MALTA REVIEW OF EDUCATIONAL RESEARCH

Volume 18, No. 2, 368-387
Faculty of Education©, UM, 2024

An AI Pilot Bootcamp Exploring the Creative Relationship of Us and Tech

Vanessa Camilleri
University of Malta
Vanessa.camilleri@um.edu.mt

Christian Colombo
christian.colombo@um.edu.mt

Stephen Bezzina
stephen.bezzina@um.edu.mt

Marouska Vella Bugeja
marouska.vella-bugeja.07@um.edu.mt

Carl James Debono
carl.debono@um.edu.mt

Abstract: As artificial intelligence continues to make its way into virtually all aspects of our lives, it becomes increasingly important for upcoming generations to understand their relationship with technology - not simply as passive consumers, but also as creators able to properly harness its power while fully aware of its limitations. Through an exploratory bootcamp for adolescents focusing on creative, philosophical and ethical aspects of artificial intelligence, we have piloted a curriculum which aims to explore the relationship between humans and technology through thought-provoking questions, while offering practical hands-on challenges and room for independent exploration for all abilities in the classroom. This article presents the design process of the curriculum and the pedagogical approach, including practical concerns and adaptations needed for execution. Furthermore, it reflects on lessons learnt and condenses the outcome of the pilot bootcamp into a learning framework, especially relevant for technology bootcamps aiming to provide an enjoyable yet thoughtful and formative experience.

Keywords: Bootcamp; technology; artificial intelligence; framework.

Introduction

Operating within the University of Malta, a mostly publicly-funded institution, the Faculty of Information and Communication Technology (ICT) serves as a major provider of higher education to meet industry's needs. As such, it is acutely aware of the mismatch between the number of yearly ICT graduates and the demands for technical human resources by industry. Yearly, numerous staff members visit schools to encourage students to choose STEM subjects. Through career expos and other activities all year round, primary and secondary students are presented with hints of what studying technical subjects could look like. Yet, we feel that these piecemeal approaches do not really give a clear and lasting impression of the true picture.

During information sessions, we repeatedly encounter students who may be avid users of technology but cannot really understand what goes on in the creation of apps and devices they interact with. It is in this context that the Faculty of ICT started considering providing a more immersive and interactive experience for young learners who want to experience technology from the creation/creative perspective. Coupled with this, we are aware that Artificial Intelligence (AI) is gaining momentum internationally as well as locally, and its impact on society at large, as well as the global economy could be rather significant.

In 2019, the Malta AI strategy was published, aiming to become 'The Ultimate AI Launchpad' by 2030. This strategy is supported by a series of actions that had to be undertaken between 2019-2023, one of them being to "Build awareness amongst the general population of what AI is and why it is important" and to "Build awareness of AI amongst students and parents".

Against this backdrop, the Faculty of ICT started a collaboration with the Malta Digital Innovation Authority (MDIA) by proposing a pilot summer bootcamp for Maltese preteens to foster curiosity and engagement with the creation of technology-based tools and applications, as well as bolster their AI literacy journey. This collaboration was spurred on by the MDIA's dual role as a government entity which acts as a regulator, and also a promoter of innovative technology.

The rest of the article goes through the design process of the bootcamp, taking into consideration the goals that guided our thinking while providing an

overview of the lesson plans and the hands-on material used in practice. Next, in Section 3, we provide an outline of the practical considerations and adaptations needed to execute the bootcamp. The section concludes by reflecting on the conclusion of the bootcamp through an award ceremony and feedback collection for evaluation. Taking our experience into consideration, Section 4 proposes a learning framework which could serve as a blueprint for similar future initiatives.

Designing the Summer Bootcamp Curriculum

With the idea of introducing students to ICT and AI, particularly those who might not otherwise have the opportunity to, the two main goals were to: 1) make it accessible to all (i.e. assuming no prior technical knowledge); and 2) keep the fun element high on the agenda. Therefore, we combined a hands-on experience through which students could create their own applications, while also giving it a philosophical element to fuel the students 'curiosity. This is how the idea of "Exploring Intelligence - A Bootcamp on Us and Tech" was conceived with the tagline "Curiosity at play, creating an app everyday".

Curriculum Design

The bootcamp curriculum was planned to spread over five days with a total of three-and-a-half hours of sessions each day, with the main idea being to ask a series of questions which guide the contents of the course: "What is 'human ' and 'natural 'versus 'artificial'?", "How do we use technology to help us reach our goals?", "Are there limits to technology?", and "What can go wrong?".

The following expands on what the curriculum proposed for each day.

Day 1: What is Real?
The first question the students are presented with is "What makes us human?". It is a profound philosophical question which is crucial to consider if one wants to explore the boundaries of "natural" vs "artificial" and eventually to attempt to answer the question "What is technology?".

In terms of the learning objectives, by the end of the day, participants were expected to:
(i) clearly articulate the differences between "natural" and "artificial" by providing specific examples from their daily lives;

(ii) explain the philosophical concept of "What makes us human?" by referring to key ideas discussed during the day;
(iii) formulate a personal definition of "technology" based on the exploration of its boundaries in relation to natural and artificial constructs;
(iv) identify applications and uses of AI in the world around us.

Day 2: Finding Patterns Around Us

Pattern recognition is a primal ability which animals and humans have depended upon to survive and thrive in the world. In this sense, it is something very "natural" and yet it is also something we have been successful at "teaching" machines to do proficiently in an "artificial" way. Students on the second day see that once one has the ability to recognise patterns, one can classify objects, distinguish between language symbols, and even differentiate between winning and losing game plays.

In terms of the learning objectives, by the end of the day, participants were expected to:
(i) demonstrate the ability to identify patterns in various contexts, such as in nature and language symbols, and explain the significance of pattern recognition in daily life;
(ii) differentiate between natural pattern recognition abilities in humans and the artificial pattern recognition capabilities of machines, providing examples for each;
(iii) utilise their pattern recognition skills to program a machine to classify objects, distinguish between different language symbols, and predict game outcomes based on observed patterns.

Day 3: Teaching Machines to Talk & Play

Building on the previous day, students are invited to employ pattern recognition algorithms using machine learning techniques to develop more advanced applications, taking more inputs such as a camera feed into account. This brings up the question of "what is intelligence?" and hence "what is "artificial" about artificial intelligence?", "Can machines fool us into thinking they are human?".

In terms of the learning objectives, by the end of the day, participants were expected to:
(i) articulate a basic understanding of "intelligence" and differentiate between natural human intelligence and the constructs of artificial intelligence;

(ii) apply simple machine learning techniques to develop applications that utilise pattern recognition algorithms, specifically integrating inputs from the camera;
(iii) critically assess scenarios where machines might appear "human-like" in their interactions, such as during gameplay, and discuss the implications and limitations of machines potentially fooling humans.

Day 4: Can Things go Wrong?
On the fourth day, after having seen the potential of technology, students are encouraged to ask more sobering questions: "What if the outputs of the algorithm are wrong?", "Are there or should there be limits to technology?", "Which decisions should or shouldn't be taken by machines?", "How does all this affect us?". After this day students will be able to modify the training data of the algorithm and observe how this influences the output of the algorithm.

In terms of the learning objectives, by the end of the day, participants were expected to:
(i) explain the potential limits of technology, discussing scenarios where human intervention is essential and where machines might not be the best decision-makers;
(ii) critically evaluate the outputs of an algorithm, identifying potential inaccuracies or biases, and discuss the implications of incorrect algorithmic decisions;
(iii) demonstrate the ability to modify the training data of an algorithm and effectively analyse and describe how these modifications influence the algorithm's output;
(iv) evaluate any ethical considerations which should be discussed when making use or providing AI systems in the world around us.

Day 5: My Own Technology and App
The last day of the summer bootcamp provides students the space to explore their own creativity based on what they would have done during the previous days.

In terms of the learning objectives, by the end of the day, participants were expected to:
(i) integrate and apply knowledge and skills acquired from the previous days to conceptualise and design an app of their choice;
(ii) create a basic prototype of their own app, showcasing their personal interpretation in terms of creativity and technology;

(iii) effectively present their app to peers, articulating its purpose, functionality, and the inspiration behind it, while also reflecting on the potential ways forward.

Lesson Plans and Hands-on Material

In the rapidly evolving world of technology, and in particular AI, theoretical knowledge alone is insufficient. For true comprehension, especially among younger learners, a hands-on approach is paramount. Engaging in practical exercises and projects not only solidifies understanding but also sparks curiosity, fostering a deeper connection with the subject matter. Recognising this, our bootcamp heavily emphasised experiential learning, ensuring that students didn't just learn about AI, but they in fact experienced it.

To facilitate this immersive learning experience, we used two cutting-edge educational platforms: Machine Learning for Kids (https://machinelearningforkids.co.uk/) and HatchXR (https://hatchxr.com/), together with other relevant online resources. Both platforms are designed with young learners in mind, offering intuitive interfaces and tools that demystify complex AI concepts. Machine Learning for Kids provides a foundation in core AI principles using relatable, kid-friendly exercises, where the students understand and grasp the concept of learning models whilst being exposed to a hands-on experience of how to train, test and make use of pre-trained learning machines. On the other hand, HatchXR was utilised to empower students to venture into the realms of augmented and virtual reality, bringing their AI insights to life in three-dimensional spaces. We also considered using the MIT App Inventor (https://appinventor.mit.edu/) to enable students to deploy apps on their phones. However, after experimenting with the technology ourselves, we discovered potential compatibility issues with a smartphone brand.

Throughout the bootcamp, these platforms served as our digital playgrounds, spaces where abstract concepts transformed into tangible projects, and where students could construct their artefacts in real-time. The following are the specific activities undertaken using these platforms, showcasing the breadth and depth of our hands-on curriculum.

Day 1: The first day of the bootcamp focused on introductions to AI. The questions and the tasks were designed on philosophical thoughts that were also disguised as fun, interactive activities. The theme of what's truly real, and

whether machines understand something beyond our world, was woven into the activities available on the "Machine Learning for Kids" platform, where students trained a model to decipher an alien language, blurring the lines between fiction and a reality we could potentially create. Next, the "Emoji Masks" activity used machine learning to translate facial expressions into emojis, showcasing how AI can interpret the subtle nuances of human emotion.

Throughout these exercises, we transitioned from theory to practice. More than speaking about AI, we were attempting to have our young participants deduce some of the power wielded by AI tools. Furthermore, we introduced the students to "HatchXR," a platform for building 3D worlds, experiencing firsthand the potential of technology to create immersive realities. The first day curriculum thus aimed at how AI shapes, and perhaps even reshapes, our perception of the real world.

Day 2: Day 2 delved deeper into the concept of pattern recognition, a fundamental skill that humans have relied upon for survival. The day's activities were designed to highlight the natural instinct of recognising patterns and how this has been translated into machine learning. The "Machine Learning for Kids" platform was again employed, starting with the "Snap!" activity. Here, students explored the basics of coding and computational thinking, reinforcing their ability to identify and utilise patterns in a digital environment. The "Virtual Pet" activity further emphasised pattern recognition, as students trained their virtual pets based on certain behavioural patterns. To expand their hands-on experience, students were introduced to Google's "Teachable Machine" (https://teachablemachine.withgoogle.com/). This platform allowed them to quickly train a machine, using images, sounds, or poses, offering a more advanced and interactive exploration of pattern recognition in AI. Through this activity students started discussing the concept of data samples, how the volume of the dataset affects the performance of the model and how confidence levels are produced depending on the training dataset provided. During the last session, students worked with “HatchXR” to add dialogues to their characters, whilst recognising and collecting patterns inside the 3D-world.

Day 3: On the third day, the bootcamp built upon the foundational knowledge of the previous days, shifting focus to the application of pattern recognition in human-machine communication. The day was structured to help students grasp how machines can be trained to understand and respond to human

language and actions. The "Machine Learning for Kids" platform was central to this exploration. The "Quiz Show" activity was the first on the agenda, where students designed quizzes that utilised machine learning to evaluate answers, within a playful environment. This activity emphasised the potential of machines in assessing and responding to human supplied inputs. The subsequent "Chatbot" activity provided students with a firsthand experience in training a machine to converse. By inputting various phrases and responses, students observed the intricacies of human-machine communication. These activities aligned with the day's objective of understanding the nature of intelligence and discerning what makes artificial intelligence "artificial". During the final session, students learnt about 3D interactive stories in "HatchXR" and built their own narratives inside the gameworld.

Day 4: the fourth day of the bootcamp focused on the critical examination of AI, addressing its potential pitfalls and the ethical considerations surrounding its use. The day's curriculum was designed to make students ponder on the accuracy, biases, and decision-making capabilities of algorithms. Using the "Machine Learning for Kids" platform, the "Fooled" activity was introduced first. This activity allowed students to experience how algorithms can be misled or manipulated, emphasising the importance of unbiased and accurate data in training models. The subsequent "Explainable AI" activity provided insights into the inner workings of algorithms. Students were encouraged to explore the reasons behind specific AI decisions, fostering a deeper understanding of the decision-making processes of machines. Through these activities, students were encouraged to elicit how dataset biases can affect the final performance of the model, thus how results still depend on data on which the model was trained on. These activities directly align with the day's theme: understanding the potential inaccuracies in algorithmic outputs and the broader consequences these inaccuracies can have on real-world decisions. By the end of Day 4, students not only gained a critical perspective on AI but also had the opportunity to work with "HatchXR" to experiment with basic coding principles in designing simple games within virtual 3D environments. They could now apply their newfound understanding of data and AI to create interactive experiences within their chosen environments.

Day 5: The concluding day of the bootcamp was dedicated to creativity, allowing students to integrate their learnings from the previous days and channel them into personal projects. The day was structured to empower students to envision and design their own app, using any platform or media of their choice. Students were given the freedom to brainstorm, conceptualise,

and outline their own technology-enhanced creations. They were allowed to adopt and put into practice what they learned in the previous days. Students could choose whether to develop their creation on "Machine Learning for Kids" or on "Hatch XR". This hands-on approach ensured that students not only understood AI concepts but could also apply them in practical scenarios. Collaborative sessions were encouraged, where students could share their ideas, receive feedback, and refine their concepts. By the end of Day 5, students had successfully integrated their knowledge, showcased their creations, and presented their unique interpretations of AI and technology, fulfilling the day's objectives of synthesising previous learnings, demonstrating creativity, and effectively presenting their concepts to peers. Discussions as to how their works could be further developed and/or improved naturally arose during the student presentations, enabling exchange of ideas and peer to peer learning.

Bootcamp Execution and Adaptations

Practical Considerations

Whilst we had practically a free hand when it came to curriculum design, our choices were more restricted when it came to the budget, the labs, and the rest of the available infrastructure. While the bootcamp was largely funded by MDIA and a small registration fee was implemented to promote participant commitment, unfortunately, there were still a few instances of no-shows.

The Faculty of ICT building and equipment available offered some constraints and limitations. The building consists of three floors of offices, labs, and meeting rooms spread over two connected blocks, each with an internal yard. Two labs were identified for use during the bootcamp, each having 15 machines to be shared amongst 30 students. Throughout the bootcamp, the building was still open for staff members and university students, however it is usually rather quiet during the summer months. The main concern was to ensure that the bootcamp participants were constantly supervised and that they could not leave the area designated for them. This was facilitated by the choice of labs in close proximity to each other, containing participants to one floor block of the building.

We prioritised inclusivity by providing multiple access points. Students were encouraged to bring their own mobile devices with a designated WiFi network for their convenience. Additionally, faculty computers were available for those who preferred not to bring a device or who did not possess a mobile device.

With this setup at hand, we opened applications for a maximum of 60 students and given the hands-on nature of the planned activities, we opted for a ratio of one educator for every six students. This meant that each of the two lecturers delivering and coordinating the sessions in the respective labs had four assistant tutors offering students more personalised support.

Given the time allocation for each day, we opted to split the day into three 75-minute sessions, with two breaks of 20 minutes each in between. This was done to help students take a mental break from their work and refocus their attention to the tasks at hand. During the break, students were given the option to either move to a communal indoor space or to the outdoor yard of the block. In each case, students were supervised and accompanied by the assistant tutors.

Material Adaptation

While the initial curriculum design served as the blueprint for the week of activities, we made adaptations to the circumstances as required and the material from platforms like "Machine Learning for Kids" and "HatchXR" served only as a foundational guide. In fact, it was essential to ensure flexibility in the pedagogical approach to this bootcamp by enabling an adaptive teaching methodology, where co-teachers played a pivotal role in customising the learning experience. They closely monitored each student's progress, identifying their strengths, areas of improvement, and unique learning paces. Based on these observations, co-teachers provided tailored guidance, ensuring that every student, regardless of their prior knowledge or learning speed, felt included and engaged. This approach not only fostered a more inclusive learning environment but also empowered students to take ownership of their learning journey. They were encouraged to ask questions, explore beyond the set curriculum, and delve deeper into areas of personal interest. In essence, the material was not a rigid framework but a fluid guideline, adaptable and responsive to each student's needs. Through these adaptations, the bootcamp ensured that learning was not just about absorbing information but about nurturing curiosity, confidence, and a genuine passion for AI.

Most of the time, students were provided with a guided worksheet to help them develop their creation, with tutors available to offer assistance when needed. Some worksheets had an extension for those who had high achieving abilities and wanted to go a step further, thus allowing a better challenge even to those who excelled in the creativity of such applications. Similarly, higher

level tasks were given to some students when they already knew a great deal about the topics covered by Scratch and "Hatch XR." This was done to make sure that all students continued to gain from the experience. As a result, there was no need for students to adhere to a strict curriculum; instead, they could learn at their own speed and regularly expand their knowledge according to their interests and comprehension levels. This also played a crucial role in attaining the objectives of these sessions of learning through discovery.

Working in pairs gave the students the opportunity to see firsthand how cooperation and sharing of ideas can result in a more engaging and dynamic programme. It was evident that each pair discussed various design and narrative perspectives, demonstrating the greater variety that can be produced when creative ideas are combined and generated.

Certificate Award Ceremony

To celebrate the work of the students, we organised an award ceremony at the end of the bootcamp week. During the ceremony, we took the opportunity to explain the rationale behind the curriculum covered during the week, as well as the overall aim of helping students in their journeys in topics such as technology, AI, and ethical thinking. The highlight of the ceremony was a five-minute video showing instances from the week during which they were immersed in their activities. The positive response and the enthusiasm shown by the students and their parents during the award ceremony, continued to assure us of the positive experience that students had during the week.

Students were given a certificate of participation as well as an Informal Education Certificate accredited by the Directorate for Quality and Standards in Education, Ministry of Education and Employment as well as the National Commission for Further and Higher Education Malta. This official accreditation was considered important by the parents as well as the students attending the bootcamp.

Feedback Received and Lessons Learnt

While we were continually open for feedback throughout the bootcamp, adapting as necessary, on the last day we provided an online form for parents and students to optionally give us their feedback in writing. 21 online forms were received. The feedback was overwhelmingly positive with overall satisfaction scoring an average of 4.57 out of 5. From the comments it seems

that the most appreciated aspect of the bootcamp was the fact that students had the opportunity to explore on their own by creating their own app/game with 14 out of 21 respondents mentioning it as the aspect which their “son/daughter enjoyed the most''. The suggestions given in the feedback mostly revolved around having “more time”, either in terms of longer days, more days, or providing other bootcamps throughout the year and/or different areas of Malta. On the improvement side, we received two key pieces of feedback. One parent felt communication with parents was "last-minute" at times, and another student found the internet registration process cumbersome. For future bootcamps, we've developed a clearer communication schedule to address the first point. Regarding internet access, we were aware of limitations with personal devices and for this reason opted to provide access to on-site machines for all participants as a backup. However, we're actively exploring solutions for easier-to-use internet connections in the future.

The significance of "off-screen" time, as recommended by health authorities, is often overlooked by young adolescents. This involves taking a physical break after a set amount of time spent in front of an electronic device to avoid eye strain and for overall physical and mental health. In fact, it was observed that most students opted to remain indoors during both breaks, using their personal portable devices—such as laptops or tablets—while maintaining their mealtime habits. Taking good care of oneself is another crucial component that needs to be emphasised in technology education. It was therefore discussed that in order to encourage students to take a real break from their devices, physical activities should also be offered at future events of a similar nature. It was also proposed that students attend an educational session regarding the significance of these breaks for their everyday lives as a whole.

The bootcamp's success suggests a strong appetite for such programmes. In the future, we can explore creating a more personalised approach to cater to a wider diversity of abilities and learning styles.

The positive response to the game-creation activity suggests it could be a valuable element to include in future bootcamps. We can explore how to expand on this concept to further engage students. By incorporating these learnings, future bootcamps can offer an even richer and more inclusive experience for young learners.

Best Practices and Recommendations

Based on the lessons learnt from the first execution of the summer bootcamp as a pilot study, this section teases out the best practices and recommendations from the experience.

Perhaps the most central aspect of our approach was to design a curriculum that could be adapted to the young learners 'needs whilst at the same time moving away from the traditional teacher-centred classroom approach. Recent studies highlight that effective youth education hinges on adapting teaching and educational practices to the diverse cognitive and socio-emotional growth patterns of young learners (Codding, 2021; Tomlinson, 2017). This necessitated that we adopt practices that whilst offering guidance, the young bootcamp participants were encouraged to use their own initiative and creativity as much as possible.

Concurrently, the ubiquitous role of AI in various sectors necessitates skills that transcend age and technical know-how. The ability to differentiate between real and artificially generated information, along with valuing human traits in an AI-dominated world, are new literacies. These skills extend beyond traditional academic boundaries, rooted in observation of the real world and critical thinking about the surrounding environment and context. Such competencies are vital in levelling the knowledge and skill disparity across societies, especially those that are very heavy on curricular and exam-driven practices.

Educational Best Practices in the AI-Driven Landscape: A Comprehensive Framework

Designing and building a framework for best practices that works in a flexible learning environment necessitates an analytical approach grounded in real world examples and pilot studies.
Figure 1, illustrates the framework that emerges from the bootcamp pilot study's list of recommendations for designing the most effective approach towards stimulating curiosity, initiative and supporting problem-solving skills. The framework below places the Wellbeing of the student at the core, expanding towards finding a Balance between the physical state of the learner and the drive to be actively engaged with technology. This gives rise to a more Active and participative learning, that is then framed within the Technology

Challenge. In this case, the challenge aimed to spark curiosity in the world of Artificial Intelligence.

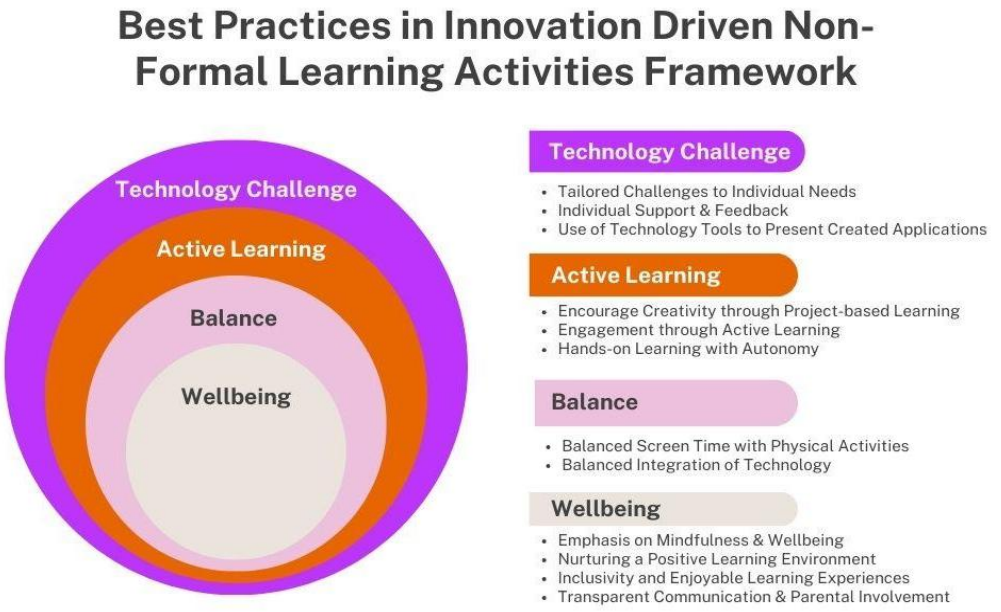

FIGURE 1: PROPOSED FRAMEWORK FOR INTEGRATING BEST PRACTICES IN INNOVATION DRIVEN NON-FORMAL LEARNING ACTIVITIES

Wellbeing

Emphasis on Mindfulness and Well-Being: Incorporating practices like meditation and mental health discussions helps students develop self-awareness and coping mechanisms, addressing the unique stressors faced by 11-13-year-olds (Tatter, 2019). While the bootcamp did not include such mindfulness activities, the educators felt that having a set time when students would switch off from the screen and find the time for reflection, would have been of benefit. This was one of our recommendations for inclusion in upcoming bootcamp activities with children.
Strategy: Incorporate practices that support mental and emotional health.
Application: Integrate mindfulness activities, stress management workshops, and discussions on digital well-being.

Nurturing a Positive Learning Environment: Creating a supportive, inclusive classroom culture is essential for socio-emotional development (Jennings & Greenberg, 2009). Emphasising open communication, empathy, and self-reflection, especially in discussions about technology, promotes interpersonal skills and emotional intelligence.
Strategy: Create a supportive, inclusive atmosphere that encourages risk-taking and learning from failure.
Application: Cultivate a culture of respect, encouragement, and constructive criticism.

Inclusivity and Enjoyable Learning Experiences: Engaging students in enjoyable, playful activities enhances intrinsic motivation and participation (Robinson, 2023). However, planning for activities that are not built on expectations of previous knowledge creates a more inclusive environment that bridges the digital divide that is sometimes more apparent in digital literacy associated skills (Nguyen et al., 2020). The bootcamp activity's strategy was that of proposing activities that were flexible enough so that the participants could adapt them to their knowledge. However, there are future thoughts of including some elements of gamification such as badges in such informal learning activities.
Strategy: Design learning experiences that are accessible and enjoyable for a diverse range of learners.
Application: Use a variety of teaching methods to cater to different learning styles and ensure content is culturally sensitive and inclusive.

Transparent Communication and Parental Involvement: Keeping parents informed and involved in their children's education builds trust and community, enhancing the learning experience. For the bootcamp activity such parental involvement proved to be essential to provide information about the children's previous experiences and thus help us align the activities more to their needs. The communication was further aided through a daily email which summarised the work done during the day, and provided additional tasks and activities which the participants could choose to further work on when at home.
Strategy: Maintain open lines of communication with stakeholders, especially in contexts involving younger learners.
Application: Regular updates, workshops, and feedback sessions with parents or guardians to keep them informed and involved.

Balance

Balanced Screen Time with Physical Activities: Integrating physical activities with digital learning is essential for a well-rounded development, promoting both mental and physical well-being (Mathew, 2023). Educators and assistant tutors remarked how the children were choosing to keep watching the screen, either mobile or laptop, even during the break times. Some children opted to keep working on their projects, others opted to log on to social media platforms, whilst others were happy to play mobile games or watch videos. It was observed though that very few children opted to interact socially with the others during this time, and only about a third of the entire group (n=60), opted to have their break outdoors in the yard. This is another of our recommendations for the next iteration of the bootcamp.
Strategy: Create a schedule that balances digital learning with physical movement.
Application: Integrate short, frequent breaks for physical activity and ensure sessions are not overly prolonged.

Balanced Integration of Technology: The bootcamp's name was "Exploring Intelligence - A Bootcamp on Us and Tech", and this meant that not all activities had to include a technology component. Rather, a number of activities took on the format of a discussion with philosophical undertones. We advocate for purposeful technology use, embedded in meaningful activities, which has been found to enhance learning while avoiding overshadowing the true purpose of learning. On the other hand, studies have also found that where technology use was not embedded in purpose, interest and engagement were affected negatively (Calvo-Porral & Pesqueira-Sanchez, 2022; Consoli et al, 2023; D'Angelo, 2018).
Strategy: Utilise technology to enhance learning without it becoming the sole focus.
Application: Blend traditional teaching methods with technological tools, ensuring tech serves as a facilitator, not a replacement.

Active Learning

Encourage Creativity through Project-Based Learning: Allowing students to create their own tech projects fosters creativity, accomplishment, and pride (Jalinus & Syah, 2023). During the bootcamp activity, each student group was assigned to develop their unique project, to be later presented to their peers. This approach not only fostered their creativity in the development of their

projects but also increased their motivation to deliver a presentation that represented their efforts.
Strategy: Embed creative problem-solving within project-based learning.
Application: Assign projects that require critical thinking, innovation, and collaboration, allowing learners to apply concepts in practical scenarios.

Engagement through Active Learning: The bootcamp vision was built around the concept of active learning (Prince, 2004), where young participants were exposed to a problem or a quest and they had to build their own experiences into solving the challenge they were set. This was found to be particularly effective for the age group of the young participants, and it could accommodate for the flexible project-based approach of our planned curriculum.
Strategy: Incorporate experiential activities that require active participation.
Application: Design sessions with interactive discussions, group problem-solving, and real-world case studies.

Hands-on Learning with Autonomy: The bootcamp activity through its active learning approach was focused on providing practical, problem-solving activities, whilst allowing students to choose projects that aligned better to their interests. Whilst all the activities proposed, aimed to support creativity and problem solving, the methods and approaches differed to allow for diverse learning styles and experiences.
Strategy: Foster a learning environment that encourages exploration and self-directed learning.
Application: Provide resources and tools for learners to undertake projects or research independently, with guidance available as needed.

Technology Challenges

Tailored Technology Challenges to Individual Needs: Recognising individual learning styles and needs is paramount. Although the group was split into two in a randomised way, the initial activities that were given throughout the first day served to identify learners with different motivations and aspirations. This allowed for more tailored activities as well as flexible pacing. Assigning assistant tutors to help the main educators offer a more personalised experience is important to assure the success of such a flexible approach.
Strategy: Implement adaptive learning systems that analyse individual learner profiles and performance data.
Application: Use technology to customise content and pace for each learner, ensuring materials are challenging yet achievable.

Use of Technology Tools to Present Created Applications: Using presentations to display student's work is an effective way of engaging learners and motivating them to create work which they would be proud to display. We dedicated a substantial amount of time during the final day so that each group could present what they did in any way they wanted. They were not asked to make use of any specific tools, but they could use any which they were familiar with or simply just illustrate their application without the use of any additional tool.

Strategy:

Incorporate diverse technology tools to enhance the presentation of student-created projects.

Application:

Integrate training on technology tools such as presentation software, video editors, and interactive platforms into the curriculum.

Focused Individual Support and Feedback: Providing personalised feedback and allowing self-assessment opportunities can significantly impact middle school students' emotional support and academic growth (Hattie & Timperley, 2007). The role of assistant tutors helps in providing timely support throughout the activities and maintains a suitable educator-to-student ratio. The bootcamp's vision was that of providing this support to ensure a safer and a more learner-centred environment.

Strategy: Ensure timely, personalised feedback and support.

Application: Use a combination of peer, mentor, and instructor feedback mechanisms to address individual needs.

Conclusion

In December 2023, the European Union member states agreed on the first ever comprehensive EU AI Act to provide regulation and guidelines for industries, enterprises and governments integrating AI in their products and services to support and protect individuals from any harm that such technologies may cause. However, it is also up to the individuals to educate themselves in the correct use of AI technologies. Such a level of AI literacy is at the core of the success of these technologies. Individuals who are literate in the use of AI technologies will be equipped to protect themselves as well as others from harm, but will also be empowered to maximise the tools 'potential so as to improve their quality of life and wellbeing as well as that of other individuals.

Against this backdrop, the timing of a bootcamp for adolescents focusing on AI, is propitious. Rather than simply being relegated to blindly consuming technology, young members of our society need the necessary tools and awareness to navigate an increasingly complex technological landscape. Far from simply opening up job opportunities for these youngsters, such knowledge and understanding is crucial for the future of our democracies, substantial parts of which are being played out on digital platforms governed by AI algorithms.

We feel that the overall outcome of the first execution of this bootcamp on AI was an extremely positive one: It was beneficial for the students as well as us educators because it allowed us to observe firsthand how adolescents can explore and learn on their own given the right guidance. By showing pupils the value of creativity, they felt empowered to express their creativity through their work. In the process, students could better grasp how artificial intelligence is not just the robotic, artificial machine they had imagined, but requires significant involvement in several aspects - from the choice of the data input, to the underlying models and algorithms, to the interpretation of the output and the ethical implications of the whole process. This also made the participants aware of the huge implications that such tools have on our daily lives - both positive and negative.

To ensure that AI-driven education benefits a wider spectrum of society, extending these educational practices to various age groups and diverse backgrounds is crucial. In the coming years, we aim to be able to oversee a number of instances of the summer bootcamp within different contexts and communities around the island.

References

Calvo-Porral, C., & Pesqueira-Sanchez, R. (2022). Does the use of technology create technology engagement? Comparing three structural models. Spanish Journal of Marketing-ESIC, 26(3), 385-404.

Codding, Diane, et al. (2021). "Computing for communities: Designing culturally responsive informal learning environments for broadening participation in computing." The Journal of applied instructional design 10.4.

Consoli, T., Désiron, J., & Cattaneo, A. (2023). What is “technology integration” and how is it measured in K-12 education? A systematic review of survey instruments from 2010 to 2021. Computers & Education, 104742.

D'Angelo, C. (2018). The impact of technology: Student engagement and success. Technology and the Curriculum: Summer 2018.

Hattie, J., & Timperley, H. (2007). "The Power of Feedback." Review of Educational Research, 77(1), 81-112.

Jalinus, N., & Syah, N. (2023, May). Project-Based Learning to Enhance Creativity and Learning Outcomes. In 9th International Conference on Technical and Vocational Education and Training (ICTVET 2022) (pp. 67-73). Atlantis Press.

Jennings, P. A., & Greenberg, M. T. (2009). "The Prosocial Classroom: Teacher Social and Emotional Competence in Relation to Student and Classroom Outcomes." Review of Educational Research, 79(1), 491-525.

Marzano, R. J., Marzano, J. S., & Pickering, D. J. (2003). "Classroom Management That Works: Research-Based Strategies for Every Teacher." ASCD.

Mathew, A. (2023). "Navigating the Digital Age: The Impact of Screen Time on Child Development". LinkedIn. https://www.linkedin.com/pulse/navigating-digital-age-impact-screen-time-child-alvina-mathew/

Nguyen, A., Hong, Y., & Gardner, L. A. (2020). A taxonomy of digital learning activities for digital inclusion. In Proceedings of the 28th European conference on information systems (ECIS), an online AIS conference, June 15-17, 2020. Association for Information Systems.

Prince, M. (2004). "Does Active Learning Work? A Review of the Research." Journal of Engineering Education, 93(3), 223-231.

Puentedura, R. R. (2014). "SAMR: A Model for Enhancing Technology Integration." EdTech Magazine.

Robinson, G. (2023). "Educational Enhancement" : Playful Learning: The seriousness of fun. University of Sussex. https://blogs.sussex.ac.uk/tel/2023/06/13/playful-learning-the-seriousness-of-fun/

Tatter, G. (2019). "Usable Knowledge": Making Time for Mindfulness. Harvard Graduate School of Education. https://www.gse.harvard.edu/ideas/usable-knowledge/19/01/making-time-mindfulness

Tomlinson, C. A. (2017). "How to Differentiate Instruction in Academically Diverse Classrooms." ASCD.