

## Adaptive learning

Babcock, in partnership with Area 9 Lyceum and the Defence School of Electronic and Mechanical Engineering embarked on a project to bring Adaptive learning to the school for foundation Maths, to focus on functional and foundation maths, where military students were being most impacted by failing, understanding that maths enables and underpins their technical knowledge. With engineering tutors in the capability project team, we saw that many students struggled to understand engineering principles due to the lack of foundation knowledge and understanding in maths. The aim was to enhance learner's base knowledge and understanding and in turn give them the best start on their journey to becoming great Engineers.

Through exploration and research, initially prompted by a high attrition rate at the school, it was found that the lack of a foundation knowledge and understanding of Maths was contributing to a high attrition rate of trainees and a low pass rate. It has been proven that Maths underpins all aspects of engineering and having a sound knowledge and understanding of foundation Maths gives the trainees a firmer platform from which to start their engineering training.

In collaboration with Area 9 Lyceum and their adaptive learning platform, a project was undertaken to evolve the once "one size fits all" approach to foundation delivery into a blended solution, where data and insights are leveraged to provide a 1 to 1 experience where learners are supported to success. This enabled tutors to target interventions exactly where and when they were needed for both individual and groups. With the support to success

The project has delivered the maths pilot to approximately 160 learners at the beginning of their journey to become electronic and mechanical engineers. While the project continues, the current impact seen both tangible and intangible benefits of a reduction in overall failures, over 50% reduction in time to proficiency, increased engagement from learners and the ability for trainers to target learning interventions to challenge, stretch and ultimately support the learners to succeed. Further to this, work is still ongoing to identify suitability for the entire maths career pipeline through to HNC to be delivered as adaptive learning, and collaborative work with sister defence colleges and civil contracts to realise the benefits that adaptive learning brings to training in all engineering disciplines.

The Adaptive learning project not only focussed on the delivery of learning, it also brought in in-depth analysis of both the course design and the assurance of content against measured objectives.

The other side of the insights derived from the Adaptive Learning platform are the learner metacognition, which in day to day learning shows learner confidence levels in the subject, enabling tutors to target interventions around areas of weakness with the added benefit of knowing how confident the learner was with their learning. Aside from metacognition being used for point of need learning, the duty of care staff at the school and the trainees company can also coach learners in their approach towards learning and engineering. A learner who displays high levels of unconscious competence can be coached towards being a more confident engineer, and mirrored to that, a learner who displays high levels of unconscious incompetence can be coached to be a more diligent engineer who is less likely to take risks.

Learners are engaging with a platform with a live capture of 20 data points, which the adaptive platform algorithms use to guide the learner along their unique path to proficiency. As well as the platform being able to flag events that need reviewing by the Trainer, all data is captured and displayed in a "educators dashboard" giving insights into every learner's progress at any given moment, as well as exactly where support is required. This can both be seen as a high level overview, and a detailed view, all the way down to granular learning objectives, to understand exactly where to target interventions, often removing the need for the trainer to draw out of the trainee where they need support.

Due to how adaptive learning content is built, by breaking each key learning point (KLP) into granular learning objectives, every learner is formatively assessed on every granular learning objective. For example, with the subject of imperial/metric conversions, every learner is formatively assessed on all 82 granular learning objectives.

In comparison, in the traditional classroom blended approach, formative assessment progress test results would be available to the tutor after each stage, during the module. This would only give the trainer information on whether the trainee answered a question correctly and was limited to a set number of questions.

The adaptive learning platform is always on, and with the new found wealth of data and insights has driven learning, and the support of learners beyond the boundaries of the classroom, and beyond the boundaries of an 8am to 5pm school day.



The project was initiated and managed by Babcock, whose core project team contained engineering and education SME's. Area 9 Lyceum, being world leaders in the field of adaptive learning and the Defence school of electronic and mechanical engineering who agreed to participate in the pilot knowing that they had a problem with Maths, which had an impact along whole career learning journeys. The first action was to fully define and understand the problem which required deep collaboration and honesty from all three organisations.

Babcock, Area 9 Lyceum and the Defence School all came into the project with a common goal of the betterment of trainee engineers, in both their subject matter and lives beyond learning. As a result of the metacognition insights available to the school, their support of learners beyond the classroom gained benefit from a new data source.

At the time of the pilot phase of the project, Covid-19 had become a driving factor in reducing the face to face exposure between cohorts and tutors. This accelerated the pilot phase and deepened the collaboration between Babcock and the School. As well as effectively delivering Maths through adaptive learning, with Area 9 making the necessary live tweaks to the platform, the school became more engaged as they were seeking to leverage every opportunity available to deliver remotely while maintaining duty of care of the learners.

With understandable difficulties with working within a defence environment, many aspects of what would be a straightforward integration within a civil sector, needed deep conversations with military stakeholders to enable the effective and efficient roll out of the project pilot.

Although benefits borne from the adaptive learning pilot are still being discovered and measured, the core achievements of the project can be split into four distinct areas that have been a catalyst for further innovation:

1. Against measurable existing outcomes, the path to proficiency has overall been shortened by more than 50%. What was traditionally a "one size fits all" classroom based learning experience due to time and staffing constraints, it's now delivered at a pace to suit the learner's needs, with supporting data insights enabling targeted interventions, ensuring tutor support is at the point of need. This has reduced waste, and increased learner and tutor engagement and satisfaction. Traditional classroom based delivery of the maths package was around 26 hours, whereas average time to completion of the Adaptive Learning package is 8 hours, 20 minutes, with 12% of learners completing the package in less than 6 hours.
2. Along with all learners reaching 100% proficiency within the guided learning hours, a second order effect was both measured and noted. Learners going on to the next phase of their STEM training were seen to be more confident and better prepared for learning. With an increase in grades measured in their subsequent modules. Proving the initial driving concept that maths underpins engineering.
3. Being able to measure the metacognition of learners has enabled them to be coached to be more receptive to learning and more confident in their own abilities. The adaptive learning platform through approximately 20 live data points can accurately measure a learners confidence levels, which has enabled the school to coach learners into making better and more considered decisions, as both engineers and members of society. This is something that has gone beyond the subject of maths and works towards the betterment of the individual learners and the team as a whole.
4. The innovation involved in the development and deployment of the adaptive learning platform has exposed many connected areas for development and improvement that were previously unidentified. This included finding circa 60% of maths KLP's being present in subsequent modules through the training pipeline at the school, and through further collaboration, identifying almost identical instances and issues at sister defence colleges, who are now engaged with the project team.

In summary, the adaptive learning project, although initially brought about to increase the base level of foundation maths, giving the learners a better place to start their engineer training from, has shown many more benefits and highlighted many more areas for improvement that were not previously considered. The initial aims were to reduce the attrition rate at the college and increase the pass rates in maths. Although other effects were initially secondary, the adaptive learning maths projects has shown that learners can thrive within the learning environment and be supported to reach their true potential. Tutors now have a deeper sense of purpose by targeting exactly where their support is needed and directly seeing the quantifiable benefit of their action through data insights. For course design and assurance, having every learner formatively assessed on every granular learning objective also provides instant and ongoing feedback on the performance of learning material.



The success of the project has been a catalyst for a deeper understanding of the maths and career pipeline, and the collaboration across the defence engineering colleges. The establishment has embraced the need for further innovation and the evolution of the learning ecosystem.

The Adaptive Learning Engineering Maths project has provided evidence that a UK based defence engineering contractor has effectively collaborated with an international SME, to deliver a solution to the UK military. The solution has solved a deep issue within, which shows the betterment of the engineering students who are being trained, and ultimately the UK tax payer.

Through this project, the collaboration has grown, with sister defence schools now taking parts as well as parts of Babcock's civil sector. Realising and sharing the benefits of not only the solution, but how collaborative effort can win the day.