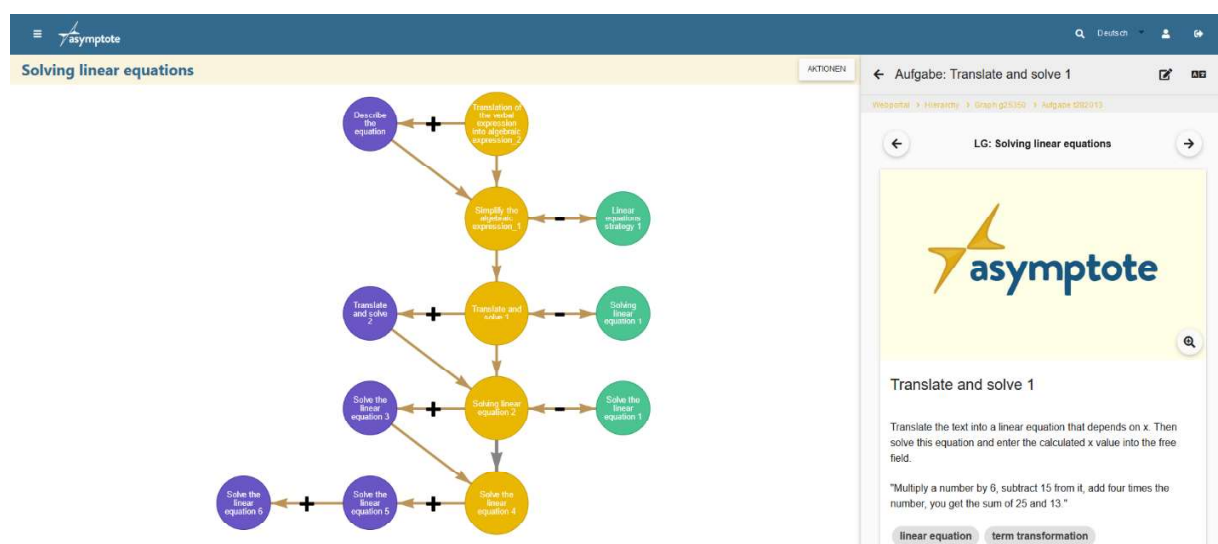

Figure 1: Web portal view of the task "Translate and solve 1" in the learning graph "Solving linear equations" with its structure on the left side.

Second Component: The smartphone app

The app enables students to work on the learning graphs in a technically low-key, self-regulated manner. By entering a code, they are connected to the learning graph to be worked on and can then solve as many tasks as possible at their own pace. An exemplary task solving process in the ASYMPTOTE app is shown in Figure 2.

It is up to the individual student whether support tasks are consulted, or a challenge task is tried if the students previously succeeded in the main task. Students have four attempts per task, the first of which is a free attempt in case of an accidental wrong entry. In case of incorrect answers, students are encouraged to use hints, or solve a support task firstly in case one is provided by the teacher. The student's input is immediately validated by the app,

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i.e., the students receive feedback on the correctness of the task. Moreover, if provided, the student can directly choose to continue working on a challenge task. Also, the sample solution can be viewed to validate and retrace the calculation steps once a task is completed. On a motivational level, the ASYMPTOTE app uses elements of shallow gamification (cf. Lieberoth, 2015) in the form of points, which can be viewed by the students at any time.
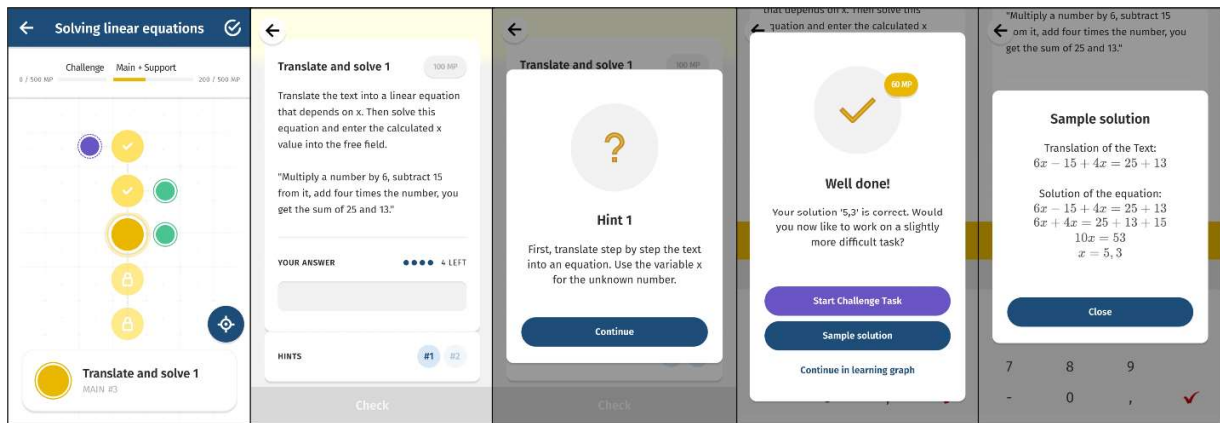

Figure 2: An exemplary task solving process in the ASYMPTOTE app: opening the task, problem description, hints, answer validation and sample solution (from left to right).

Third Component: The Digital Classroom

The Digital Classroom enables the teacher to orchestrate the processing of a learning graph in real time and to assist students synchronously in case of problems. This feature is characterized by the following core features (see also Figure 3):

- Monitoring tool: In order to respond quickly to problems, as well as provide in-depth evaluation of learning graph processes later, the teacher can track all of each student's interactions with the app. This includes typed answers, viewing hints, and viewing the sample solution.

- Evaluation: With the data from progress tracking, there are many opportunities to analyze the learning activity through the learning graph in more depth and/or optimize future learning graph processes based on that.

- Chat function: The teacher is able to send messages to all students or only to individuals through the Digital Classroom. In turn, students can contact the teacher via the app with questions or difficulties, sending pictures or voice messages.

The Digital Classroom is currently under active development to add further functionalities. For example, in the new Digital Classroom, only one QR code will be issued to students for connection. Teachers will be able to represent, manage and analyze their classes in the portal and it will be possible to edit more than one learning graph per Digital Classroom. This will also provide the basis for a number of advanced analysis tools for the teacher that will not only improve the simple evaluation of a learning graph process but will also allow for long-term analysis. The further developed Digital Classroom will be available at the conference.

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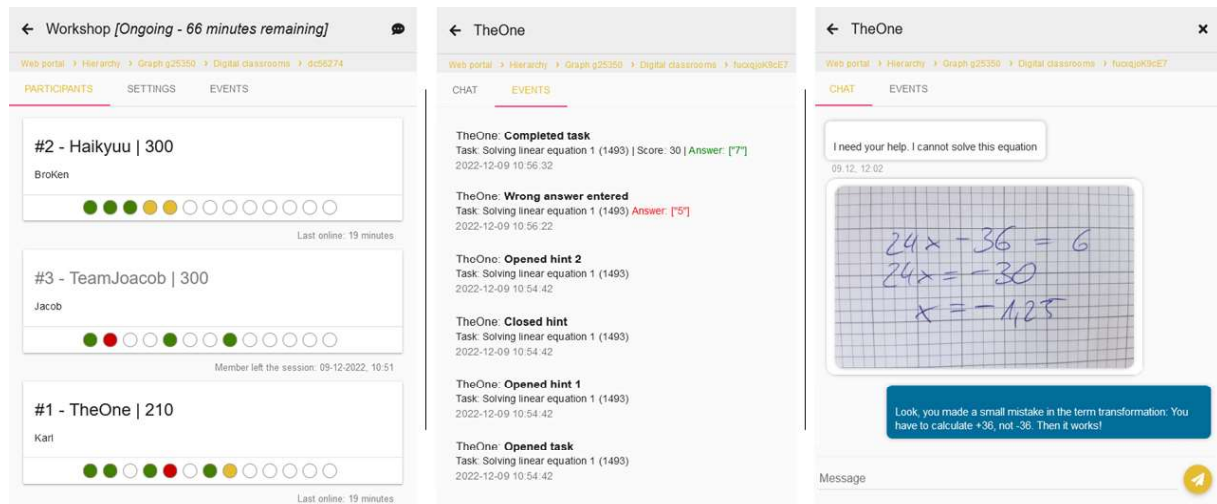Proceedings of the ROSEDA Conference.

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Figure 3: The Digital Classroom feature: monitoring, evaluation and chat (from left to right).

OUTLOOK: THE WORKSHOP

In the workshop, the participants get to know the system both from a student's and a teacher's perspective. Hereby, the participants work on a learning graph via the ASYMPTOTE app. Subsequently, the participants can share their experiences on how to use the app and discuss on desirable further developments. The teacher's perspective is focused on in the second part of the workshop. It is presented how to create tasks and learning graphs in the web portal, as well as how to use the Digital Classroom feature. The participants create their own tasks in the ASYMPTOTE web portal. The workshop ends with a discussion on the potentials and limitations of ASYMPTOTE.

To participate in the workshop, the ASYMPTOTE app should be downloaded beforehand. Also, a registration in the ASYMPTOTE web portal is needed. All participants should bring their own laptops and have a smartphone/tablet on site. Let's join the world of ASYMPTOTE!

Acknowledgment

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