

# White Paper for Co-Teacher

Autumn 2018 Version



## Shoulders of Giants – Mission & Story

Shoulders of Giants (SoG) has an ambitious goal – to revolutionize education in the 21<sup>st</sup> century and enable scalable learning management with our AI tutoring platform, SoG Co-Teacher. Finland has one of the highly ranked public education programs in the world, a legacy we are truly proud of. We want to spread this legacy globally by taking the recent breakthroughs in AI and bringing them together with personalized teaching. In a nutshell; we want to be at the forefront of democratizing learning by making cost-efficient and high-quality education available to everyone, whenever and wherever they need it.

Shoulders of Giants began with the original idea of our board member, Pete Stockley. This idea started to gain traction in late 2016 when Elja-Ilari Suhonen, our CEO, founded the company together with his teacher at the time, Aarni Moisala. In fact, the early stages and development of this journey were documented in Elja's bachelor's thesis as he completed his B.B.A. IBM saw promise in our early vision for Co-Teacher, and we were accepted in their Global Entrepreneurship Program. Not long after, SoG won the Startup Garage competition organized by Nebula and Bassoradio in December 2017. In January 2018, we set office in Aalto University's Startup Center and our virtual organization became concrete.

In 2018, product development for Co-Teacher continues in collaboration with several educational institutions, aiming for a global commercial launch by the end of the year.

## Global Landscape of Modern Education

There's growing demand for higher education, as the rising number of applicants globally demonstrates. With growing populations comes a pressing need to provide communities access to even a basic level of education. The best way to combat the global challenges that humanity faces is by nurturing a higher global standard of education. Education empowers individual people all over the world to make smarter decisions and launch beneficial projects, movements and organizations. Many schools would like to help make this vision a reality, but currently they lack the resources and tools to do so.

Public funding to schools is widely being cut, making the task of cost management increasingly critical and challenging. Personalization is a major component in successful education and student motivation, but with larger classrooms and course sizes this is very difficult to achieve.

So long as the cost of education increases directly in proportion to the number of students, scalable learning can never become a reality. More students traditionally means more grading, FAQs and other routine tasks that take up an unproportionate amount of teacher work hours. With modern technology, we can finally offer an alternative and overcome this old and limiting model.



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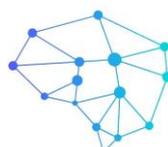
## Co-Teacher – Learning Management That Evolves With You

The screenshot shows the Co-Teacher interface for a course titled 'WAT: Watson AI'. At the top, there is a navigation bar with 'Home', 'Canvas', 'Settings', 'Evaluation', 'Manage', and 'Feedback' menus. The user is logged in as 'Rivo Gmail'. Below the navigation bar, there are buttons for 'Back to list' and 'Edit course'. The main content area is divided into several sections: 'Descriptions' with a course description, 'Teachers' listing two teachers (Rivo Gmail and Teacher Tobi), 'Upcoming deadlines' with three tasks (Submit Learning Diary, Finnish evaluation results, and another Submit Learning Diary), and 'Students list' showing 4 students and missed deadlines. A 'Week 1' section is also visible, containing 'Lecture times' and 'Practice times'.

Picture 1. Course overview as seen from a teacher account in Co-Teacher

The Co-Teacher platform acts as the middle man between teachers and students. Co-Teachers algorithm detects students who are missing deadlines and gives teachers tools to help them in the early stages of falling behind. In addition, Co-Teacher works as a tutor that answers students' questions and helps them find information regarding their studies. It also takes care of tasks like grading on behalf of the teacher, leaving more time for them to improve their pedagogy and be more in touch with students. Because Co-Teacher can independently guide the students through most of a course's practical implementation, schools can teach more students and offer more courses without a corresponding increase in workload and costs. In this way, Co-Teacher improves the quality and availability of education while also saving the money of schools. Communal learning is facilitated on the platform by making it smoother to form and communicate in work groups, and peer-to-peer tutoring is encouraged with credit incentives.

Co-Teacher also offers a selection of integrated tools for general study management. Canvas is Co-Teacher's **course catalogue** inside which course management happens. Students can access the full week-by-week curriculum and receive **automated reminders**, assignments and feedback. Teachers, on the other hand, can update and edit the course contents as well as **track the progress** of individual students. The identification of students in need of help becomes faster, giving students a better chance to receive the support they need before problems compound. **Smart calendar** helps students plan their studies so that they finish their assignments in time and plan their use of time better in general. Calendar helps students to schedule all their studying related activities including deadlines and time spent on assignments and match them with any extra-curricular activities including hobbies, work schedules and enough time to rest and rewind. Students can integrate their personal Google and Microsoft calendars to combine their entries in Co-Teacher.



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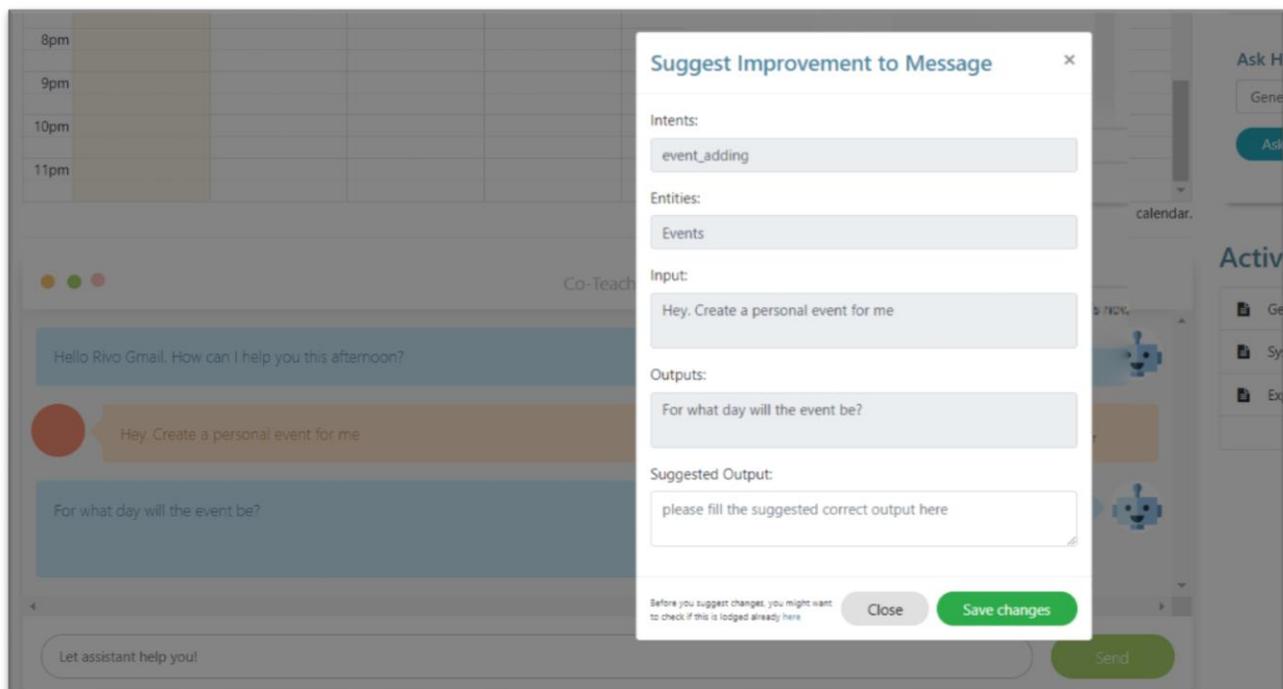
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Co-Teacher also features a **machine learning chatbot**, capable of dealing with the roadblocks and questions that students might have. Because it is backed by IBM Watson's AI, it learns to accurately handle a wide variety of issues. This chatbot makes sure that students get help whenever and wherever, without needing to wait for a teacher to read their email. Easy access to personalized support keeps students motivated, helps them graduate on time and leads to fewer drop-outs. Drop-out detector function contacts the student through chat when deadlines are getting close, but no task has been submitted.

Co-Teacher's chatbot can be automated to make **questionnaires** for students. These questionnaires can be done to either monitor students' progress on the course, get feedback on their studies or to execute midterm examinations. Feedback from the students' progress can be used to adjust teaching during the course to better meet students' needs, improving their ability to learn. Automating midterm examinations reduces teachers' workload and allows students to recapitulate their studies with Co-Teacher.

Another highlight of the platform is a **text evaluation tool**, which gives teachers and students a summary of the main concepts and keywords found in a text or web source. Using the right keywords, teachers can use this tool to pre-evaluate assignments and essays, making the grading process much smoother. This tool is also available to students, who can use it to review academic materials when looking for references to use in their assignments.



Picture 2. Co-Teacher being taught to answer correctly a request to add a new calendar event

Both teachers and students can participate in the **social development of Co-Teacher's AI**. Teachers can input Co-Teacher with the right answers while students can suggest improvements and report answers they think are flawed. To prevent misuse, all these suggestions must go through a teacher or similar admin user before they are validated. This process allows the platform to quickly learn through machine learning, improving its internal logic and becoming ever more accurate in its grading and tutoring.



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## Technical details for Co-Teacher

Co-Teacher is a web-based SaaS platform that incorporates artificial intelligence and machine learning. Co-Teacher is built on custom code based on IBM Watson and Amazon Web Services. In the chart below is a list of the languages and frameworks Co-Teacher uses in its functions:

### Language

- PHP
- JavaScript
- Python
- HTML (plus CSS)

### Framework/Library

- Laravel (PHP)
- VueJS (Js)
- JQuery (Js)
- NodeJS (Js)
- Spacy (Python)
- Laravel Mix
- Laravel Echo

### Databases

- MySQL

### External API Services

- Pusher
- Watson
- Conversation (Now Assistance)
  - Natural Language Understanding (NLU)

- AWS
  - S3, Lamda, Elastic Beanstalk, CloudWatch Logs, SES
- Google
  - Calendars
- Microsoft
  - OAuth, Calendars

### Others (Laravel packages)

- Smarlot PDF Parser
- phpoffice/phpword
- soundasleep/html2text
- spatie/laravel-google-calendar

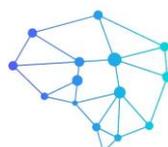
### Others 2 (HTML/CSS/JS) Library

- Bootstrap 4.0
- FullCalendar
- Momentis
- Summernote
- JQueryDatatables
- Bootstrap Clockpicker
- Bootstrap Editable
- Dangrossman Daterange Picker
- NotifyJS

Chart 1. List of languages Co-Teacher uses in its code framework

Our Laravel back-end is connected to the IBM Watson Assistant service, receiving information from the Bluemix conversation model and returning the answers for questions to teachers and students. Users can run internal Laravel functions through the Watson Assistant chatbot using natural language to retrieve specific data from the database, using the extracted entity values as query parameters. Watson NLU API receives students' assignment submissions and extracts the key concepts from the text. Using AWS Lambda for data extraction makes the system capable of handling and analyzing big files without slowing down. Socket connections are used for fast messaging between students and teachers as well as for storing questionnaire answers from chat to database.

Co-Teacher currently stores and handles all data in the EU. Domain of the Co-Teacher website, found at <https://co-teacher.devolon.cloud>, is in the cloud on Devolon's server in Estonia. Data stored by Watson is being stored at an IBM Database in Strasbourg, France. Data in the database is purged every three weeks.



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The Database sends information on natural language understanding to be processed in the Watson Conversation Center in the UK. Data is processed in UK and sent back to France.

In the current Summer 2018 version, Co-Teacher doesn't collect personal information other than the contact information provided by students. Certain student information about their progress is shared to teachers, but otherwise students' data remains anonymous, including any suggestions to improve Co-Teacher's query responses. Additional information on data collection is provided in the Privacy Policy document of Shoulders of Giants Ltd.

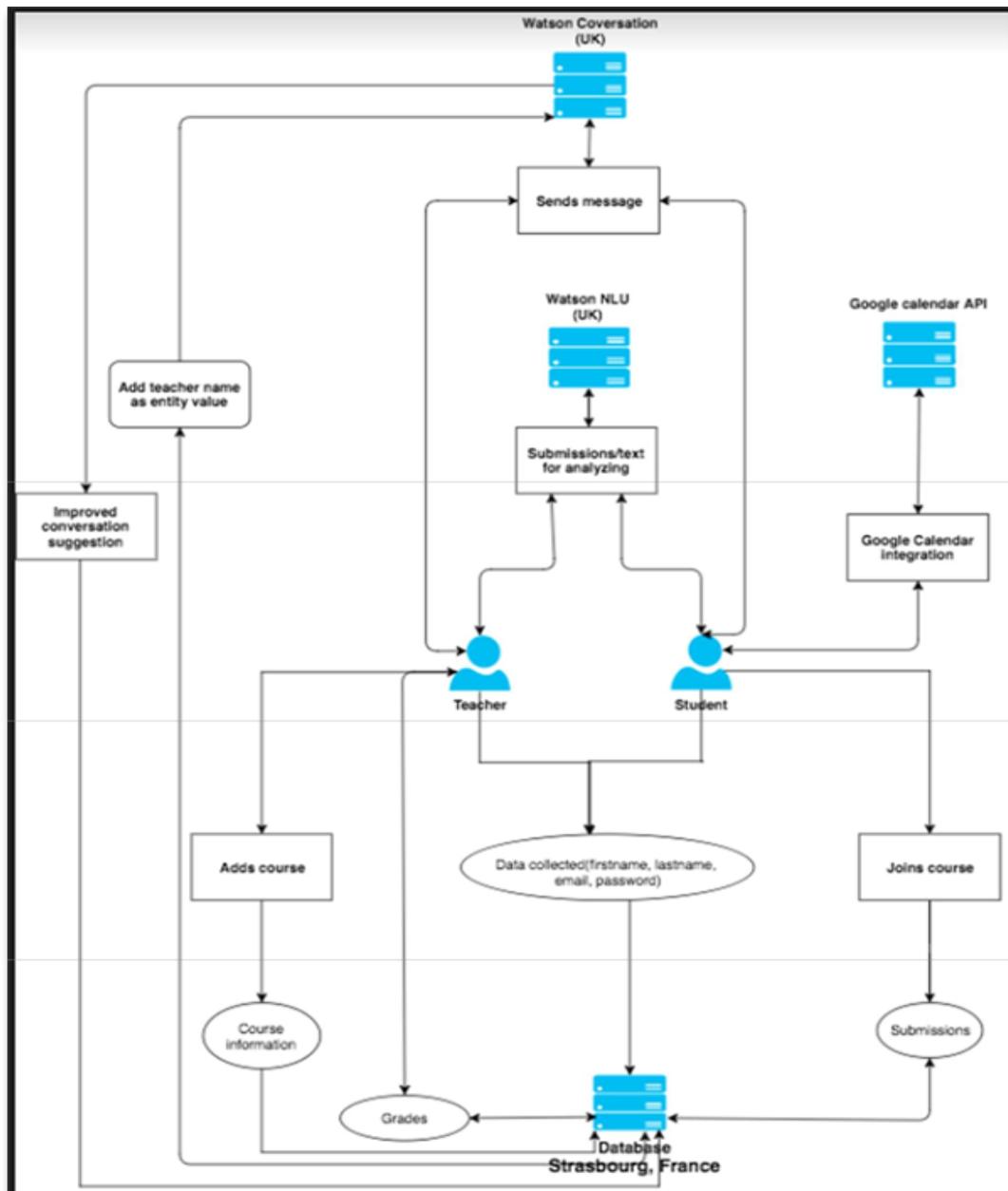
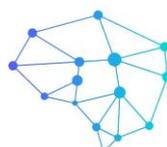


Chart 2. Map of the data flow in Co-Teacher



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## Co-Teacher in Piloting – Intelligence to Educate the World

In current practical implementations, Co-Teacher can run courses either completely or partially online with a high level of automation. Teachers can then put less effort into the mechanical tasks in course management – deadline reminders, FAQs, evaluation and so on. The intelligent chatbot can also take the role of a secondary student counsellor, helping meet the high demand for counselling among students. This way students get instant access to all the information related to individual courses, but also information about their overall progress and options regarding their degree. With this information, they can make smarter decisions when selecting their courses and enrolling on student exchange programs, for example.

This also means that Massive Open Online Courses (MOOCs) can be offered more easily with ready-made content that the students are guided through by automation. Not only can the course sizes grow, but completion rates are boosted through increased interactivity. Course feedback can be collected and dissected with minimal labour both during and after the course, so it can be taken into consideration for pedagogical improvement – even as the course is underway.

Co-Teacher can be piloted either as a complete platform or a set of individually selected functionalities.

### Quantifying the Benefits of Using Co-Teacher

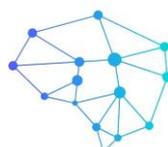
Shoulders of Giants has conducted four pilots with Finnish institutions of higher education to test and quantify the benefits of using Co-Teacher in terms of saving time and reducing costs.

These benefits have been reviewed through qualitative interviews with over 20 teachers and 200 students. Before the pilot, interviews with teachers were carried out to identify key issues that our partners face in their teaching and verify how Co-Teacher can successfully solve them. Students were interviewed to map their current overall motivation and attitude towards studying and the needs they have for management and counseling in their courses. After the pilot, a final report was conducted to evaluate the outcome with our partners.

A reduction of 30-50% was found in the time spent by teachers and assistants on the tasks that can be automated with Co-Teacher, allowing them to address students' personal needs better. Meanwhile, students' completion rates in the courses increased by an average of 20% when compared to historical statistics. Students also showed more commitment in online studies and expressed feelings of improved support in their feedback.

## Get in Touch – Let Us Transform Your Education Together

Currently we are looking to carry out more pilot projects globally, in addition to our current partnerships in Finland. The Co-Teacher is available as a complete management platform, where billing is based on the amount of subscription licenses. Alternatively, it can be tailored for your organization's needs specifically, using only some of the individual functionalities separately and being billed directly for use.



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The platform doesn't aim to be a replacement for all the systems currently being used, but instead works well in conjunction with them. All pilots entail full maintenance, training and implementation support from our end. We offer a project manager and software developers to support you throughout the pilot. We can also help determine the most suitable and beneficial areas for the pilot through qualitative interviews with teachers and other pedagogical staff, crafting the right action plan for you.

If you want to learn more about how we could help you scale your teaching while reducing costs, reach out:

- through our website <https://shouldersofgiants.fi>
- or directly to Ari Kaukiainen, our Head of Sales and Partnerships at [ari.kaukiainen@shouldersofgiants.fi](mailto:ari.kaukiainen@shouldersofgiants.fi)

We would love to answer any questions you have, whether big or small.

We are also interested in piloting Co-Teacher in a B2B context, aiming to develop a similar management platform for employee training programs that businesses have.

Shoulders of Giants has to the moment partnered up with these companies and organizations:

