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Experiential and Outdoor Learning in the Transition to University Courses—The Mathematics Case

Davide Penazzi, Joseph McCready-Fallon and Sharon Rosser

ABSTRACT
Student retention is a priority in universities, as drop-out rates among university students within 12 months of starting continue to rise, according to UK figures released by the Higher Education Statistics Agency (HESA) (https://www.hesa.ac.uk/data-and-analysis/performance-indicators/non-continuation, accessed February 2022), and with approximately a quarter of freshmen not enrolling for a second year in the US (NSC Research Centre. 2020. *Persistence and Retention*. Snapshot report. https://nscresearchcenter.org/wp-content/uploads/PersistenceRetention2020.pdf, accessed 1 June 2021). The transition to university, and in particular to a mathematics degree, is a challenging period for many students. Several methods to support HE students through this initial stage have been developed across the years, mostly designed in and for academic settings. This paper will describe an innovative approach, beyond the traditional classroom, which involves a three-day residential course tailored specifically to support the transition of mathematics students into HE, examining its implementation into the BSc Mathematics and MMath degree programs and its effectiveness with first-year Mathematics students at the University of Central Lancashire. The results provide an evaluation of this intervention over four years, showing the positive impact on attainment, together with increased student participation and engagement.

KEYWORDS
Coaching; facilitation; mathematics education; outdoor; transition to HE

1. INTRODUCTION

This research came about as the result of a residential outdoor learning initiative designed to help students bond together in their first year at the University of Central Lancashire, a program known as "Frontier Education". The Mathematics cohort first took part in the Frontier Education retention program in 2012 and the mathematics lecturers soon realized that an adaptation and extension of this program could also help with developing graduate mathematicians who were able to think independently, take a problem-solving approach to their academic work and also co-operate with peers. These qualities are strongly connected with having a mathematically resilient mindset: a construct theorized by Johnston-Wilder et al. [21], whereas a successful student in mathematics needs to believe that their ability can grow, value their studies, and know how to find support when needed

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and understand how to work at mathematics. Some of the activities used on the Frontier Education program seemed in fact to emulate the mathematical processes and approaches that need to be taught during the mathematics course. It was also noticed that in an outdoor setting, students were more open to engaging, attempting novel approaches and develop the resilience to cope with making mistakes than in the classroom setting. This prompted a collaboration between the authors on the development of a tailored outdoor course: Frontier Education – Mathematics. After four years' development and implementation, it is now possible to share the results and findings regarding the effectiveness of this program in this article.

2. THE "MATHEMATICS PROBLEM": BACKGROUND ON THE DIFFICULTIES IN STUDENTS' TRANSITION TO MATHEMATICS DEGREES

2.1. Historical Perspective

Many of the educators of the western tradition can be said to fall into either a behaviorist, with its emphasis on knowledge being derived "from reason without recourse to the senses" [38, p. 5]; or an experiential approach [27], which states that "experience is the only source of knowledge" [38, p. 6]. The past 1000 years have witnessed education being dominated in the West by religious institutions and political systems [36]. This led to the prominence of the behaviorist approach in schools, and in particular in subjects such as mathematics. Skinner [39] exemplifies it with the notion of reinforcement, i.e., the "gradual elaboration" of more complex patterns and the maintenance of strengthening knowledge as the complexity increases. Reinforcement is then used as an effective means of controlling behavior in learning. In the same period, other educational theorists with a radically different view were coming to the fore, namely, Piaget, Vygotsky, and Dewey [8,9,29,34]. For them, young people were not blank slates but beings who form their knowledge by interacting with the world, with social interaction, and from lived experiences. The experiential approach is best described by David Kolb, whose work started in the1960s and the thrust of his argument was on the central role that experience plays in the learning process:

> Learning is the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience. [23, p. 41]

Kolb's model is at the root of outdoor learning and today is in active use in the world of commercial training and is acknowledged as being highly influential on managers, teachers and academics.

Universities bridge the gap between schools and the workplace, and the world of the working mathematician, whether in academia or in industry, is littered with novel and unusual tasks, ill-posed problems to solve and interactions with people from a variety of backgrounds. Being hired for their ability to solve wide ranges of problems, identify patterns in data and routinely using advanced mathematical techniques [3], mathematics graduates need the ability to adapt. This ability stems from having been exposed to a wide range of real problem-solving experiences and having been able to develop resilience and efficiency by reflecting on these. This is not the world of the controlled development of behaviorism and can come to a shock to the new graduate. Indeed, the authors argue that introducing an experiential component to the learning of mathematics would better prepare future working mathematicians. There is, though, a major obstacle to this proposal, and it is a well-rooted habit of the students transitioning to HE.

2.2. The Current State of Mathematics Skills Development in Schools – a Worldwide Problem

There has been a steady decline in the basic mathematical skills preparation of students starting a STEM University degree across the world, as a variety of reports and studies suggest: Hawkes & Savage [16] in UK, Gill et al. [13] in Ireland; Llamas et al. [25] in Spain; Groen at al. [15] in Australia. The European Society for Engineering Education's report "Mathematics for the European Engineer" [37] states it is common in the Western world. On the other hand, there is an increasing need for mathematically competent students. In the UK, the report "Employer Skills Survey 2017: UK Results" [41] identifies that a fifth of the job vacancies in the UK is due to a lack of numeracy skills. This is in a country with 1.36 million unemployed people, representing approx. 3.9% of the population [31].

The decline of the mathematics competencies in degree provision together with the decline in new mathematics graduates has been called the "mathematics problem" since the 1990s. "Tackling the mathematics problem" [26] identifies a series of areas of intervention: the school curricula, market forces, attracting students to mathematics, the role of universities, preparedness of teachers, etc. Despite changes in some school curricula (recently in Wales [20]) that can address some of the issues, the main obstacle of teachers who are not prepared or not confident to teach mathematics remains [11]. Park et al. [32] identify teachers as the main factor in contributing to the development of mathematical skills, with the teachers' mindsets and instructional practices being reflected on the students' performance. This, in fact, is enhanced by an incremental instruction aimed at mastery rather than one aimed at solutions of standard tasks. But while there is a desire to increase the experiential approach to the teaching of mathematics, reality shows that there is not the capability to move away from a traditional behaviorist approach, especially with the current shortage of mathematics teachers, and the consequent hiring of unprepared educators. In the UK, the focus on grades makes this shift particularly difficult:

> a significant proportion of the marks in… [secondary] mathematics examinations are awarded for procedural precision … , candidates are "drilled" until they are skilled at accurately applying the procedures, without them necessarily having understood the processes they are using or the concepts that underlie them;

Hence "most undergraduate mathematics students believe that they are good at mathematics [due to their examination results]" [24]. It appears thus that schools have developed an ineffective form of Skinner's "developmental control".

The dichotomy between experiential and behaviorist educational approaches also exists in HE, but there is a substantial difference: the experiential approach is more natural to the researching mathematician, who requires in their practice problem-solving skills and the mathematically resilient mindset. In fact, university lecturers have been for a long time more inclined to follow the sector-wide recommendations such as [6,17,42] encouraging towards developing more student autonomy in relation to their learning. Mathematics undergraduates are encouraged to be self-directed and develop information-seeking behavior rather than being passive receivers. In the 1990s, a National Science Foundation paper urged faculties to "… promote new kinds of learning, for example, developing the skills of communication, teamwork and life-long learning" [30, p. iv].

But the major obstacle in using an experiential method of teaching in HE comes from the students themselves, who are so used to behaviorist approaches, which they struggle to accept or understand classes that are not traditional chalk-and-talk.

> With conscientious lecturers [using an experiential approach] appeared to be the case as they asked questions of themselves and their students regarding what should I cover and how do I involve the students in the mapping of the outcomes. But many students were so used to didactic teaching that they were resistant to change. [28, pp. 11–22]

A student interviewed by Hockings et al. [18] well describes why it is difficult for students to engage with independent learning:

> [the school teachers] wanted you to get the good grades so they put the effort in to make sure you did rather than leaving you to-, it wasn't that we weren't prepared, it was that, it's just that you would get in trouble if you hadn't done it. Whereas [at university], it's like, "Do it if you want, see how you do."

So, how can the students be supported in developing a mathematically resilient mindset, without them falling into the behaviorist – passive learner habit which naturally resurfaces when they are presented with mathematics problems?

2.3. Implementing a Tailored Outdoor Learning Intervention: "Frontier Education – Mathematics" as Part of the First-year Curriculum

At the University of Central Lancashire, outdoor learning is already widely used across the subject areas to help with the transition into HE. The "Frontier Education" program was initiated in 2002, and the feedback received from staff and students indicated that the residential experience had enhanced the "bond" and sense of belonging within the group [33] that in turn helped many students to overcome feelings of isolation, which for some students may result in dropping-out of the course. The use of the outdoors as an educational and developmental tool enabling learners to interact with other learners in an outdoor environment is not a new phenomenon. As Beard and Wilson [1, pp. 101] suggest, "outdoor environments have a long history of providing very special places for individuals to learn, in a profound way, about themselves and their social interaction with others." The Frontier Education programs often involve outdoor activities such as gorge scrambling, canoeing and hill walking interspersed with experiential games, problem-solving and facilitated sessions which include working as a team, utilizing models such as Belbin's [2] Team Roles, and Greenaway's [14] Active Reviewing Cycle.

Using the course structure and resources of the Frontier Education (FrEd) program, the authors adapted the course and re-named the program Frontier Education – Mathematics (FrEdMath). The focus is shifted to the development of reflective practice in the students own learning, which should then help them redefine their episteme of mathematics, i.e., their perception of the nature of the subject itself, developing the required mathematical skills and a mindset conducive to academic success. FrEdMath is currently delivered between the fifth and seventh week of teaching, when students have formalized their nascent ideas of what the on-going mathematics course will entail. Over the three days, the students are challenged with complex and multifaceted activities, which rely on knowledge acquired in the previous session. Each activity is supported by a reflection session, and also, as the activities last for up to three hours, there is a review-in-action, i.e., short facilitation sessions during the activities aimed at tackling obstacles hindering further continuation [19]. In FrEd Mathematics, the program is tailored to develop subject-specific skills as indicated in the QAA Benchmark Statement for Mathematics, Statistics and Operational Research (MSOR) graduates [35]. Alongside general study skills, which need to be developed by graduates in any subject (communication skills, working independently, etc ...), it is acknowledged in QAA [35, pp. 13–14] that students also need to develop skills relating particularly to logical argument and solving problems in generality, and facility with abstraction, including the rigorous development of formal theories, formulating real-world problems in mathematical terms, solving the resulting equations analytically or numerically, and giving contextual interpretations of the solutions. This set is thus a combination of common skills that can be developed by a generic outdoor learning course together with skills that need to be addressed with specific activities and facilitation developed for mathematics graduates.

The activities have no mathematical content (in the standard and traditional sense), in fact, during the activities, there is no or very limited reference to the mathematics course. This is to avoid the onset of behavioural habits from the familiar school approach to mathematical problem-solving. It is then the post-activity reflection, which provides the opportunity to review and transfer learning to the context of the particular course of study and the students' future employment. With student mentors and lecturers present, students are supported in discussing similarities and differences between the experiences during the activities and their practices as mathematics students. This supports the findings of the QAA [35] Benchmark Statement for MSOR graduates which states the importance of mathematics courses to "take theoretical knowledge gained in one area and apply it elsewhere" and also recognizes "the crucial aspect of the process is the cultivation of the general skill of transferring expertise from one context to another" [35, p. 14)]. The activities and reflections during FrEdMath course, moreover, provide the students with the right tools to navigate the transitional stage in redefining their episteme of mathematics. This stage is, of course, not completed over the three-day FrEdMath, hence it is essential that the mathematics educators and academic support (lecturers, personal tutors, student mentors) are present in the reflection sessions together with the outdoor learning coaches, to aid the transfer of learning into the context of the degree. Hence, FrEdMath is an integral part of and is deeply interlinked with the whole first year of the degree and beyond.

3. THE EVALUATION

To evaluate the effectiveness of FrEdMath, we used the academic results of the BSc Mathematics and MMath students, supported by short questionnaires to lecturers and older students to confirm that their perception of change in the students aligned with our aims. Whilst the results of this study indicate an improvement in attainment and engagement of students taking part in the FrEdMath program, it is recognized that there are many other factors that may have contributed to the success and achievement of these students being examined as part of this study, and these factors will be discussed further in conclusion.

3.1. Quantitative Results

Firstly, a statistical analysis on the attainment across the years 2014/15–2017/18 was carried out. The original Frontier Education (FrEd) program was delivered to the mathematics students in 2014/15 and 2015/16, whilst the revised and adapted version of FrEdMath program was delivered in 2016/17 and 2017/18.

All students participating are were enrolled in the first year of the BSc Mathematics or the MMath courses. All first-year students attend the same six modules, which are year-long and bear the same number of credits. There is thus no need to rescale or limit our selection to specific modules. The grade we consider is the average of the grades of these six modules after the first attempt at the exam, in percentage (Average Percentage Mark – APM). We exclude students who had withdrawn early in the year and who could not do the first exam due to illness.

We use the two-tailed Mann–Whitney U-test with a significance of 0.05. As the population is above 20, we will assume that the distribution is normal. We perform the following two comparisons:

(1) Mean grade between participants and non-participants across 2016/2017 and 2017/18 ($N = 48$). Showing the effectiveness of participating in the FrEdMath program over not participating.
(2) Mean grade between participants of the "original" FrEd program and of the adapted FrEdMath program ($N = 81$). Showing that the FrEdMath further improves achievement over FrEd.

Our hypotheses for this study are:

H0: There is no difference in attainment between the two groups. (Null hypothesis)

H1: There is a difference in attainment between the two groups.

Comparison 1: We consider all first-year students in the academic years 2016/2017 and 2017/2018 completing the exams. The students are divided into participants FrEdMath (N1 = 30) and non-participants to FrEdMath (N2 = 18). The mean APM among FrEdMath participants across the two academic years is 58.48% [SD = 15.55; Confidence at 95% = 5.81] and among non-participants is 44.27% [SD = 18.94; Confidence at 95% = 9.42]. Mann–Whitney shows the significance of the difference in means (approximately 14%) at 95% confidence [$p = 0.0127$].

Comparison 2: We consider all first-year students participating in FrEd in the academic years 2014/2015 and 2015/2016 (N1 = 30) and all first-year students participating in FrEdMath in the academic years 2016/2017 and 2017/2018 (N2 = 51). The mean APM among participants to FrEdMath is 58.4783% [SD = 15.55; Confidence at 95% = 5.81] and among participants of FrEd is 52.1596% [SD = 13.15; Confidence at 95% = 3.70].

Mann–Whitney shows a significance in the difference of the means at 95% confidence [$p = 0.0386$].

3.2. Questionnaires and Perceptions of Educators

In addition to the quantitative analysis, the authors carried out a questionnaire evaluation among lecturers teaching first-year students and the student mentors shadowing the outdoor coaches during FrEdMath.

Five lecturers and three student mentors responded (Tables 1 and 2).

A key theme arising from the responses is an increased interaction between students, although not all interviewees attributed it necessarily to FrEdMath. “After the [FrEdMath] course, more students [...] were [...] more willing to participate in discussions with classmates. They’ve also built friendships with classmates, which

Table 1. Lecturers’ questionnaire.

(1)	Did you notice any difference in the in-class behavior of the students before and after the attendance to Frontier Education? If so can you describe what you observed?
(2)	Did you notice any difference in the attitude of the students towards their own studies? (for example: attendance, interaction with other students, interaction with lecturers ...) If so, what differences did you notice?
(3)	Have you participated in a Frontier Education course in the last three years? If yes can you comment on what you observed?

Table 2. Student mentors questionnaire.

(1)	Has shadowing the coaches during the FrEd course given you skills you then used during the PASS sessions? If so which and how?
(2)	Has shadowing the coaches during the FrEd course given you ideas you then used during the PASS sessions? If so which and how?
(3)	Did you see any benefit in the students’ participation to FrEd in your PASS sessions? If so which ones?

Note: PASS is the name of the mentoring system/ Supplemental Instruction in operation.

will be beneficial when revising for exams" [Mentor 2]. There was "More peer support" and "better interaction with other students" [Lecturer 1] "clear change in discussing the work, mutual helping" [Lecturer 3], "There was a general improvement in class cohesion over time, but nothing directly attributable to [MathFrEd]" [Lecturer 5].

They also noticed improved engagement during lectures and student mentoring sessions. "They were more actively participating during sessions, showed more potential and overall more engaged [Mentor 3]" and "students were more engaged and willing to participate in class discussions" [Lecturer 1].

The student mentors reported an improvement in attendance in the non-compulsory mentoring sessions "After the [FrEdMath] course, more students attended sessions" [Mentor 2] and "Their attendance was also notably higher." [Mentor 3].

However, this improvement in attendance does not seem to reflect in the lectures "No difference in attendance in lectures" [Lecturer 2].

A different theme that emerged from the results relates more to the student mentors' benefits rather than the students', given by the chance of observing and shadowing expert facilitators and thus to develop their coaching skills:

> "I learnt different ways to engage all the students, even the ones that are quite shy. It all showed me how to facilitate in different ways to make [sessions] more interactive. [...] The structure of the debriefs which were done at the end of the activities are useful for finding out how the students are doing on assignments etc." [Mentor 1]; "it's all about pushing the student to gain an answer/solution for themselves rather than giving them hints or answers. It helped me to see how it works while I had someone overseeing me to correct me if I began to deviate from a facilitating role." [Mentor 3]

Due to the small size and scale of this project, a formal qualitative analysis, however, is needed and should be embedded as part of any future scaled up delivery.

3.3. Results Interpretation

Whilst the results of this study suggest an improvement in attainment and engagement of students taking part in the FrEdMath program, it should be recognized that there are many other factors that may have contributed to the success and achievement of these students, for example, socio-economic factors that could have hindered participation. The University of Central Lancashire is a widening participation institution, and as such, care has been taken to mitigate factors that can have been a cause of non-participation, such as poverty (FrEdMath is completely free of charge) and religious beliefs (it is not run on Fridays, Saturdays or Sundays, praying areas are provided, dietary requirements are catered for). But other factors with a known correlation to attainment, such as caring duties [7], and those whose correlation is debated, such as job commitments [5,40], have been reasons for non-participation. The actual effect of these factors is difficult to determine, without further research, but the questionnaires evaluation show a change for participating students in positive behaviors, in particular, in their ability to access support, their engagement and ability to relate to others; positive behavior is known to be an indicator of higher achievement [12].

4. CONCLUSIONS

Certainly, more research is required regarding the potential impact of experiential learning on Higher Education students in relation to the development of their specific academic skills. In particular, the development of mathematical and problem-solving skills in other subjects, and in the development of apprentices on their career path, which encompasses, at the same time, academia and workplace.

The authors believe that the facilitation approach could be useful also in class: an educator with the correct skills can perform the in-action reviewing during lectures and be equipped to choose whatever tool (experiential or more traditional) is most suited for the specific situation. Additional facilitation training may therefore be beneficial for HE academic staff.

To assist with the transition into HE, and in an attempt to address the misconceptions of mathematics and the "mathematics problem", the authors would argue in favor of introducing an experiential approach at an earlier stage in the student's education, as research suggests that a fixed mindset in relation to mathematics is developed whilst in school [4,10]. Could then an experiential approach become part of traditional secondary education? The findings suggest that there is great potential for outdoor learning and coaching to be embedded in traditional education, especially in subjects, like mathematics, which are often considered "dry". The work of Sue Johnston-Wilder is leading the way in this regard [21,22]. The approach is examining ways for learners to develop resilience when it comes to dealing with maths anxiety: with the adoption of a coaching approach, the need for reflective thinking gives the "coachee" control of their own learning and deciding on the strategy and actions they wish to take. This approach, if fully taken onboard, could substantially reduce the "mathematics problem", but the need for a shift towards experiential learning needs buying in from the teaching community. As many teachers also share the same "baggage" of their students in relation to the perception of mathematics, they first need to overcome their own limitations, before embarking on a process to develop as coaches. Perhaps, participation in a similar short residential outdoor course, tailored primarily for mathematics teachers, could help to facilitate this shift, challenging their own perception of the subject and, as a consequence, improve mathematical resilience, and thus continuation with the studies, in school students.

The thrust of education especially in the domains of Higher Education in the latter half of the twentieth century is a far cry from the behaviorist approach of Skinner in the 1900s. The move towards the adoption of an experiential approach has resulted in students being seen to be at the center of the learning process. It is hoped that this study further informs the debate in HE and secondary education and helps to shape not only mathematics curricula but that of many other subjects.

The results of this study have shown that experiential learning allied to a coaching approach can have a significant impact on student retention and attainment. The authors believe that the effectiveness of this approach will foster collaborations between mathematics educators and coaches, enhancing the connection between learning experiences, individual past experiences, students' motivation and aspirations, the program of study at the university and the transition into real-world practice and future employment.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s).

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, Davide Penazzi, upon reasonable request.

APPENDIX

Offering a Similar Program in Your Own Institution – Top Tips and Handy Hints!

In order to create and deliver a similar bespoke program, it will be necessary to first establish whether your institution has the facilities and expertise in Outdoor Learning to draw from or whether you need to seek support from an external provider.

If employing an external provider, a clear understanding of the agreed outcomes and a shared vision between facilitators/coaches with an Outdoor Learning background and the staff at the Mathematics department from the institution is key. It is important to recognize that the delivery of this program is based on *Outdoor Learning*, and, therefore, an external provider will not just need skills and expertise in the delivery of outdoor activities, but also the ability to coach, facilitate and stimulate reflection.

The following questions may help with your planning and whether an external provider is required:

Staffing and Resources

- Are there staff within the institution sufficiently experienced and qualified (with appropriate National Governing Body Awards) to deliver a range of outdoor activities? If not, consider employing a provider of Outdoor Learning, who has the necessary expertise, skills and qualified staff.
- If using an external provider of Outdoor Learning, the institution's subject specialist staff should be involved in the program design to ensure specific outcomes are met.
- Does the institution have sufficient specialist equipment and resources to deliver the program or could this be hired by the Outdoor Learning provider?
- Do you have sufficient equipment for the number of people within the group, taking into account the range of sizes and abilities that may be presented within the group.

You will need to find a location, a "base", which is suitable for the kind of activities you want to deliver. Your institution might have a venue close to a National Park (possibly used with a different scope, such as biology research, that you can book for a few days), or you may use a provider with a sufficiently equipped base. Ask the following to assess the suitability:

Location

- Do you have suitable "outdoor" areas to use for activities, that are within easy reach of your "base"?
- Do you have access to suitable indoor and outdoor learning spaces (although the preference would be to partake in activities outdoors, is there sufficient indoor space available in case of poor weather)?
- Is the location accessible to all? (including students with any particular requirements)
- Are there any access issues? Do you require permission by the landowner / Institution / Local Authority for delivering this program at the selected venues?
- Is transport available to transport students and staff to activity locations?
- If using a residential centre – the usual checks regarding health and safety / food hygiene / adequate bedrooms, cooking, washing and drying facilities should be carried out beforehand.
- If using a self-catering hostel / bunkhouse, consider employing a catering business to take care of preparing and serving meals.

An important consideration is the timing of the course. At what time of year would it be most beneficial for the course to run (for students and staff)?

Time of Year

- Consider the timing of the delivery of the program with the demands of the Course of Study / assessments / exams / student and staff availability
- Consider the time of year for the delivery of the program, taking into account likely weather conditions, and the activities that may be delivered at that time in order to meet the objectives of the course.
- Consider adapting the program and activities due to the weather, time of year and ability of the group. Have alternative activities in mind in case of poor weather or in order to include students of limited ability / specific medical conditions. Changes to the program should be in consultation with the Outdoor Learning Provider and the subject specialist lecturing team, to maximize learning and to relate students' reflections back to the subject area.

As previously mentioned, the collaboration between the Mathematics staff at the institution and the Outdoor Learning practitioners is key to the program design and execution. It is also extremely beneficial in the development of the relationship between Mathematics staff and students if staff engage fully with the program and participate, when possible, in the activities and the reflection sessions. In doing so, the outcome of these reflective sessions can then be put into context and brought back to life once students return to the institution.

Don't be afraid to try! It might take a few attempts to get the program fine-tuned but you will see the benefit and positive impact the experience has on the students and their interaction with each other even from the first course!

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BIOGRAPHICAL SKETCHES

Davide Penazzi graduated with his PhD in Mathematics, Model Theory, in 2011 from the University of Leeds, where he remained as a research fellow until 2013, when he took a position at the University of Central Lancashire and is now a Senior Lecturer in Mathematics. Davide's research is in model theory and applications to other areas of mathematics, such as topology and geometric group theory. More recently, Davide has been researching in Mathematics Education; in particular, on fostering mathematical resilience in students (from primary school to university) using facilitation, coaching, experiential games and, in general, techniques from outdoor learning.

Joseph McCready-Fallon's interest lies in developing people. All of us have potential waiting to be tapped. Maybe it has been already – this begs a question; how much better can you be? His role as a coach is to help people realize that they have this potential within. Jo is the director of a coaching company that provides one-to-one coaching and training services for those who wish to become coaches. I have been coaching for over 15 years and have worked with a wide range of clients ranging from executives to graduates. His recent work has been with medical doctors in both primary and secondary care. He is a specialist consultant for the delivery and facilitation of outdoor activities with the University of Central Lancashire, where he course directs and coaches a wide range of students. Furthermore, in his role as the National Coach Lead for the Institute for Outdoor Learning (IOL), he coaches, mentors, and assesses candidates aiming to have a regional impact on outdoor education, as well as overseeing the development of coaching within IOL.

Sharon Rosser. Sharon is an experienced teacher, lecturer, and facilitator within the outdoors. As the Outdoor Program Manager within the School of Sport and Health Sciences at the University of Central Lancashire (UCLan), Sharon is responsible for the management and delivery of UCLan's 'Frontier Education' program across the whole university. Frontier Education is a personal and team development program designed to ease the transition into University life by developing peer support networks, collaborative working, building a cohort community and enhancing communication, leadership and employability skills. Using the outdoors as a medium for teaching, learning, coaching, and leadership, Sharon also teaches on the BA(Hons) Outdoor Adventure Leadership degree program at UCLan.