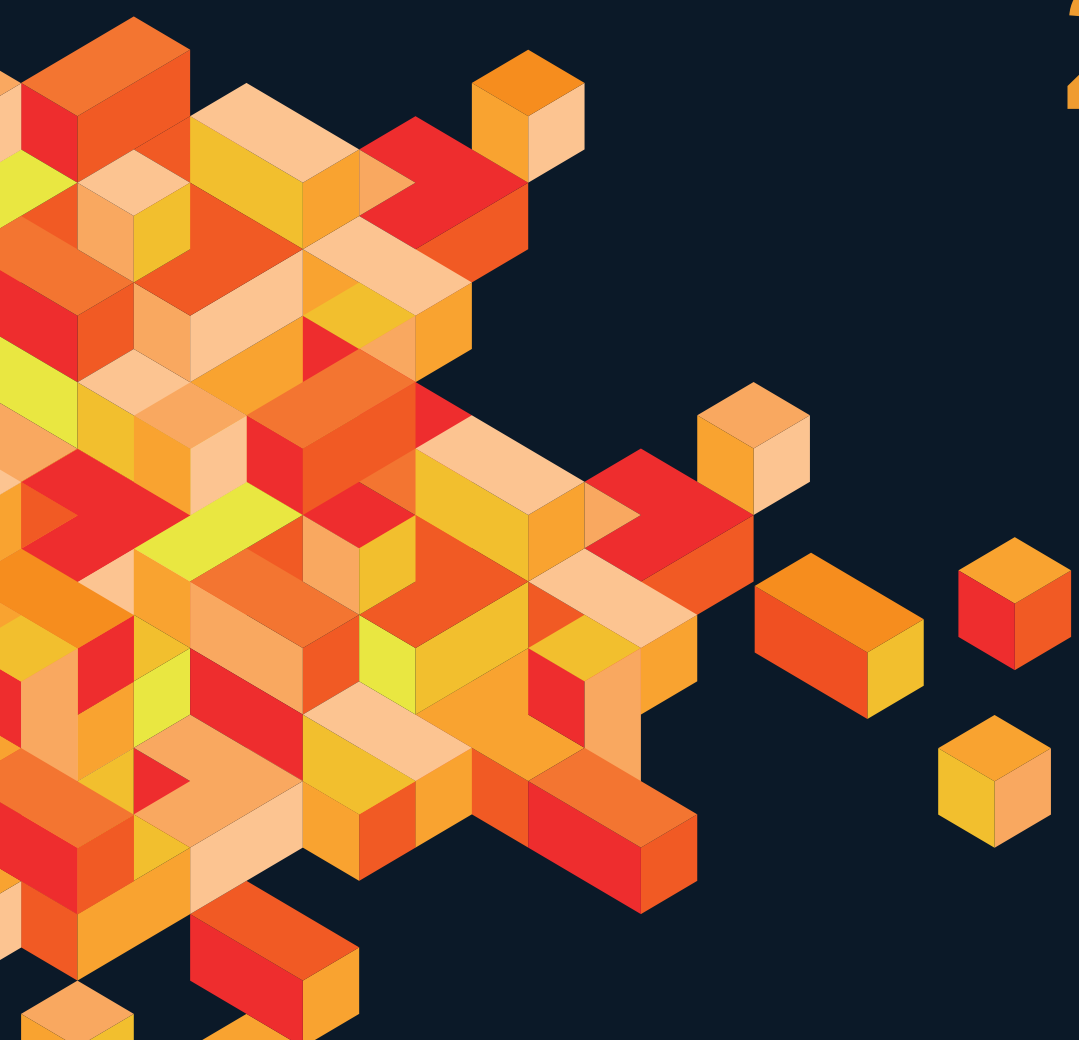
STACK CONFERENCE 2024



Bonjour

Ciao

Dia dhuit

Grüezi

Habari

Hallo

Halò

Hei

Hello

Hola

Kon'nichiwa

Nǐ hǎo

Tere

Zdravo

WELCOME

Dear valued participants,

a warm welcome to all of you here in Amberg on the campus of Ostbayerische Technische Hochschule Amberg-Weiden for the International Meeting of the STACK Community 2024.

Founded in May 1994 we are a modern and innovative Technical University of Applied Sciences, which offers a hiqhly qualifying and future-oriented education. We are regionally anchored and internationally active with a wide range of practice-oriented degree programs in combination with a broad experience in application-oriented research. Both locations, Amberg and Weiden, offer a lively campus, state-of-the-art equipment, and an ideal student-to-staff ratio; ideal conditions for our more than 4000 students and over 110 professors.

As a Technical University of Applied Sciences, we have a strong focus on Sciences, Technology, Engineering and Mathmatics (STEM), areas that currently experience a fundamental change in education and application based on the digital transformation. Therefore, we established a Competence Center for Digital Education and an Innovation Network for Digital Adaptive Technology. STACK became a core element at our university for addressing the challenges of this transformation. Over the years, STACK became an important part of our university's strategy to develop teaching and learning and to address the needs of a variety of students in different STEM subjects. We have been using STACK for about 7 years now and shared our experience by contributing to most of the previous conferences.

We have benefited a lot from the STACK community in the past. Therefore, we are happy to in return host the STACK Conference in 2024 the year our 30th university anniversary. I wish all participants of the conference a successful, productive, and inspiring meeting. Have a great time here in Amberg and despite all the work do not forget to network, make friends, celebrate and enjoy yourselves!

All the best
Prof. Dr. Clemens Bulitta, President

Ostbayerische Technische Hochschule
Amberg-Weiden

STACK CONFERENCE TEAM

Prof. Dr. Mike Altieri
Project manager project IdeaL and project STACK Net

Dr. -Ing. Michael Weinmann
Chair person

Katja Dechant-Herrera
Assistant chair person

Aviva Lisann Kaiser
Assistant chair person

Meiline Wolf
Graphic design and visual media

Marion Wagner
Graphic design and visual media

Jennifer Weber
VR officer

Jonas Winkel
Technical officer

PROJECT IDEAL

IDEAL — Innovationsnetzwerk für digitale adaptive Lehre / Innovation Network for Digital Adaptive Teaching

Digital tools in teaching pose challenges and offer opportunities to solve current issues in everyday university life for both learners and teachers. These include heterogeneous student groups, the increasing internationalization of students, a high dropout in engineering science and media-related teaching skills.

Granted by the Stiftung Innovation in der Hochschullehre the IdeaL project addresses this complex problems by setting up an innovation network in which flexible learning modules for adaptive digital teaching are developed and produced, innovative learning spaces are set up and expanded, and a service center for digital exercises is set up. In order to anchor the offerings in the university structures, the measures in the areas mentioned are subjected to quality assurance through continuous evaluation and adjustment and networking with internal and external partners is promoted to make the project results visible.

Do you have any questions, suggestions or even a desire to work with us? Then contact us!

More information:

Telephone: +49 (9621) 482-3731

Email: ideal@oth-aw.de

Further information and a project description:
www.oth-aw.de/ideal

Contact:

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Project manager project IdeaL

Dr. -Ing. Michael Weinmann
Project coordinator project IdeaL

Katja Dechant-Herrera
Project coordinator project IdeaL

PROJECT STACK NET

STACK Net

STACK-Netzwerk zur Verbreitung der WiMINT-Lehre/ STACK network for the dissemination of digital tasks in business and STEM teaching

Thanks to a global community of developers, the open source e-assessment system STACK now enables innovative teaching methods in the subjects of economics, mathematics, computer science, natural sciences and technology. Nevertheless, there is no networking structure and no uniform quality standards for digital tasks in the German-speaking STACK community. The STACK Net project aims to address this gap by improving the networking of the German-speaking STACK community. A regular flow of information about national and international activities is ensured through STACK newsletters. Additionally, a community website is under construction, serving as a platform for networking and as a point of contact for interested persons. This platform is intended to support the introduction of STACK at universities, the procurement of STACK tasks, the exchange between different subjects and the documentation of quality standards. STACK Net pursues clear goals such as regularly sending a newsletter, developing a community website and networking in events related to STACK.

More information:

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Aviva Lisann Kaiser

Project coordinator project STACK Net

Service-Center Digitale Aufgaben/
Service Centre for Digital Exercises

The Service Centre for Digital Exercises at OTH Amberg-Weiden provides assistance to educators seeking to incorporate digital assessments into their courses. Utilizing state-of-the-art tools such as STACK, JSXGraph, GeoGebra, and CodeRunner, the Service Centre team transforms existing paper-based questions to digital questions featuring randomisation, automated correction, and specific feedback, or develops new questions according to individual requirements. Additional services include question translation, database research, implementation support, integration of gamification, and evaluation through learning analytics. So far, the Service Centre has fulfilled requests from all four faculties of the university, producing questions for digital exercise sheets, exams, and various forms of assessment in subjects such as mathematics, electrical engineering, statistics, economics, and computer science

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Contact:

Johannes Knaut
Head of Service Centre for Digital Exercises

In the realm of education, where knowledge takes flight,
STACK stands tall, a beacon of light.
An assessment tool, innovative and true,
Empowering users, all the way through.

Today the Annual Conference takes its stand.
In the city of Amberg, a city so grand,
A gathering of minds, both near and far,
To explore, to learn, and to raise the bar.

The conference brings together a community so vast,
Sharing their insights and ideas that will last.
Three days of programme with workshops and talks,
Supporting program, breaks, posters and walks.

With participants from all over the globe,
True magicians but without a robe
Programming to give students a helpful guide,
Even so it sometimes equals a rollercoaster ride.

Equipped with computers we start the fight,
To get the code doing what we like,
Implement feedback, solutions and graphs,
just to mention barely the half.

This is the context we all have to face
But in this work as well lays some grace,
So, welcome all, to this special affair,
Let us embrace the spirit of learning and share.

I hope I captured the essence of this invention of Chris,
This thing called STACK, which no one wants to miss

Dr. -Ing. Michael Weinmann

SUBMISSIONS

Presentation

For the sessions with this format, the presentations are clustered thematically. The presentations should shed light on their topic in depth. Depending on the type of presentation, there are 30 or 15 minutes, discussion included. Please note that attention will be paid to the observance of the times.

Talk

Each Talk is 30 minutes in duration. It is recommended to use 20-25 minutes to present and 5-10 minutes for discussion.

Lightning talk

Each lightning talk is 15 minutes in duration. It is recommended to use 10-12 minutes to present and 3-5 minutes for discussion.

Poster

The posters are presented in an openly accessible room. In the course of this, there will be room for detailed discussions on individual posters. The presentation session itself takes place in VR. Each presentation is 15 minutes in duration. It is recommended to use 8-10 minutes to present and 5-7 minutes for discussion.

Workshop

In workshops, the topics are presented with the active involvement of the participants. Workshops last 90 minutes each, and the format is free. The participants can be involved in a variety of ways.

KEYNOTES

Visual e-Assessment with JSXGraph in Calculus

Dr. Wigand Rathmann

Wigand Rathmann has been a lecturer in engineering mathematics at Friedrich-Alexander-Universität Erlangen-Nürnberg since 2008. As part of his teaching, he makes intensive use of interactive diagrams based on JSXGraph to illustrate mathematical facts. In 2018, Mr. Rathmann was awarded the Faculty of Engineering's teaching prize, which particularly highlighted his use of digital media. He is currently working as a partner in the ERASMUS+ project "Interactive Digital Assessments in Mathematics" on the development of STACK tasks with graphical interaction for questions from multidimensional analysis.

Prof. Alfred Wassermann

Dr. Alfred Wassermann is academic director at the professorship for mathematics and its didactics at the University of Bayreuth, where he also completed his habilitation in mathematics. His research is devoted to combinatorics, design theory, coding theory and q-analog structures. He is co-author of the book "Die bedeutendsten Mathematiker" and is an editorial board member of several journals with a mathematical focus. He is a member of the JSXGraph developer team and has been involved in its development for many years.

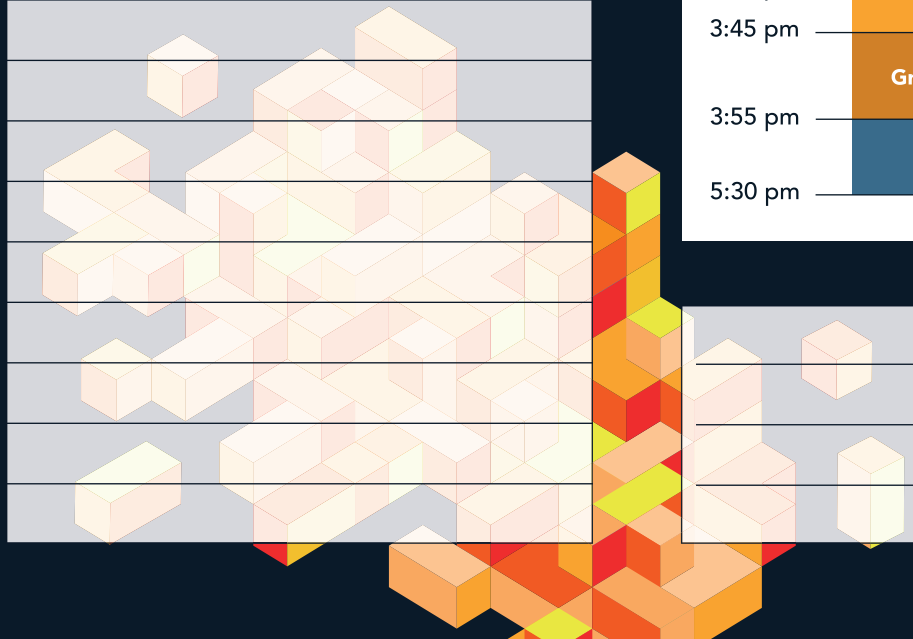
Activating Elements in Formative Feedback: From Receptive to Active Learning with Automated Feedback

Prof. Dr. Guido Pinkernell

Guido Pinkernell is Professor of Mathematics and its Didactics at the University of Education Heidelberg, Germany. After studying mathematics and music at the Universities of Hannover (DE) and Cardiff (UK), he worked as a secondary school teacher for eight years before returning to research in mathematics education at the Universities of Münster and Darmstadt. His main research interest is the teaching and learning of mathematics with digital media and tools.

MONDAY
11.03.2024

	FOYER	ROOM 313
8:00 am		
8:30 am	Welcome coffee and registration	▪ Beginners Workshop (German): Mathematische Aufgaben im digitalen Zeitalter: Entdecke die Welt des STACK-Fragetyps in Moodle
10:00 am		
10:30 am		
12:30 pm		
1:45 pm		
3:15 pm		
3:45 pm	Group photo	
3:55 pm	Campus tour	
5:30 pm		



INNOVATORIUM	DIGITALES KLASSENZIMMER
	▪ Beginners Workshop (English)
Coffee break	
▪ Welcome speech ▪ Visual e-Assessment with JSXGraph in Calculus ▪ Activating Elements in Formative Feedback: From Receptive to Active Learning with Automated Feedback	
Lunch break	
▪ A model for STACK internships to promote STACK adoption in African universities ▪ Empowering African STEM Education: A Journey from Intern to Key STACK Contributor ▪ STACK Empowering African Undergraduate Mathematics Education	▪ Meclib: A library for efficient authoring of STACK questions with interactive graphics ▪ The gitsync Moodle plugin for facilitating version control of questions ▪ Question management and duplicate/similarity detection ▪ Author and User Tests on Updates of the STACK Plugin for ILIAS
Coffee break	
VIRTUAL LOCATION: Introduction to VR for online participants	

WORKSHOP | 08:30 am - 10:00 am (Digitales Klassenzimmer)

Beginners Workshop (English)

Tim Lowe[1] (tim.lowe@open.ac.uk)

[1] The Open University, United Kingdom

This workshop is aimed at new users of STACK, or those interested in trying it hands-on for the first time. We will show how a simple randomised question can be written in STACK and participants can join in writing the same question, or one of their own.
Participants will need to bring their own laptop if they want to try authoring a question themselves.

WORKSHOP | 08:30 am - 10:00 am (Room 313)

Beginners Workshop (German): Mathematische Aufgaben im digitalen Zeitalter: Entdecke die Welt des STACK-Fragetyps in Moodle

Stefanie Zegowitz[1] (zegowitz@rz.tu-clausthal.de)

[1] TU Clausthal, Germany

STACK (“System for Teaching and Assessment using a Computer algebra Kernel”) ist ein Fragetyp in Moodle und ILIAS für die Erstellung und Bewertung von mathematischen Aufgaben. Ein Schlüsselfeature ist die Verwendung des Computer-Algebra-Systems (CAS) Maxima, um Eingaben auf ihre mathematischen Eigenschaften zu prüfen und auszuwerten. Das System zeichnet sich durch eine hohe Anpassungsfähigkeit, Wiederverwendbarkeit von Aufgaben mittels Zufallsvariablen und vielfältigen Gestaltungsoptionen durch die Integration von HTML und LaTeX aus.
Das Ziel des Workshops ist Teilnehmenden die praktische Anwendung von STACK näherzubringen. Der Schwerpunkt liegt auf den grundlegenden Aspekten, insbesondere dem Aufbau einer STACK-Aufgabe und den wesentlichen Einstellungsoptionen. Anhand von praktischen Beispielen werden die Teilnehmenden durch den Prozess der Aufgabenerstellung geführt.
Das begleitende Handout zum Workshop enthält Informationen über die verschiedenen Komponenten einer STACK-Frage sowie einen Überblick über die zentralen Eingabetypen. Es bietet zudem praktische Übungen und Tipps, die im Anschluss des Workshops als Selbstlernkurs genutzt werden können.

PRESENTATION | 10:30 am - 12:30 am (Innovatorium)

Visual e-Assessment with JSXGraph in Calculus

Wigand Rathmann[1] (wigand.rathmann@fau.de), Alfred Wassermann[2] (alfred.wassermann@uni-bayreuth.de)
[1] Friedrich-Alexander-University Erlangen-Nürnberg, Germany; [2] University of Bayreuth, Germany

JSXGraph (https://jsxgraph.org) is an open source JavaScript library for interactive geometry, 2D and 3D plotting, and data visualization in the web browser. It is developed as an open source project at the Chair of Mathematics and Didactics and the “Center for Mobile Learning with Digital Technology” at the University of Bayreuth.
Plug-ins for embedding of JSXGraph in moodle or ILIAS are available. Additionally, STACK comes with its own plug-in to embed JSXGraph constructions. This not only enables the visualization of questions in STACK, but also opens up the possibility to answer questions by manipulating a construction visually. STACK then can check these types of answers.
In this keynote, we will demonstrate some features of JSXGraph, show how to embed JSXGraph constructions in STACK, and give ideas for this kind of "visual assessment" with a focus on optimization, ODEs, and multidimensional Analysis. The latter examples have been developed for the course "Higher Mathematics for Engineers" at the Friedrich-Alexander-University Erlangen-Nürnberg.

PRESENTATION | 10:30 am - 12:30 am (Innovatorium)

Activating Elements in Formative Feedback: From Receptive to Active Learning with Automated Feedback

Guido Pinkernell[1] (pinkernell@ph-heidelberg.de)
[1] Pädagogische Hochschule Heidelberg, Germany

Feedback is one of the teacher's most important contributions to a successful learning process. Especially in formative contexts, a teacher can choose from a variety of feedback content, ranging from detailed explanations for low-performing students to well-placed cues for the high-performing.
Ideally, automated feedback should be as adaptable to the student's response as feedback from an experienced teacher. Whereas in analogue teaching feedback is usually situational and intuitive, for "a priori" programming of feedback in assessment software it is helpful to know of the different types, forms and structures from which to choose.
With interactive JSXGraph and, since recently, GeoGebra applets available for integration into STACK feedback, there is now a wide range of feedback forms open for exploring.
This talk will give an overview of what we currently know about successful automatic feedback. It will also propose ideas for adaptive feedback design that are intended to foster active rather than receptive learning.

PRESENTATION | 01:45 pm - 03:15 pm (Innovatorium)

A model for STACK internships to promote STACK adoption in African universities

Santiago Borio[1] (smborio@idems.international), Zavick Otieno Juma[2], Motognon Wastalas d'Assise Dogbalou[2], Michael Obiero Oyengoo[3]

[1] IDEMS International, United Kingdom; [2] Trieste University, Italy; [3] Maseno University, Kenya

The adoption of STACK in African universities, has been driven by the need for efficient assessment solutions, limited resources, and increasing student enrolment. To support the implementation of STACK and enhance mathematics education in Africa, IDEMS International and its Kenyan counterpart INNODEMS have collaborated to establish the INNODEMS STACK Internship Programme. This programme has trained a local team of interns who have successfully integrated STACK into undergraduate courses in universities across Africa. Through their training in STACK question authoring, technical support, and professional skills development, the intern team has played a vital role in the effective implementation of STACK in African universities. The programme has yielded positive results in Kenya, at Maseno University, Masinde Muliro University of Science and Technology, and across Ethiopian universities. Challenges such as technical complexities, limited resources, and cultural contextual factors have been overcome through collaboration, regular training, knowledge sharing, and adaptability. This paper presents a model for internships based around practical training and direct contributions to ongoing work, its impact in its initial pilot, and plans for scaling as well as its limitations.

LIGHTNING TALK | 01:45 pm - 03:15 pm (Innovatorium)

Empowering African STEM Education: A Journey from Intern to Key STACK Contributor

Godfrey Wabwire Ouma[1] (godfrey.wabwire@innodems.org)

[1] Innodems, Kenya

This abstract outlines an insightful journey through my transition from an intern to an employee at INNODEMS Kenya, where I've had the privilege to contribute to empowering African universities in STEM education using STACK. Transitioning from intern to a pivotal member of the INNODEMS STACK team has shaped both my career and the educational landscape in the region. I've been involved in diverse projects, from question authoring to providing tailored technical support for African universities.
By fostering a culture of constructive feedback and inquiry, I've witnessed firsthand the profound impact on student engagement and understanding. Moreover, my experiences have ignited a passion within me to pursue further studies and deepen my understanding of STACK and its implications for educational advancement, as well as explore the transformative power of feedback-driven learning within the context of African universities, and the role of STACK in shaping the future of STEM education on the continent. In this lightning talk, I will account for my journey, experiences, learnings, future objectives, and outcomes witnessed.

PRESENTATION | 01:45 pm - 03:15 pm (Innovatorium)

STACK Empowering African Undergraduate Mathematics Education

Michael Obiero Oyengo[1] (obiero@maseno.ac.ke), George Lawi[2], Santiago Borio[3], Stern David[3]

[1] Maseno University, Kenya; [2] Masinde Muliro University Of Science and Technology; [3] IDEMS International

There are many challenges facing education in African institutions of higher learning, especially public institutions. Most of these challenges result from reduced government funding and increased student enrollments that are not met by equivalent increase in infrastructure and personnel development to support learning and research. This has led to an imbalance in student to teacher ratio especially in some common foundational courses, that in extreme cases can be up to 1300:1, and inadequate teaching and learning resources. It is thus unrealistic to provide personalized feedback to formative assessment in order to support learning. As a consequence, STEM subjects, which rely heavily on mastery of content through repetitive computations and attempts to quizzes supported by immediate feedback, have suffered a great deal. This has presented a unique opportunity to innovate in the teaching and learning using open-source digital tools. Over the last five years, a number of African math educators have led the effort to adopt STACK in the teaching and formative assessment of Mathematics. The initial drive towards collaboration was born of the “2019 Cross Pollination workshop” that brought together African math educators who were innovating at various education levels. A series of workshops in Kenya and Ethiopia offered training to lecturers on STACK, and this led to the first African STACK conference that enabled African educators with experience on STACK to define a roadmap for transformation of African undergraduate mathematics education. In this paper, we will provide an account of the African STACK journey, its impacts on teaching and learning, its institutionalization, the creation and activities of the Africa STACK community and development of the Open Question Banks (OQB) that has the potential generate even greater impact in the teaching and learning of STEM subjects across Africa. We will also discuss potential collaborations on content development and research to improve the usage of STACK while strengthening the Africa STACK community.

LIGHTNING TALK | 01:45 pm - 03:15 pm (Digitales Klassenzimmer)

Meclib: A library for efficient authoring of STACK questions with interactive graphics

Martin Kraska[1] (kraska@th-brandenburg.de)

[1] Technische Hochschule Brandenburg, University of Applied Sciences, Germany

Meclib is a collection of JavaScript objects and Maxima based feedback functions for use in STACK questions in the field of engineering mechanics.
Authoring questions with interactive graphical input such as free body diagrams and complex feedback is considerably simplified by using the library. It is not even required to write a single line of JavaScript, because the JSXGraph based objects are entirely specified from within the question variables.
Recently, the library objects have been recoded to allow their inclusion in dynamic script-controlled or interactive animations, e.g. for demonstration of mechanisms.
Some applications for the new features are demonstrated in the presentation.

PRESENTATION | 01:45 pm - 03:15 pm (Digitales Klassenzimmer)

The gitsync Moodle plugin for facilitating version control of questions

Edmund Farrow[1] (edmund.farrow@ed.ac.uk), Chris Sangwin[1]

[1] University of Edinburgh, United Kingdom

Sharing questions between organisations with separate installations of Moodle can be achieved with a simple export and import. Maintaining those questions, however, is much harder. If both organisations make fixes and improvements to the questions, identifying, combining and deploying the changes to keep both organisations up-to-date is time-consuming and prone to error. This is also the case for a single user maintaining two copies of a question on different courses on the same Moodle installation and is a particular problem for STACK questions as they are often very complex.
This talk details the gitsync plugin we have developed to automate parts of the question maintenance process. Using PHP command line tools, users can export entire question contexts via a Moodle webservice onto their local computer. The questions are stored in individual XML files arranged in a directory structure organised by question category. Manifest files maintain a link between the question files and the matching questions in each Moodle context, allowing updated questions to be re-imported as new question versions rather than new questions (utilising the importasversion plugin developed by Tim Hunt, Michael Kallweit and Andreas Steiger).
If the question files are stored in a version-controlled repository, changes from different sources can be manually compared, combined and committed using existing and extensive tools commonly used for software development. Git is the version control system currently supported by gitsync. To avoid data loss, the plugin checks for uncommitted changes in the repository before import and export and also uses the Moodle question version numbers to check for unexported changes in Moodle before importing. Git support can be switched off to allow users to use a different version control system if they prefer.
This talk includes a technical overview of the gitsync plugin, use cases and a demonstration.

LIGHTNING TALK | 01:45 pm - 03:15 pm (Digitales Klassenzimmer)

Question management and duplicate/similarity detection

Georg Osang[1] (gosang@idems.international)

[1] IDEMS International

Within IDEMS, we are creating and editing questions especially for use within Africa, in the process building a large database of questions. Many questions are being reused directly or with minor fixes and modifications in different courses and universities. Keeping track of such changes and identifying the latest version of a question is often tricky, especially if improvements to a question are made within a course in response to student feedback or usage data.
Upcoming work for a github integration (Chris Sangwin, Edmund Farrow) is promising to help solve some of these issues, however, from the existing base of questions, we need to identify a master copy of each question from the entire database to make use of this. This talk is meant to briefly showcase a simple tool that can be used to identify unique, similar and duplicate questions to aid with the process of manually curating our question banks, and to have a discussion around ideas for question bank management.

PRESENTATION | 01:45 pm - 03:15 pm (Digitales Klassenzimmer)

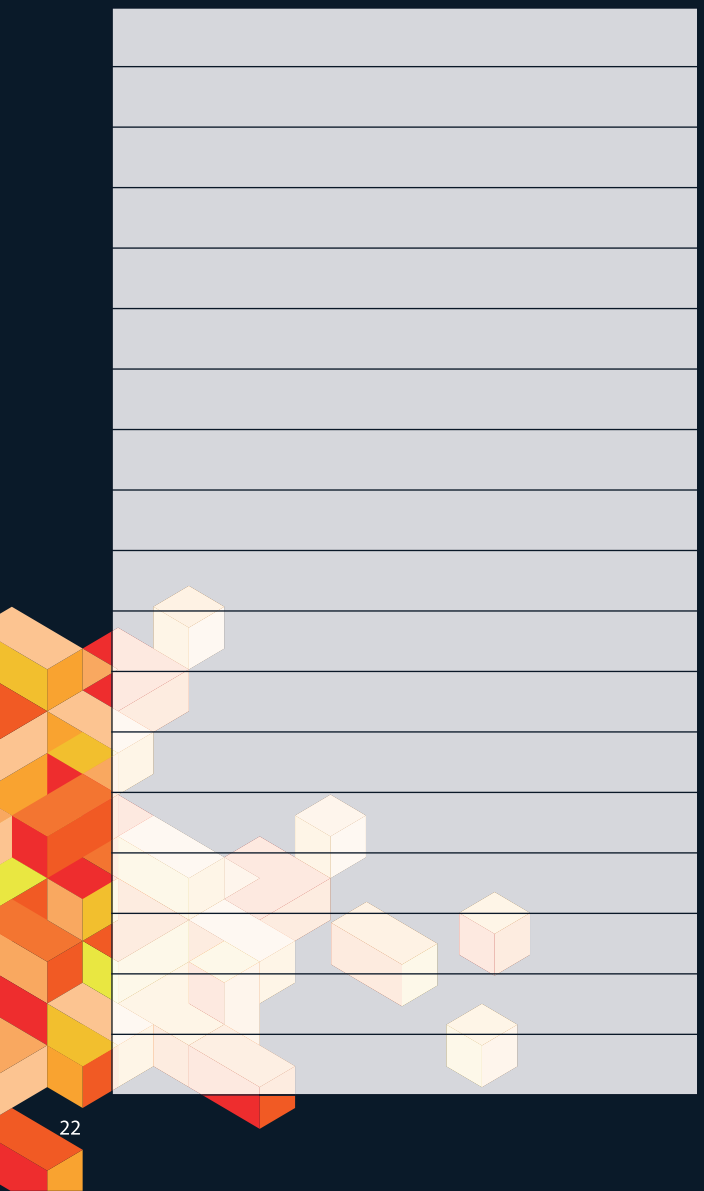
Author and User Tests on Updates of the STACK Plugin for ILIAS

Kinga Sipos[1] (kinga.sipos@unibe.ch)

[1] University of Bern, Switzerland

Comprehensive testing has been conducted over the past year on the integration and updates of the STACK plugin within the ILIAS e-learning platform. The testing procedures focused on assessing basic functionality, usability, and performance from both user and author perspectives. The primary goal was to ensure backward compatibility by encompassing features used in existing STACK exercises at the University of Bern.
Tests spanned multiple phases, including evaluations of the question editing interface, question preview functionality, and integration within ILIAS tests. Summarising the experiences garnered during testing the STACK plugin for ILIAS 7 in 2023 and for ILIAS 8 at the beginning of 2024, the testing process has contributed significantly to reestablishing basic functionalities, refining and enhancing the plugin's integration within ILIAS.
The insights gained from testing guide future developments, ensuring ongoing improvement to address the needs of users and authors while maintaining backward compatibility. This iterative approach to testing and development supports the continued effectiveness and seamless integration of the STACK plugin within the ILIAS e-learning environment.

TUESDAY
12.03.2024



	FOYER	ROOM 313
8:00 am	Welcome coffee	
9:00 am		VIRTUAL LOCATION: Poster
10:30 am		
11:00 am		
12:30 pm		
1:45 pm		
3:00 pm		
3:30 pm	SIG: Bar camp	SIG: Professionals Network
5:00 pm		
5:30 pm		
7:00 pm		
7:30 pm		
11:00 pm		

INNOVATORIUM	DIGITALES KLASSENZIMMER
▪ OK!Thermo: OER Learning Tool for Thermodynamics ▪ Lerninseln Digital - Modern learning materials for engineering mathematics ▪ Enhancing Statistics Learning through Automated STACK Testing ▪ An outline of achievements in integrating STACK to Undergraduate Mathematics Education in AfricaAn outline of achievements in integrating STACK to Undergraduate Mathematics Education in Africa ▪ Quality Assurance of STACK Exercises in the Context of OER Materials ▪ Web-based Workflow for Maintenance of STACK Assignment Collections	
Coffee break	
▪ An open African STACK question bank ▪ Building open STACK question banks ▪ On ongoing extensions of a comprehensive collection of mathematical STACK problems in German language ▪ STACK style guide for STEM Assignment Collections	▪ AuthOMath event: using GeoGebra in STACK
Lunch break	
▪ STACK for School Education ▪ Visual Input with JSXGraph ▪ Investigating the feasibility of Automating the Advanced Higher Mathematics and Physics Scottish school exams ▪ New Developments Around the Evaluation Tool STACKrate	▪ Feedback on Lecturer experience with STACK at MMUST, Kenya ▪ On the Testing of Linear Algebra with STACK System ▪ 10 years of e-tests in large courses for engineering students ▪ Implementation and effectiveness of mathematical STACK problems in higher education for engineers: Lessons learned.
Coffee break	
	SIG: Mathe digital
Old town tour	
Conference dinner	

POSTER | 09:00 am - 10:30 am (Virtual location)

OK!Thermo: OER Learning Tool for Thermodynamics

Johannes Goebel[1] (johannes.goebel@hs-duesseldorf.de), Matthias Neef[1], Vivian Kowalzik[2], Birgit Szczyrbal[2], Andreas Prüfer[2], Klaus Lambers[2], Frank Rögener[2], Lisa Marie Demant[3], Sylvia Schädlich[3], Laura Schriefers[4], Arne Graßmann[4], Frank Alsmeyer[4]

[1]Hochschule Düsseldorf, Germany; [2]Technische Hochschule Köln; [3]Hochschule Ruhr West; [4]Hochschule Niederrhein

OK!Thermo is a learning tool that is being developed to overcome learning obstacles in the STEM basic subject of thermodynamics. It consists of a collection of exercises that are implemented in moodle/ILIAS and categorised into competence fields, content references and levels of difficulty. This enables it to be used in various teaching/-learning scenarios, from self-study to examinations.
The learning tool is designed to overcome the subject-specific learning bottlenecks in thermodynamics and support students' mental modelling. This is described and evaluated with the help of didactic design patterns. Both the design patterns and the collection of exercises will be available as Open Educational Resources (OER) via ORCA.nrw.
The motivation for the project stems from the challenge that thermodynamics as a basic subject in engineering degree programmes is often associated with above-average failure rates. Students traditionally find it difficult and describe it as a “frustrating subject”. The project aims to overcome these barriers and improve students' understanding through interactive resources, particularly in relation to the theoretical modelling of thermodynamics. To identify these hurdles, the method “decoding the diciplines” is used.

POSTER | 09:00 am - 10:30 am (Virtual location)

Lerninseln Digital - Modern learning materials for engineering mathematics

Sandra Keiper[1], Marie-Pauline Wiechmann[1] (wiechmann@tu-berlin.de)

[1]Technische Universität Berlin

The module “Analysis I and Linear Algebra for Engineers” is the largest course offered by TU Berlin with up to 3000 students in the winter term. Alongside lectures and tutorials we offer an open learning space to our students, which is supervised by our tutors. There, students can practice all important topics using our extensive question set. In the previous winter term we started to digitize these materials.
We use different approaches like interactive and randomised exercises to improve attractiveness and to be able to offer materials for different skill levels. For this we use the Moodle platform with the integrated Tools Stack and JSXGraph.
Besides randomization, increased attractiveness and interactivity in this approach gives us the possibility to precisely analyse which topics our students perform well in and which not. This gives us the chance to adapt our materials accordingly. Particularly we aim to analyse which question types yield good learning support. Because of the large number of students, this might be relevant for other Stack and Moodle users.
In this poster presentation I present our work which is funded by the project “QIO - Lerninseln Digital” and evaluate the use of Stack questions for the module ”Analysis I and linear Algebra for Engineers “

POSTER | 09:00 am - 10:30 am (Virtual location)

Enhancing Statistics Learning through Automated STACK Testing

Natalja Maksimova[1] (natalja.maksimova@tktk.ee), Oksana Labanova[1] (oksana.labanova@tktk.ee), Elena Safiulina[1]

[1] TTK University of Applied Sciences, Estonia

The purpose of this article is to explore the possibility of creating STACK tests with generated data and automating feedback mechanisms in the context of a statistics course at the TTK University of Applied Sciences (TTK UAS), thereby presenting a novel experience in utilizing STACK.
The challenge stems from the limited number of contact hours available to lecturers for an in-depth study of material on classical theoretical distributions of random variables, necessitating alternative methods to enable students to thoroughly study and reinforce the curriculum of statistics subject, as well as to monitor the acquisition of their own knowledge.

POSTER | 09:00 am - 10:30 am (Virtual location)

An outline of achievements in integrating STACK to Undergraduate Mathematics Education in Africa

Nixson Kiplagat[1] (nixson.kiplagat@innodems.org)

[1] INNODEMS Kenya, Kenya

This poster presents the initiatives undertaken by our broader team aimed at improving the quality of undergraduate mathematics education in African institutions. Our approach focuses on question creation for undergraduate courses, provision of technical support to African institutions, developing and improving Open Question Banks which are freely accessible to anyone, thereby facilitating a seamless learning experience for all stakeholders.
With the goal of fostering excellence in mathematics education, IDEMS International and its counterpart INNODEMS collaborated closely with Maseno University, Masinde Muliro University of Science and Technology, Rongo University, and the Technical University of Kenya in Kenya, University of Namibia in Namibia, and across Ethiopian Universities for the success of STACK implementation. This poster will outline the achievements in these countries.

POSTER | 09:00 am - 10:30 am (Virtual location)

Quality Assurance of STACK Exercises in the Context of OER Materials

Lisa Marie Demant[1] (lisa-marie.demant@hs-ruhrwest.de), Sylvia Schädlich[1], Johannes Goebel[2], Matthias Neef[2], Laura Schriefers[3] (Laura.Schriefers@hs-niederrhein.de), Frank Alsmeyer[3], Arne Grassmann[3]

[1] Hochschule Ruhr West, Germany; [2] Hochschule Düsseldorf; [3] Hochschule Niederrhein, Germany; [4] Hochschule Niederrhein

This contribution outlines the quality assurance process as part of the OER-content project “OK!Thermo”, in which four universities are working together to develop STACK exercises to improve the entry into the subject of thermodynamics. The main aim of the project is to ensure that the pool of exercises is not only professionally based, but also offers a high level of accessibility and usability for a diverse target group through close cooperation between the participating universities and the application of a structured quality assurance process.
A core component of quality assurance is a workflow that covers the development cycle of the exercise from concept development to testing. This schedule ensures a systematic and comprehensive review, starting with the conceptualisation of the assignment through to the final release for publication. The quality assurance process was developed jointly by all participating universities and comprises various tools, including concept templates and a guideline for creating exercises, standardised tagging and a comprehensive checklist. These tools ensure that the exercises developed meet a high quality standard.
The presentation will focus specifically on the approval process for collaborative quality assurance for STACK exercises. This takes place in two steps for each exercises: The first university (creator) develops the exercise taking into account the concept templates and the guideline, while another university (external reviewer) checks the quality via the checklist. This approach promotes objectivity and consistency with regard to quality standards.
The contribution also highlight th devoloved ressources for the process such as checlists and a “Do & Don‘t”-Guide that seperates binding standards from areas for free task design.

POSTER | 09:00 am - 10:30 am (Virtual location)

A Web-based Workflow for Maintenance of STACK Assignment Collections

Inga Saatz[1] (inga.saatz@fh-dortmund.de), Felix Schorlemer[1], Melanie Beutel[1]

[1] FH Dortmund, Germany

The development of STACK assignment collections for STEM subjects in higher education is very time-consuming and error-prone. Therefore, the exchange and evaluation of STACK tasks collections between different developers is beneficial to ensure the quality of the assignment collections. As a collection could contain hundreds of assignment tasks, additional metadata has to be assigned to each STACK task to annotate them with additional metadata, according to task classification, modification history and evaluation results. However, a central exchange platform for stakeholders from different higher education institutions was missing.
This contribution proposes an automated web-based workflow for managing stack task collections. The workflow contains the following steps:
1. The user uploads a STACK assignment collection as a compressed file in a repository.
2. For each STACK assignment task in the uploaded file, the necessary metadata is extracted from the corresponding XML file automatically. For example, authors, the number of answers and total points per task. Additionally, each STACK assignment task is assigned an identifier in the extraction process to identify each assignment task. Furthermore, for each STACK assignment task a link to an assignment task preview within the Learning Management System, from which STACK assignment collection was exported.
3. The extracted metadata is saved in a document database, which allows to add supplementing metadata in the web-interface for maintenance, editing status, evaluations, quality checks, and search keywords, such as corresponding topics, keywords, and task types. A web frontend allows users to view and edit the stored metadata in the form of a searchable table.
The web-based workflow is being implemented and tested by six universities in the project Alepa.nrw, which is funded by the Ministry of North-Rhine Westphalia, Germany. The web-based workflow could be adapted to other application contexts.

PRESENTATION | 11:00 am - 12:30 pm (Innovatorium)

An open African STACK question bank

MOTOGNON WASTALAS D'ASSISE DOGBALOU[1] (wastalasdassise@gmail.com)

[1] University of Trieste, Italy

Over the last few years, STACK proved its viral scaling potential and is now a great opportunity to explore the full potential that STACK can offer to incorporate assessment into undergraduate STEM courses. This effort aims to make STACK assessment accessible to community users, including educators, learners, and stakeholders in education and STEM disciplines. Despite numerous challenges in various forms for the adoption and integration of STACK in higher institutions and at all levels of education, the benefits of online assessment have enabled IDEMS International, in collaboration with INNODEMS, to support the development and the implementation of complex STACK questions to meet the needs of students in various institutions in Africa.
Among the challenges associated with the implementation of STACK questions, there are limitations, pedagogical biases, gaps in authoring complex STACK questions, issues with sharing question banks efficiently, and an insufficient quantity of open-source high-standard quality questions.
Over the past two years, I have been part of an effort to address these challenges, especially in relation with the African institutions' needs, as STACK developer within the UK social enterprise IDEMS International. My presentation will delve into my personal challenges, successes, and contributions to the transformation of undergraduate mathematics education through STACK.

PRESENTATION | 11:00 am - 12:30 pm (Innovatorium)

Building open STACK question banks

Emmaculate Atieno Odhiambo[1] (emmaculate.atieno@innodems.org), Mary Sayuni Sawema[1]

[1] INNODEMS, Kenya

The adoption of STACK in Kenyan institutions has been driven by the need for efficient assessment solutions, limited resources and increasing student enrollment. This has been implemented by collaboration among four mathematics and mathematics education graduates based at Maseno, Kenya trained and mentored by IDEMS International colleagues and lecturers from African Universities. The team developed, and is constantly improving, open question banks for undergraduate courses used mostly but not exclusively in universities across Africa, which are freely accessible to anyone. The collaborative efforts among the broader team have significantly contributed to the successful development and implementation of said Open Question Banks which not only support individual learning experiences but also facilitate easy access to diverse range of questions fostering a dynamic and resourceful education environment.

LIGHTNING TALK | 11:00 am - 12:30 pm (Innovatorium)

On ongoing extensions of a comprehensive collection of mathematical STACK problems in German language

Maike Schelhorn[1] (maike.schelhorn@h2.de), Oleg Boruch Ioffe[1] (oleg-boruch.ioffe@h2.de), Katharina Jänicke[1], Reik Volker Donner[1]

[1] h²-Hochschule Magdeburg-Stendal, Germany

Since the winter term 2022/23, Magdeburg-Stendal University of Applied Sciences uses STACK as part of its regular courses Mathematics 1 – 3 for civil engineers. Specifically, we offer weekly selections of problems matching the topics covered by the current lecture (allowing students individually testing and continuously monitoring their learning progress) along with voluntary e-assessments held every three to four weeks (providing the opportunity to collect bonus points for the final exams). In addition, a wider collection of problems is made accessible as part of a digital mathematics learning support centre.
Most of the problems initially selected have been taken from two existing, partially overlapping databases with mathematical STACK problems in German language, which have been collected by the Ruhr University of Bochum ("DOMAIN") and the Cologne University of Applied Sciences ("Digitaler Aufgabenpool Mathematik"). During this initial selection process, we have systematically categorized the existing problems according to the topics covered by our local courses, and addressed a few existing issues with wording, notation or technical implementation whenever identified in the initial screening phase or during their practical use in our regular courses.
During our introduction of STACK problems in our courses, we have identified several topics in our mathematics for engineering curricula, which have not yet been well covered by the existing problem collections in German language. Accordingly, we have started systematically identifying and addressing such underrepresented topical fields. While some areas (like probability and statistics) are currently being filled with translations of existing problems in English language, others (like the solution of inequalities, trigonometric equations, or applications of L'Hôpital's rule for evaluating limits for mathematically ill-defined expressions) require the development of new STACK problems to fill the present gaps, which will be reported about in our presentation. Whenever appropriate, the new problems make use of interactive visualizations using JSXGraph. Our aim is to provide our students with a comprehensive collection of digital problems covering all topics of our mathematics courses in the first two study years. Newly developed as well as revised problems will be shared with the German STACK community as open educational resources.

LIGHTNING TALK | 11:00 am - 12:30 pm (Innovatorium)

STACK style guide for STEM Assignment Collections

Tobias Panteleit[1] (tobias.Panteleit@th-koeln.de), Johanna Friederike May[1], Inga Saatz[2], Stefan Roth[3], Michael Kubocz[3]

[1] TH Köln, Germany; [2] FH Dortmund, Germany; [3] RWTH Aachen, Germany

Online-based assignment collections for STEM subjects contain symbolic, arithmetic and answer-choice questions with automated feedback. The open-source plugin STACK (System for Teaching and Assessment using a Computer Algebra Kernel) can be used for this purpose, which allows the creation of randomized tasks based on a computer algebra system. The creation of valid tasks in STEM subjects is very time-consuming and therefore error-prone. An exchange of created assignment collections as OER material would be ideal in this purpose.
By using STACK tasks, learners can be offered individual feedback and learning paths. In order to be able to use assignment collections from different sources in a course, standardization of solution input, the structure of learning paths and the given feedback is required to provide learners with a consistent user experience.
As a solution, the use of a style guide for the creation of STACK tasks is suggested to facilitate the exchange and use of tasks between universities and disciplines. Requirements for a consistent presentation of tasks and the design of learning paths are provided based on best-practice examples.

The style guide addresses, among other things, the following questions:

- How do I structure a task/feedback?
- What settings should I choose?
- How can variables be used meaningfully?
- How can images be integrated into tasks?
- How can formula symbols and units be parameterized to allow adaptation to different disciplines or countries?
- For example, in electrical engineering, the complex number “i” is denoted by the symbol “j”.

The style guide contains a handout with instructions for use for learners, which can be integrated into the tasks. In addition, the style guide shows how tasks can be automatically converted according to your own requirements (e.g. converting formula symbols or units).

The advantages of a style guide would be:

- The style guide serves as an orientation aid when creating STACK tasks and thus helps to avoid errors when creating tasks.
- The possibility of interdisciplinary and international exchangeability of STACK assignment collections.
- Learners receive a standardized presentation of tasks and feedback, which contributes to orientation and ease of use.

WORKSHOP | 11:00 am - 12:30 pm (Digitales Klassenzimmer)

AuthOMath event: using GeoGebra in STACK

Chris Sangwin[1], Guido Pinkernell[2], Tim Lutz[3]

[1] University of Edinburgh, United Kingdom; [2] Pädagogische Hochschule, Heidelberg, Germany; [3] RPTU Kaiserslautern-Landau, Landau, Germany

The Erasmus+ project AuthOMath https://www.authomath.org/ has enabled us to integrate STACK with GeoGebra. In particular, we can now include GeoGebra worksheets as an input enabling students to give an answer which is a geometric diagram. Mathematical and physical phenomena can be better understood and explored via visualization. This feature was released in STACK 4.5.0. This is a practical workshop for users interested in getting started with this new feature.

LIGHTNING TALK | 01:45 pm - 03:00 pm (Innovatorium)

STACK for School Education

Dennis Schnapka[1] (stackcreator.education@gmail.com), Daniel Wierzba[1] (stackcreator.education@gmail.com)
[1]Dennis Schnapka & Daniel Wierzba STACK-Creator for Education & Research GbR, Germany

In our talk we will present a segment from our exercise pool designed for learners in higher school education. The STACK tasks we have created incorporate numerous features utilized within the STACK system. All exercises feature randomized task variables, allowing them to be worked on with always new values an unlimited number of times. Additionally, learners have the option to seek a hint, contributing to differentiation as learners themselves decide whether to seek assistance. Furthermore, we provide a complete solution pathway tailored to the randomized task variables. We also utilize the feedback tree, which provides feedback on whether the task was solved correctly or not. A specific selection of exercises also includes elaborate feedback trees that offer error-centered feedback by examining common error patterns. The feedback tree is also adapted to the randomization. Moreover, some tasks utilize JSXGraph to visualize the problem. This includes displaying coordinate systems in two or three dimensions and representing scenarios such as objects in three dimensionsfor linear algebra exercises. JSXGraph is used to illustrate diagrams and such in statistics. The synergy of these components creates a pleasant experience when working on our exercises. Ultimately, learners can engage in much more autonomous and self-regulated learning.
The aim of the talk is to highlight the availability of a range of STACK tasks for the educational sector, with this task pool continually expanding.

LIGHTNING TALK | 01:45 pm - 03:00 pm (Innovatorium)

Visual Input with JSXGraph

Carsten Miller[1] (carsten.Miller@uni-bayreuth.de)
[1]Universität Bayreuth, Germany

Static tasks with multiple choice input or with algebraic input and evaluation often form the basis of test scenarios. Tasks with randomized elements are a logical enhancement of such test scenarios. Students receive individualized tasks that are subsequently reviewed. Symbolic evaluations extend the content of test items enormously and allow specific feedback, especially in combination with randomized initial situations.
With the help of the graphics library JSXGraph, (test) items obtain a visualization component, which initially only serves to illustrate content. Students can thus explore mathematical content interactively before an answer to a particular test questionis given. In combination with STACK, JSXGraph can also be used to create tasks that allow graphical or geometric input. Students then submit a geometric construction or an adapted function graph.

PRESENTATION | 01:45 pm - 03:00 pm (Innovatorium)

Investigating the feasibility of Automating the Advanced Higher Mathematics and Physics Scottish school exams

Konstantina Zerva[1] (k.zerva@ed.ac.uk), Ben Chooyin[1], Jack Fortune[1], Rachel Hollingsworth[1], Mitchell McLachlan[1], Heather Napthine[1]

[1] University of Edinburgh, United Kingdom

Automatic online assessment is becoming increasingly common for formative work in mathematics and other STEM disciplines. Many courses at university level have weekly auto graded quizzes which are used to test students' understanding and give instant feedback. Also, the COVID-19 pandemic accelerated the use of online assessment in high stake summative exams. There are several advantages to automating examinations, including increased efficiency, reduced grading bias, and improved feedback for students.
The aim of this talk is to investigate the feasibility of automating the SQA (Scottish Qualification Authority) Advanced Higher Mathematics and Physics examinations using STACK.
A past exam paper for each course was implemented into STACK. While the majority of the questions were successfully automated in STACK, there are questions for which the direct automation is not possible. However, upon closer examination of the more challenging questions, it became obvious that many of them had underlying objectives that could be effectively assessed using STACK. To achieve this, we conducted an extensive research into existing educational taxonomies, such as Bloom's Taxonomy, and the principles underpinning the current assessment system. Subsequently, we designed a taxonomy tailored to the specific goals of the SQA's Advanced Higher Mathematics and Physics courses. These newly created taxonomies provided a clear rationale for necessary modifications to the existing questions, enabling us to allocate extra marks while maintaining the original assessment objectives.

LIGHTNING TALK | 01:45 pm - 03:00 pm (Innovatorium)

New Developments Around the Evaluation Tool STACKrate

Daniel Meißner[1] (daniel.meissner-i4k@ruhr-uni-bochum.de), Jonas Lache[1,2] (jonas.lache@ruhr-uni-bochum.de)

[1] Ruhr-Universität Bochum, Germany, [2] Hochschule Ruhr West , Germany

This lightning talk will highlight recent developments in STACKrate, a JavaScript-based tool for the evaluation of STACK questions using a star rating principle. We will discuss some new features and improvements that have been added since the 2022 community meeting where we first introduced STACKrate and which enhance the functionality for educators. We will also outline the planned adaptation of STACKrate to the new STACK-JS functionality, ensuring compatibility with future versions of STACK. Finally, we will showcase the user-friendly STACKrate snippet generator, which simplifies the process of integrating STACKrate into STACK questions.

LIGHTNING TALK | 01:45 pm - 03:00 pm (Digitales Klassenzimmer)

Feedback on Lecturer experience with STACK at MMUST, Kenya

Zevick Juma[1], George Lawi[2] (glawi@mmust.ac.ke)
[1] University of Trieste, Italy; [2] Masinde Muliro University of Science and Technology (MMUST)

Resource limitations for the effective delivery of lectures in mathematics, especially for large classes, is a challenge Kenyan universities continue to struggle with. The Department of Mathematics at Masinde Muliro University of Science and Technology (MMUST, one of the largest Public Universities in Kenya) has been employing STACK for continuous assessment in high enrolment courses (min 800 students) over the past two academic years. This was done in response to the need for innovative and cost-effective ways of improving the teaching and learning of mathematics, which continues to attract high enrolment.
INNODEMS, the Kenyan counterpart of IDEMS International, a not-for-profit organisation supporting African universities in the integration of STACK, has been at the forefront of supporting MMUST courses through resource development and capacity building. STACK has been implemented in eight courses each year, for the past two academic years. The focus of this lightning talk is to share lecturer experience/feedback and perceived usefulness of STACK within the African context, as well as the plans to upscale it to other contexts.

PRESENTATION | 01:45 pm - 03:00 pm (Digitales Klassenzimmer)

On the Testing of Linear Algebra with STACK System

Masumi KAMEDA[1] (mxcnn668@yahoo.co.jp), Mitsuru UDAGAWA[2]
[1] Sanyo-Onoda City University (up to March 2023), Japan; [2] Nagoya University, Japan

This report discusses the implementation of Computer-Based Testing (CBT), specifically Internet-Based Testing (IBT), in a higher education setting for a Linear Algebra course. The Learning Management System (LMS) used was Moodle, and the web-based quizzes were created using the STACK mathematics online assessment system. Initially, the approach involved conducting 15 face-to-face classes followed by a final class where all students gathered in a university classroom to take a web-based test under direct supervision, using their personal laptops. This method was practiced for about five years. However, during the COVID-19 pandemic in 2020, the format shifted to 15 remote classes followed by a final in-person class in the university classroom where students took their regular exams on their laptops. In the academic years 2021 and 2022, after conducting 15 remote sessions, students took their regular exams via web tests at individual learning locations. This presentation reports on the practices related to these IBT implementations.

PRESENTATION | 01:45 pm - 03:00 pm (Digitales Klassenzimmer)

10 years of e-tests in large courses for engineering students

Florian Lindemann[1] (lindemann@tum.de)

[1]TU München, Germany

The presentation deals with my experiences in the implementation of e-tests for advanced calculus content for students of electrical engineering and information technology in the 3rd and 4th semester bachelor. Due to the very large number of students (usually 350-400 examinees, of which about 200-300 are active during the semester), automated, individualized feedback plays a major role, which can be implemented excellently with Stack. I will report on the structure of my e-tests and discuss some exemplary Stack questions.

Experience has also shown that, in addition to the attempt to develop good Stack questions in terms of content and didactics, secondary factors can also be very relevant for the success of e-tests:

- How do you motivate students to participate seriously in voluntary e-tests?
- How do you make students feel good about working at e-tests?
- Dealing with correct solutions that are entered into Stack in the wrong format
- Dealing with almost correct solutions

In my presentation, I will show how we have tackled these issues. I will also present statistics on participation/-success rates and how theses rates changed over the semester. Furthermore, I will give the analysis of student evaluations on the e-tests of the last years.

LIGHTNING TALK | 01:45 pm - 03:00 pm (Digitales Klassenzimmer)

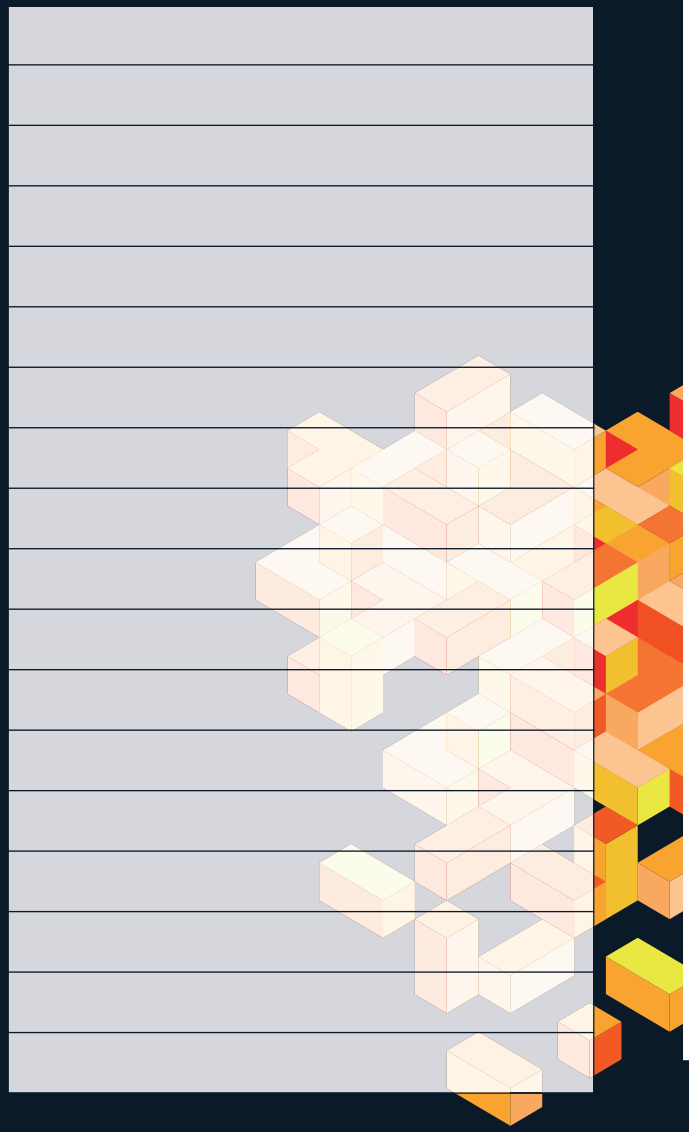
Implementation and effectiveness of mathematical STACK problems in higher education for engineers: Lessons learned

Oleg Boruch Ioffe[1] (oleg-boruch.ioffe@h2.de), Maike Schelhorn[1] (maike.schelhorn@h2.de), Jessica Schäfer[1], Reik Volker Donner[1]

[1] h² – Hochschule Magdeburg-Stendal; Fachbereich Wasser, Umwelt, Bau und Sicherheit, Germany

Since several years, Magdeburg-Stendal University of Applied Sciences has been using digital mathematics problems for enriching its mathematics teaching. Starting in fall 2022, STACK is being increasingly used in the regular mathematics courses in several study programs, with the numbers of courses covered being on continuous rise. At present, STACK problems have become integral parts of the courses Mathematics 1 – 3 for Civil Engineering (in German language), Mathematics 1 – 2 for Sustainable Resources and Management (English), and since fall 2023 also Mathematics 1 – 2 for Water Engineering and Recycling Management (German), currently taught by three different lecturers from the university's two engineering departments. A complete coverage of the introductory (first year) mathematics courses in all Engineering programs is envisioned to become effective in fall 2024.
With the different study areas and lecturers, the teaching formats (regular in-presence lectures and tutorial classes, in-presence seminarist lectures with integrated examples, inverted classroom lectures combined with in-presence tutorial classes) and the respective degree of STACK integration (curated problem collection for self-study, weekly exercises, integrated e-assessments) differ markedly among the courses that already use STACK problems. This broad range of settings allow drawing a comprehensive picture of different settings for implementing STACK into higher education programs for future engineers.
By means of systematic student questionnaires (distributed among all courses three times per term) and individual interviews held by social scientists, we obtain detailed data on potential factors that may affect the students' acceptance of STACK problems as a precious resource of learning materials as well as their individual learning success. In addition, we perform detailed learning analytics based on access data from the learning management system "moodle" along with success rates of the final course exams. Combining all those complementary data sources, we are in a unique position for determining factors controlling the acceptance and effectiveness of STACK problems in higher mathematics education for engineers. Our presentation will provide details on the different course settings, obtained data sources, and our initial lessons learned so far from our systematic exploitation of STACK.

WEDNESDAY
13.03.2024



	FOYER	ROOM 313
8:00 am		
	Welcome coffee	
9:00 am		
10:30 am		
11:00 am		
12:30 pm		
1:45 pm		
3:15 pm		
3:45 pm		
5:15 pm		

INNOVATORIUM	DIGITALES KLASSENZIMMER
▪ Assessment of laboratory assignments using STACK - Part I: processing and grading of unique experimental data ▪ Using STACK Beyond Mathematics ▪ STACK in physics across the curriculum ▪ Testing STACK within the Italian system: the case of the University of Trieste	▪ STACK Assessment: A possible gateway to a more student centered teaching of mathematics of undergraduate Mathematics in African Universities? ▪ Using Stack for modelling questions ▪ Motivating Engineering Students to Practise Fundamental Math Skills with STACK ▪ STACK for PDEs
Coffee break	
▪ Proof assessment in STACK using SortableJS ▪ Assessment of proof with Parsons Problems in STACK ▪ STACKing Further with StackJS	▪ Using Meclib for creating STACK questions with interactive graphics
Lunch break	
▪ Advanced JSXGraph bindings & applying the validation system in STACK to complicated objects ▪ Assessment of laboratory assignments using STACK - Part II: grading of unique experimental data by interactive input through JSXGraph ▪ Decoding the Disciplines and JSXGraph - an approach to resolve learning obstacles in energy balancing ▪ Designing graphical physics problems with JSXGraph ▪ Planarity of Graphs with jsxGraph	▪ Developing interactive example-generation tasks ▪ Automatic assessment of the geometric perfomance of basic operations with complex numbers: An example question using STACK and JSXGraph ▪ Partial credit in computer aided assessment in calculus courses for large engineering classes
Coffee break	
▪ Large Language Models in Education: STACK Integration ▪ Network analysis of solution processes in mathematics online tests ▪ Data Procession Made Easy: A Python Tool for Extracting Information from Student Responses to STACK Questions ▪ On the present and the near future of STACK ▪ Outlook on Durham 2025	

LIGHTNING TALK | 09:00 am - 10:30 am (Innovatorium)

Assessment of laboratory assignments using STACK - Part I: processing and grading of unique experimental data

Corné Muilwijk[1] (corne.muilwijk@dcu.ie), Paul S. Young[1]

[1] School of Mechanical & Manufacturing Engineering, Dublin City University

Timely feedback on assignments with an opportunity to resubmit material is crucial for a steep learning curve. For laboratory assignments, mid-semester feedback is a challenge when large amounts of students are enrolled, and the contribution each individual student may be obscured when assessed by a group report. To address this challenge, STACK questions were developed to evaluate the postprocessing of laboratory by undergraduate engineering students. Due to experimental errors and uncertainties in the sensors, each student has their own unique laboratory obtained data set and the students' answers are graded based on the correctness of their analysis of their own data.
The assignment is to experimentally measure and calculate the heat transfer coefficient (h) from an initially heated test specimen where its temperature (T) is recorded as function of time (t) at an ambient temperature (Ta). Given the theoretical exponential decay of temperature as function of time, students are required to take the natural logarithm of (T-Ta) and carry out a least-square (LSQ) curve fit in Excel to calculate the slope of "ln(T-Ta)" as function of time t. The correct experimental heat transfer coefficient (h) can be algebraically calculated from the slope found. The STACK question for assessing the correct methodology first prompts for the raw obtained data (Ta, T, t) as numerical and matrix inputs, which are then assigned to non-graded student input variables (STa, ST, St) respectively, together with the heat transfer coefficient calculated by the student (assigned to Sh) from their analysis.
The correct answer (Th) calculated algebraically from the students input data (STa, ST, St) is then presented in the "Feedback variables" field under the Potential Response Tree (PRT) and the grade for the student is based on a comparison between Sh and Th. As the students submit their own and unique data set, the correct values for Sh are also unique for each student. The STACK question grades the correctness of the method based on student input variables, instead of a correct model answer defined in "Question Variables".

PRESENTATION | 09:00 am - 10:30 am (Innovatorium)

Using STACK Beyond Mathematics

Maciej Tadeusz Matuszewski[1] (m.t.matuszewski@durham.ac.uk)

[1] Durham University, United Kingdom

STACK is often seen primarily as a tool to aid the teaching and assessment of Mathematics. However, it has the potential to be used in a far wider range of quantitative subjects. This presentation will explore the practicalities of extending the use of STACK to a wider audience, including the training of new staff to use STACK. The experience of the Durham University Mathematical Sciences Department will be used as the primary example — exploring the engagement of the Department's STACK team with other Department's within the Natural Sciences Faculty, and efforts to introduce optional STACK workshops in general lecture training courses. The presentation will outline current ideas for best practice, and open discussion for new approaches.

LIGHTNING TALK | 09:00 am - 10:30 am (Innovatorium)

STACK in physics across the curriculum

Abigail Pied[1] (abigail.pied@glasgow.ac.uk), Alastair Palmer[1], Eric Yao[1]

[1]University of Glasgow, United Kingdom

Diversifying and distributing assessments is useful in promoting student engagement and enhancing inclusiveness. Computer-based automated marking online assessment provides a key ingredient for doing this in large class settings. It can promote engagement by increasing time spent by students on learning tasks, providing them with feedback and valuable practice opportunities. Because it is largely free of the need for teacher intervention at specific time, it allows for asynchronous learning to take place. However, typically, teachers are concerned about the scope and range of the questions that can be set for these types of assessments and students are worried that their work is not fairly assessed due to limitations of the input system used. Although designed for testing mathematics, STACK is well suited for posing physics questions. It has been adopted by physics departments at various universities, frequently for junior levels where numerical calculations and simple derivations can be tested. Here we present our adaptation of exam and tutorial questions across the levels of the physics degree curriculum while addressing common perceptions of shortcomings of computer-based automated marking assessments. In this work, STACK provides the foundation for the assessment while being supplemented by other VLE question types. To address possible teacher concerns, we start from "standard" question set which tests a wide range of intended learning outcomes and cognitive skill levels. In deploying these questions, we focus on providing fairness and consistency in marking as well as timely and personalised feedback. By encouraging student to simultaneously upload their workings and analysing student responses, accurate assessment of the student attempts can be made. Deploying these type of assessments both as formative and summative assessments in various classes shows good correlation with student performance in "traditional" assessments types. This means that STACK, when used in conjunction with other tools, can be an extremely useful tool in learning and teaching in physics and other fields.

PRESENTATION | 09:00 am - 10:30 am (Innovatorium)

Testing STACK within the Italian system: the case of the University of Trieste

Zevick Juma[1] (jumazevick@gmail.com), Lewanski Danilo[1], Elisabetta Chelleri[1]

[1] University of Trieste, Italy

The University of Trieste has recently embraced the STACK system as a platform where students can practice mathematics exercises with feedback at their own pace, especially in the courses of Linear Algebra for engineers and Statistics and Probability for biologists. Implementing STACK is a significant step in adjusting assessment approaches to raise student confidence levels in mathematics and related subjects.
In this talk, we present the students' experience with STACK. In particular, we will focus on the data analysis of the students' performance of five large mathematics courses at Trieste, paired with students' satisfaction questionnaires and an analysis of the performance in the final exam. Finally, we will mention how STACK was used for Continuous Assessment, in relation to the more theoretical identity of the Italian education system, and outline the department's future plans with STACK.

PRESENTATION | 09:00 am - 10:30 am (Digitales Klassenzimmer)

STACK Assessment: A possible gateway to a more student centered teaching of mathematics of undergraduate Mathematics in African Universities?

Motognon Wastalas d'Assise Dogbalou[1] (wastalasdassise@gmail.com), Herine Otieno[2]

[1] University of Trieste, Italy; [2] EduHubAfric

Globally there is growing interest in transforming teaching of mathematics at institutions of higher learning from the traditional lecture method to pedagogical practices that, in tandem with the principles of socio-constructivism, center the learning process on students. This interest is predicated on what has been observed as poor learning results in many of the STEM related fields such as mathematics which have been traditionally taught through the lecture approach.
Using a social constructivist lens of teaching of mathematics at university level, content qualitative analysis was employed to interrogate findings from extant research on current use of STACK for assessment of mathematics in Kenyan Universities to tease out features of STACK that can be exploited to support flipped learning and teaching of mathematics.
The findings from the study suggest that unique features of STACK such as real time feedback to the students; error analysis; and platforms for peer discussion can be successfully exploited to support flipped learning and thereby support adoption of student-centered approach in the teaching of mathematics in African universities.
Possible implications for a STACK supported flipped teaching of mathematics to African universities teaching context such as large classroom sizes, gender related gaps in achievement in mathematics and attitude towards mathematics amongst undergraduate students is also presented.

LIGHTNING TALK | 09:00 am - 10:30 am (Digitales Klassenzimmer)

Using Stack for modelling questions

Giampaolo D'Alessandro[1] (dales@soton.ac.uk), Philip Greulich[1], Rubén José Sánchez-García[1]

[1] University of Southampton, United Kingdom

We report on the use of Stack and other forms of electronic assessment in two third year modules, “Mathematical Biology” and “Structure and Dynamics of Networks”. We wanted to offer the students regular formative tests so that they could check their understanding of the key concepts of each module and test their ability to solve problems. Stack allowed us to do this without increasing the marking load. Moreover, the use of randomisation helped ensure the upholding of academic integrity.
We had noticed that students in “Applied Mathematics” modules often judge their skills only by how well they find a numerical or algebraic answer to a given question. We wanted to counter this notion. Therefore, our aim main formative aim was to make the students focus on two other aspects of the module learning experience, on top of the usual algebraic skills.
The first were simple concepts and definitions. We prepared a set of “Drag and drop into text” or “Drag and drop onto an image” Moodle questions to assess their understanding, for example, of dynamical system definitions and stability diagrams.
The students’ modelling skills were the second learning outcome we wanted to assess, e.g. how to go from a verbal description of a problem to a set of differential equations or to a network. As another example, we used Stack to provide a randomised description of a two-species model and to check that the correct system of differential equations was entered. This was our first attempt at such questions and so the question was very detailed and the freedom in the choice of answer possibly more restrictive than it could have been. The students answered these questions successfully, but we did explore more in detail whether their modelling skills had improved. We expect that a similar approach can be used to test the verbal comprehension skills of the students in other modules, e.g. simple modelling problems in a differential equations module, or building recursion relations from verbal descriptions.

PRESENTATION | 09:00 am - 10:30 am (Digitales Klassenzimmer)

Motivating Engineering Students to Practise Fundamental Math Skills with STACK

Lassi Korhonen[1] (lassi.korhonen@oulu.fi), Jukka Kemppainen[1]

[1] University of Oulu, Finland

Adequate basic mathematical skills acquired in high school are necessary for fluent engineering math studies at college or university level. If there are lacks in fundamental skills, learning and training of new mathematical concepts will be more challenging and time-consuming. In this study, we introduce an effective and resilient method to encourage and motivate students to practise basic problems, where these fundamental skills are crucial, outside the classroom. The method is based on automatically assessed STACK questions and was implemented on a second-year engineering math course Complex Analysis. The method proposed aims to prompt students to solve these questions without the aid of a computer algebra system and to prove that they can answer the problems without any external help as well. The questions, methods and pedagogical tools employed, as well as the achieved results and students' views, will be presented in this study. The collected data and student feedback show that students were making effort to practise with the given problems. Students also acknowledged the advantages of practising the basic skills and were pleased with the method used.

LIGHTNING TALK | 09:00 am - 10:30 am (Digitales Klassenzimmer)

STACK for PDEs

Laura Kobel-Keller[1] (laura.kobel-keller@math.ethz.ch), George-Ionut Ionita[1], Florian Spicher[1]

[1] ETH Zürich, Switzerland

In our joint project with Florian Spicher and George Ionita, both from ETH Zurich, we extended the range of STACK exercises to Partial Differential Equations (PDEs), setting new standards in this domain. Beyond the comprehensive integration of PDE exercises into STACK, a pioneering achievement in itself, our technical implementation introduces innovative features, such as JSXGraph.
The diverse exercises provided not only students a feedback-rich training environment for practicing techniques to solve PDEs - common in natural and engineering sciences — with varying data until mastery is achieved, but also present opportunities to explore novel features, such as the mathematical description of the hydrogen atom.
These tasks earned high appreciation from the students and engaged them more actively compared to traditional pen-and-paper exercises. Notably, the individual feedback in the response trees proves crucial for students in their learning journey, particularly in large classes where it serves as a partial substitute for teaching assistants.

PRESENTATION | 11:00 am - 12:30 pm (Innovatorium)

Proof assessment in STACK using SortableJS

Salvatore Mercuri[1] (smercuri@ed.ac.uk)

[1] The University of Edinburgh, United Kingdom

The ability to understand and write proofs is an integral part of a mathematics degree. However, the capabilities of STACK in assessing proof writing are limited. To this end, we have implemented Parson's framework of assessment into STACK, where the students must re-arrange proof steps to provide a correct proof, through a general-use "parsons" block. Parson's framework was initially developed to assess the structural and atomic elements of algorithmic questions in computer science, by providing all the necessary atomic, and perhaps some structural, elements of the solution in an incorrect order and requiring the student to rearrange them into the correct order. This framework can be particularly useful for novices, since it reduces the burden of generating steps in the correct order and structure all at once. Although proofs are often written as free-form text, their underlying structure makes it natural to extend Parson's framework to proof assessment.
In the initial implementation of the STACK "parsons" block we utilised the Sortable JavaScript library to provide the students with two lists: a blank answer list, and a populated available list (containing all the required steps to complete the proof plus any optional incorrect steps); the underlying Sortable functionality enables the student to drag and drop items from the available list to the answer list in the correct order and submit for assessment. In this talk, we will cover the details of the STACK implementation of the block and highlight how authors can leverage the various options of the "parsons" block to write proof-based drag-and-drop questions. The assessment of Parson's block will be covered in a separate talk.

PRESENTATION | 11:00 am - 12:30 pm (Innovatorium)

STACKing Further with StackJS

Sam Fearn[1] (s.m.fearn@durham.ac.uk)

[1] Durham University, United Kingdom

While STACK is perhaps most naturally suited to calculational questions with algebraic answers, work by a number of question authors has demonstrated the potential for the use of STACK in assessing other types of mathematical task, such as proof comprehension. While exploring these ideas in the context of a proof-heavy undergraduate module, I wondered about the possibility of using STACK for a type of drag-and-drop proof building exercise known as a Parson's problem. Since this wasn't a feature available in STACK at that time, I created an implementation of this idea in STACK using STACK-JS. STACK-JS is a tool for including JavaScript within a STACK question, allowing for user interaction beyond what is possible in STACK alone.
In this talk, I will give an introduction to STACK-JS, and show how it can be used to enable advanced user interaction within STACK.

PRESENTATION | 11:00 am - 12:30 pm (Innovatorium)

Assessment of proof with Parsons Problems in STACK

Chris Sangwin[1] (C.J.Sangwin@ed.ac.uk)

[1] University of Edinburgh, United Kingdom

Parson’s problems require students to assemble pre-written text into a correct order by dragging blocks into a list structure. The scaffolding provided by Parson's problems has been found to be very useful to students in discrete mathematics. Parson's problems in mathematics, especially proofs, do not always have a unique answer which is considered correct. For example in a proof of “A if and only if B” we can have two correct proofs depending on whether “A=›B” or “B=›A” is written first.
STACK provides "proof construction functions" to represent the structure of a proof and libraries for displaying and assessing proof.
The Damerau-Levenshtein distance is a metric for measuring the difference between two strings. Informally, this is the edit distance measuring the minimum number of single-character edits (insertions, deletions, transition or substitutions) required to change one string into the other. The problem of assessing Parson's problems is very similar. We want to establish the distance between the student's proof and a teacher's proof, and identify the closest proof from a list deemed acceptable by the teacher. We want to automatically provide feedback detailing which edits will transform the student's proof into a “correct” proof, e.g. “Swap these two lines”, “Insert a line here”. This talk demonstrates how to use these features which were releases in December 2023 as part of STACK 4.5.0.

WORKSHOP | 11:00 am - 12:30 pm (Digitales Klassenzimmer)

Using Meclib for creating STACK questions with interactive graphics

Martin Kraska[1] (kraska@th-brandenburg.de)

[1] Technische Hochschule Brandenburg, University of Applied Sciences, Germany

In the workshop, concept and use of Meclib in STACK questions is demonstrated.
Starting from a simple randomized question, the participants first add a parametrized illustration and then add interactive graphical input and appropriate feedback functions.
The participants get an overwiew of the available objects and their documentation and try out various demo questions.
No knowledge of JavaScript or JSXGraph is required. Basic STACK authoring skills are helpful.

PRESENTATION | 01:45 pm - 03:15 pm (Innovatorium)

Advanced JSXGraph bindings & applying the validation system in STACK to complicated objects

Matti Harjula[1] (matti.harjula@aalto.fi)

[1] Aalto University, Finland

This presentation shows how to apply validation to complex input coming from JSXGraphs, using the new bespoke validation logic and suitable presentation tuning. In the future, we might not always hide the input validation portion of the input in our JSXGraph questions.

The basic content of the presentation is as follows:

- The basic idea of general custom bindings, i.e. when points and sliders are not enough.
- Non-JSON-based custom bindings, using inert functions and thus directly CAS-compatible syntax.
- Custom display of those inert functions using texput. Only CAS-compatible syntax can have texput rules applied to it.
- Applying bespoke validation on top of all that.

LIGHTNING TALK | 01:45 pm - 03:15 pm (Innovatorium)

Assessment of laboratory assignments using STACK - Part II: grading of unique experimental data by interactive input through JSXGraph

Corné Muilwijk[1] (corne.muilwijk@dcu.ie)

[1] School of Mechanical & Manufacturing Engineering, Dublin City University, Ireland

Online learning including formative and summative assessments are omnipresent in modern courses. However, the challenge with online assessment and, especially multiple-choice questions (MCQ) in an unproctored setting, is to prevent collusion and maintain a high standard of academic integrity. Advanced question tools such as multi-step calculated questions with randomized variables using STACK offer a solution for robust online assessment. However, after some time spreadsheets may circulate amongst students that takes in the randomized variables posed in the question text and generate correct answer values. A graphical input, requiring students to drag-and-drop markers on a graph adds an extra step of manual intervention and prevents opportunistic use of circulating spreadsheets.

A STACK question assessing the postprocessing of laboratory obtained data by undergraduate engineering students was developed using JSXGraph for manual interaction with a thermodynamic property diagram. In a laboratory experiment, students measured temperatures (Ti) and pressures (Pi) at various locations (i) in a vapour-compression cycle heat pump. The assignment requires students to drag and drop markers to the correct locations on a pressure-enthalpy (P-h) diagram based on their measured temperatures and pressures. JSXGraph is used to overlay and align this property diagram with the JSXGraph native axes. The raw lab data, entered as numerical values, are assigned to non-graded input variables (SPi,STi). The Student selected Graph coordinates containing (SGhi,SGPi) were bound to STACK variables and graded against the teachers answers (Thi,TPi). As each student has their own unique data set, the correct teachers answers (Thi,TPi) were calculated in the “Feedback Variables” under the Potential Response Tree (PRT) from the non-graded students’ input variables (SPi,STi). Due to the non-linear dependence of the enthalpy as a function of temperature and pressure, an iterative procedure was used to interpolate Thi from values in a lookup-table containing thermodynamic property data assigned in “Question Variables”.

Students were allowed multiple attempts and instant feedback was given as either correct or false. The question was attempted on average 3.3 times per student, with an average grade of 4.7/10 at first attempt and an average grade of 7.9/10 based on the highest graded attempt.

LIGHTNING TALK | 01:45 pm - 03:15 pm (Innovatorium)

Decoding the Disciplines and JSXGraph - an approach to resolve learning obstacles in energy balancing

Johannes Goebel[1] (johannes.goebel@hs-duesseldorf.de), Matthias Neef[1], Birgit Szczyrbal[2], Vivian Kowalzik[2] (vivian.kowalzik@th-koeln.de), Lisa Demant[3], Sylvia Schädlich[3], Laura Schriefers[4], Arne Graßmann[4], Frank Alsmeyer[4]

[1] Hochschule Düsseldorf, Germany; [2] TH Köln - Zentrum für Lehrentwicklung; [3] Hochschule Ruhr West; [4] Hochschule Niederrhein

This paper addresses the field of thermodynamics education and uses the “Decoding the Disciplines” method to uncover and address student learning challenges. The research focuses specifically on the topic of “energy balancing” and aims to identify key “threshold concepts” that act as cognitive bottlenecks for students in mastering this fundamental thermodynamic principle.
Through the use of qualitative research methods, including interviews and concept mapping, we seek to identify the specific mental blockages that hinder students' understanding and application of the principles of energy balancing. In particular, the method of Decoding the Disciplines is used to understand and analyze the gap between the thougths of experts and novices.
Moodle Stack and JSXGraph exercises, with their feedback and their interactive graphical visualization, provide a way to alert students to and overcome these identified barriers.

LIGHTNING TALK | 01:45 pm - 03:15 pm (Innovatorium)

Designing graphical physics problems with JSXGraph

Michael Kubocz[1] (kubocz@physik.rwth-aachen.de), David Lauter[1], Stefan Roth[1]

[1] RWTH Aachen University, Germany

Learning management systems, such as Moodle, offer the possibility to embed supplementary material to any course, which can be utilized not only for a summative and formative assessment, but also for student self-study. This includes single/multiple choice questions, problems that require algebraic and/or numerical answers, with or without units for the latter. The STACK plugin is a powerful tool for creating such digital learning material in order to test students' understanding and knowledge of the topic. In addition, using the open-source JavaScript library JSXGraph, the STACK plugin also allows the integration of graphical elements, such as geometric constructions, interactive plots, 2D and 3D visualization of objects, and even animations. The graphical content can be linked to randomized parameters of a given problem itself, thereby augmenting the specific problem individually. In addition, a new type of problems can be implemented which students have to solve graphically. In this case the students can provide an answer by moving or modifying given graphical objects. In this presentation we demonstrate some examples of STACK problems employing JSXGraph, that can be used within an university physics course.

LIGHTNING TALK | 01:45 pm - 03:15 pm (Innovatorium)

Planarity of Graphs with jsxGraph

Hendrikje Schmidtpott-Schulz[1] (schmidtpott@uni-kassel.de)

[1] Universität Kassel, Germany

JSXGraph allows us to pose questions concerning graphs, that can be solved manually at the computer screen. Since it is possible to drag vertices to new locations, students can experiment with the given graph comfortably and there is no need to redraw the graph constantly. In our lectures we usually ask to verify planarity by finding an intersection-free display of the graph or to disprove planarity by identifying K5 or K3,3. Some students need to develop an intuition to successfully perform these tasks, but using only pen and paper this is rather tedious. This can be improved by the usage of STACK-training assignments.
In this talk I want to present some of our ideas to implement these questions in moodle, using STACK and jsxGraph.

PRESENTATION | 01:45 pm - 03:15 pm (Digitales Klassenzimmer)

Developing interactive example-generation tasks

George Kinnear[1] (G.Kinnear@ed.ac.uk)

[1] The University of Edinburgh, United Kingdom

In this talk, I will focus on tasks that ask students to generate several examples of mathematical objects - for instance, matrices with given eigenvalues. Tasks like this have lots of potential to stimulate students' learning, and STACK provides the means to use them with large groups of students - without the teacher needing to check everyone's examples by hand! I will describe a novel approach that makes these tasks interactive - so that students are prompted by STACK for further examples, based on the ones they have already given. I will share details of the technical implementation in STACK, which relies on some new JavaScript code within the question, together with some example tasks that use this approach. I will also summarise findings from a pilot study that compared students' responses to interactive and non-interactive versions of the same tasks.

PRESENTATION | 01:45 pm - 03:15 pm (Digitales Klassenzimmer)

Automatic assessment of the geometric perfomance of basic operations with complex numbers: An example question using STACK and JSXGraph

Stephan Bach[1] (s.bach@oth-aw.de), Bernhard Gailer[1] (b.gailer@oth-aw.de)

[1] OTH Amberg-Weiden, Germany

Visualization is an essential part of teaching and learning mathematics, not only in subject areas that are obviously geometrical. It enables the use of intuition, supports the comprehension of concepts and initiates thinking (Atiyah, 2001). Dynamic geometry software (DGS) is commonly regarded as a tool that aids in supporting geometric understanding. DGS allows synchronous connection of multiple representations and facilitates the provision of rich opportunities for practice and discovery (Soto-Johnson, 2013). However, following the idea of constructive alignment (Biggs, 1996), it is important to not only practice but also assess geometrical interpretation. Here, the combination of STACK and JSXGraph offers great potential.
The presentation will introduce a STACK question on the visualization of complex numbers. In engineering mathematics, this is a topic with multiple geometrical interpretations. For not only complex numbers themselves but also their operations can be interpreted as geometrical objects respectively transformations in the Gaussian Plane. The question introduced will focus on specific operations of complex numbers, such as complex conjugation or scaling. Based on some theoretical background on the importance of visualization in mathematics teaching, the authors will illustrate the conception of the question. This will include considerations on how to support the geometric focus. Subsequently, important aspects of the implementation, namely randomization, grading and tolerance, and feedback, will be illustrated. Special attention will be paid to particulars of the integration of JSXGraph, such as an effective transfer of randomized variables, or adaptions on the feedback-level using the new STACK-JS.
The presentation will close with a short discussion including lessons learned from the perspective of the developers.

PRESENTATION | 01:45 pm - 03:15 pm (Digitales Klassenzimmer)

Partial credit in computer aided assessment in calculus courses for large engineering classes

Meike Akveld[1] (akveld@math.ethz.ch), George Ionita[1], Andreas Steiger[1]

[1] ETH, Switzerland

As many other universities, the maths department of the ETH Zürich is chronically understaffed when it comes to marking students' homework or grading first year exams of service courses. Simultaneously, it is well known from the literature that direct feedback is one of the key factors for learning. In this paper we are planning to report on how we introduced the Moodle question type STACK into our first year calculus course for civil engineers and how we ran a partially computer aided exam. STACK allows us to do much more than simple MCQs. Grading remains automatic, but we can award partial credit in a sophisticated way attaining a closer approximation to classical open questions than standard MCQs allow for. Also, STACK has powerful tools for randomisation which can be used both in formative and in summative assessment.

PRESENTATION | 03:45 pm - 05:15 pm (Innovatorium)

Large Language Models in Education: STACK Integration

Jesús Copado[1] (jcopado@surlabs.es)

[1] Surlabs, Spain

The advent of Large Language Models (LLMs) like GPT has revolutionized education. This presentation aims to explore the challenges and opportunities presented by LLMs in the educational landscape. The integration of these advanced AI tools offers unprecedented possibilities for enhancing learning experiences, but also poses significant challenges that need careful navigation.
The presentation will introduce SURLABS' latest developments in this field. SURLABS, a forward-thinking software company, is at the forefront of integrating LLMs into educational software, being the first service provider to integrate GPT in ILIAS, offering the same tools for Moodle. Our focus is on creating solutions that are not only technologically advanced but also pedagogically sound and ethically responsible.
We will showcase some examples on how LLMs can help the author at creating STACK Questions, and present some ideas we have, on how can we improve Learning with STACK and AI focusing on the automatic generation of feedback.
In conclusion, the presentation aims to provide a comprehensive overview of the transformative potential of LLMs in education, focusing on its integration with STACK, while also addressing the challenges and ethical considerations. Through SURLABS' innovative projects, we aspire to showcase how these challenges can be turned into opportunities for enriching the educational experience in the AI age.

LIGHTNING TALK | 03:45 pm - 05:15 pm (Innovatorium)

Network analysis of solution processes in mathematics online tests

Yasuyuki Nakamura[1] (nakamura.yasuyuki.f1@f.mail.nagoya-u.ac.jp), Asahi Kurihara[1]

[1] Nagoya University, Japan

In this study, we visualized student answer data in the form of a directed network diagram for the lecture “Introduction to Mathematics” given using the automatic equation grading system STACK, and analyzed the data by calculating network properties. STACK has a function called “potential response tree”, which allows the author to set up a tree of possible or potential wrong answers in advance, automatically classify the wrong answers that fit the set of possible wrong answers, and return feedback. In this lecture, students used STACK to answer a single question multiple times, and the data was obtained as part of the answer process. Based on this data, the students' solution transitions were represented in a directed graph, and network properties were calculated. This allowed us to quantitatively measure the effect of feedback on the student's solution process and on the node corresponding to each wrong answer, using the values of the network property at each node. The numerical values were also used to make comparisons among questions, and the tendency of students to answer and the effect of feedback could be patterned according to each network property. By combining these indices with commonly used indices such as percentage of correct answers and number of times answered, it will be easier to grasp the learning status of students, and we believe that this will be useful in providing appropriate educational opportunities.

LIGHTNING TALK | 03:45 pm - 05:15 pm (Innovatorium)

Data Procession Made Easy: A Python Tool for Extracting Information from Student Responses to STACK Questions

Jonas Lache[1,2] (jonas.lache@hs-ruhrwest.de)
[1] Hochschule Ruhr West, Germany; [2] Ruhr-Universität Bochum, Germany

This presentation outlines the evolution of a project originally presented at the 2023 community meeting. The methods for processing student responses to STACK questions using Python and regular expressions presented last year have now lead on to the creation of a Python tool with a user-friendly graphical user interface (GUI). This tool facilitates the import of a Moodle quiz report in CSV format, giving the user a number of options such as the selection of input fields and response trees. The result is a CSV file containing extracted information, including students' scores in specific subtasks. Aimed at assisting educators and practitioners in the efficient analysis of student responses to STACK questions, this presentation will introduce the recently developed tool and provide insight into its potential to streamline the processing of student response files provided by Moodle.

LIGHTNING TALK | 03:45 pm - 05:15 pm (Innovatorium)

On the present and the near future of STACK

Chris Sangwin[1] (C.J.Sangwin@ed.ac.uk)
[1] University of Edinburgh, United Kingdom

Version 4.5.0 was released in December 2023. With this version, some innovations have been introduced into STACK. For example, it is now possible to include GeoGebra worksheets into STACK. Therefore, it is now time to take a look at the present, the past and, above all, the (possible) future of STACK.

LIGHTNING TALK | 03:45 pm - 05:15 pm (Innovatorium)

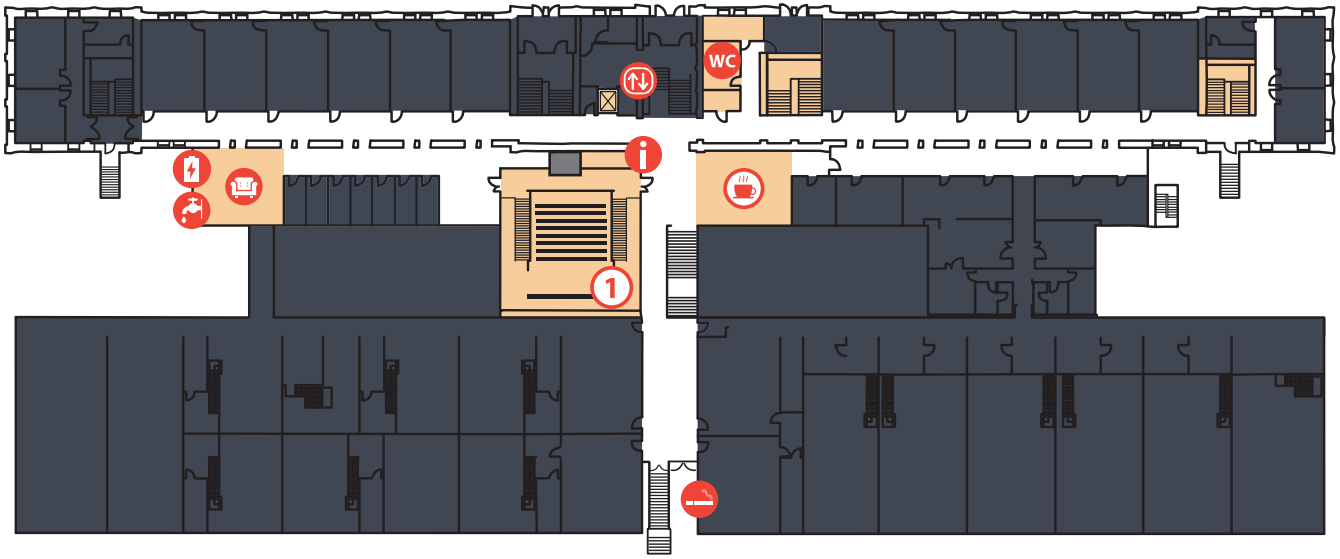
Outlook on Durham 2025

Maciej Tadeusz Matuszewski[1] (m.t.matuszewski@durham.ac.uk)
[1] Durham University, United Kingdom

A sneak peek at the next STACK conference, which will take place in Durham, UK in 2025.

FLOOR PLANS

GROUND FLOOR



FRONT DESK, INFOPOINT

ELEVATOR

WC RESTROOM

SMOKING AREA

FIRST AID

PRAYER ROOM

STACK LOUNGE

CHARGING OPTION

WATER DISPENSER

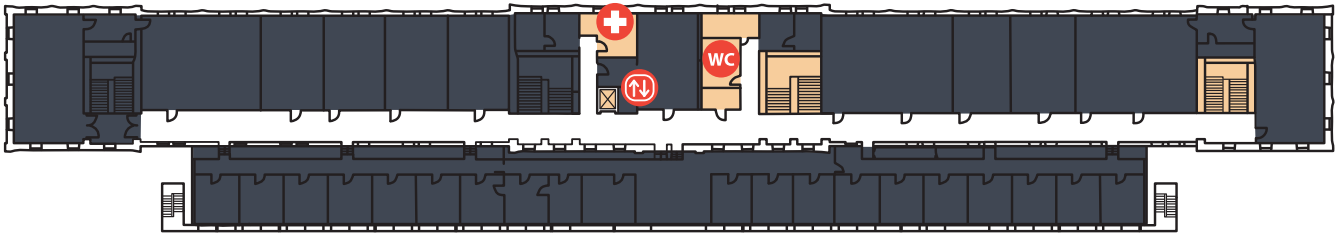
FOYER — Catering

1 EVENT ROOM 1 — Innovatorium

2 EVENT ROOM 2 — Digitales Klassenzimmer

3 EVENT ROOM 3 — Room 313

FIRST FLOOR



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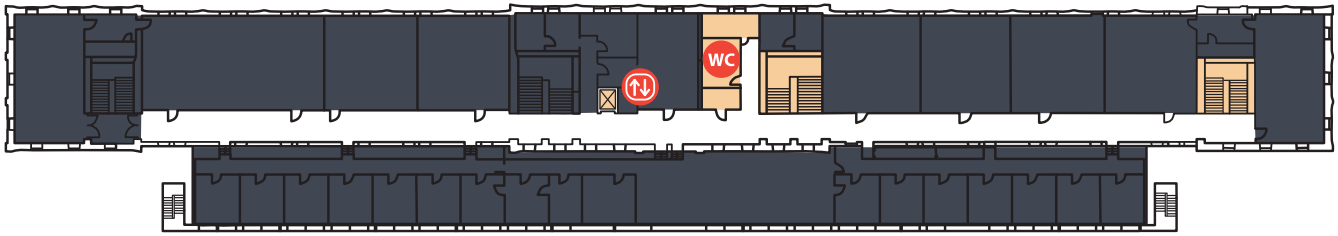
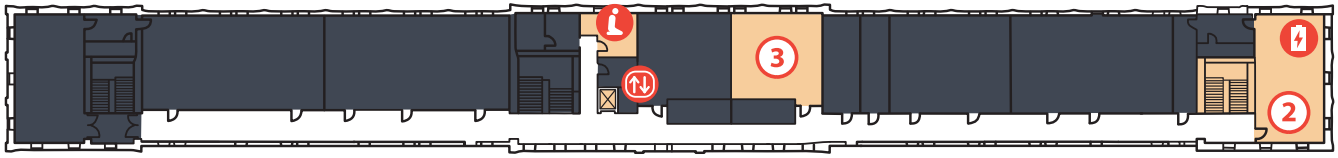


THIRD FLOOR



OUTDOOR PLAN

CANTEEN — Lunch break

MEETING POINT OLD TOWN TOUR — “Hochzeitsbrunnen” (Marketplace)

CONFERENCE DINNER:

Heimatgenuss im Bruckmüller
Vilsstraße 2, 92224 Amberg

1. Allee Parkhotel Maximilian
2. Altstadt-Hotel Amberg
3. Hotel Brunner
4. Hotel Fronfeste
5. Vienna House Easy Amberg

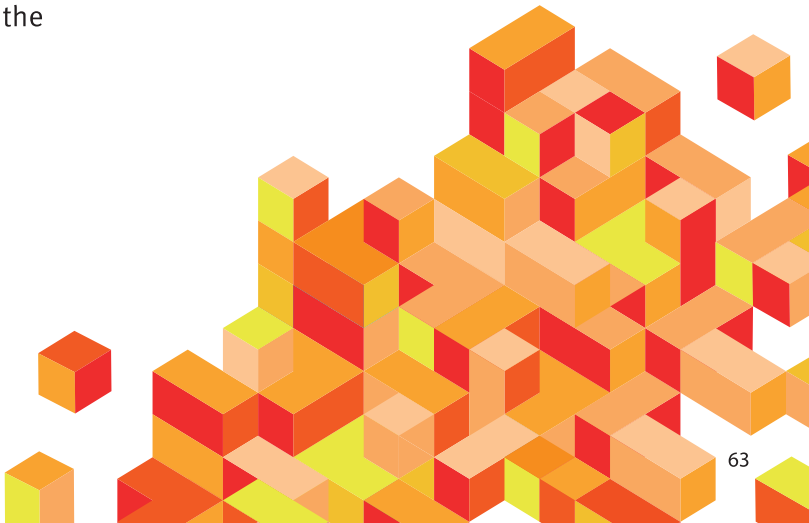
P Parking space

ACKNOWLEDGMENTS

We would like to thank all authors for their contribution to the 7th International Meeting of the STACK Community 2024 in Amberg. Special thanks go to all chairs and moderators.
Many thanks also to the organizers of the last meeting in Tallinn, Estonia, especially Oksana Labanova and Anne Uukkivi (TTK University of Applied Sciences), who gave us valuable insights into the organization of the last meeting. Our thanks also go to the International Board and Chris Sangwin (The University of Edinburgh), who established contact with last year's organizers and were always ready to answer questions.
Many thanks to all members of the program committee and the reviewers for their support and important input.
We would also like to thank the Ostbayerische Technische Hochschule (OTH) Amberg-Weiden and its staff for providing the rooms free of charge. We would also like to thank the media team led by Marion Wagner and Meiline Wolf for the graphic design and production of the visual media. We would like to thank Jonas Winkel and Marion Wagner for filming and providing the livestream. We would also like to thank Jennifer Weber for creating the VR environment. Our thanks go to the whole team for the photographs.
Last, but not least, a big thank you to all the other helping hands who supported the conference: Blanca Kraus, Lena Vilsmeyer, Lukas Schwörer and Ronya Fischer.
We wish the organizing team of the 8th International Meeting of the STACK Community, which will take place in Durham UK, every success in preparing and holding the next annual meeting.

The organization team of the international meeting of the

STACK community 2024 in Amberg



STAY CONNECTED

Check out our website for more information:

www.oth-aw.de/stack-2024

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