Optimising a Peer Based Learning Environment

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Abstract. Primary School education in Ireland is in the process of updating its pedagogical approaches, embracing new teaching methods and desiring new learning outcomes. In particular, the new curriculum emphasizes developing skills necessary for modern-day life. Peer-led interactive group learning is an effective method of teaching those desired skills. One such technology embracing these methods of learning is the "Magical Leaders" programme. However, creating an environment that allows for optimum delivery of the content is difficult as the teacher needs to deal with the new method of content delivery as well as any behavioral or social issues that exist in the classroom. We investigate three factors that affect the successful delivery of the "Magical Leaders" programme: group composition; peer leader selection; and preparation time. We find that classes in which the teacher selects the groups complete the challenges more than 10 min quicker than those classes in which the peers select the groups or they are randomly assigned. The mean time to complete each challenge was approximately the same for groups in which the peer leaders were selected by the teacher and those groups were volunteers. However, the number of volunteer-led groups that finished on or before schedule was higher. Groups with peer leaders who completed less than 30 min of preparation time finished on average 9 min quicker than groups with peer leaders who did more than 30 min of preparation time. However, while the mean time is much less the number of classes finishing on time is higher for those with more preparation time, 60%, than those will 30 min of less preparation time, 52%.

Keywords: Peer Led Learning · Education Technology · Optimisation

1 Introduction

Maximising the learning and development of all school students is an important goal for all countries, with education earmarked by the United Nations as a pillar for a sustainable future [4]. However, creating and fostering learning environments that allow each student to fulfill their potential is a key challenge.

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Primary education in Ireland is undergoing a dramatic transformation, with new updated pedagogical approaches being implemented. The National Council for Curriculum and Assessment (NCCA) want to move primary education in Ireland away from traditional rote learning to problem-based learning [9]. In their draft primary curriculum framework, the NCAA identifies seven key competencies (being creative, a digital learner, mathematical, an active citizen, communicating and using language, fostering well-being and learning how to learn) and stress experiential learning. In particular they want to "support children to become curious, creative, confident and critical users of digital technology".

Implementing this new curriculum, while at the same time creating new, efficient learning environments is a formidable challenge. This transformation also comes at a time when teachers in Ireland are reporting record levels of burnout [5].

To achieve these ambitious goals, the education sector must embrace technology. Zeeko Education[2], a Dublin based education technology company, are creating this technology. Among their products is "Magical Leaders", a peer led immersive digital learning programme. This innovative programme allows students to practice and develop the core competencies desired by the NCAA. However, no research to date has been conducted on how to best deploy "Magical Leaders" (or any peer-to-peer course) in schools in Ireland. This paper is the first study examining this topic. These results will help guide teachers on how to create an environment to efficiently complete the tasks, thereby giving the largest amount of time for important self-reflection to the students [7].

We study three components and examine how they impact the time taken to complete the various challenges within "Magical Leaders". They are: how the peer-led groups were composed; how the various peer leaders were selected; and how much preparation time was done before the challenge.

Section 2 reviews the main background concepts and discusses the NCCA and peer-to-peer learning in more detail and introduces the "Magical Leaders" programme. Section 3 discusses each component of our data capture and describes our experimental setup in detail. Section 4 presents the main results of the experiments described in 3 and discusses their findings. Finally, Sect. 5 summarises the research and discusses future work suitable for investigation.

2 Background and Related Work

2.1 Irish Primary School Curriculum

The NCAA wants to drastically reform the Irish primary school curriculum and the current pedagogical approaches in schools. The unprecedented rate of change in modern society brought about by technological innovation has resulted in mass disruption to a variety of industries and disciplines. The Primary Curriculum Framework, launched in 2023, aims to transform education in Ireland around key competencies that ensure children practice and learn transferable skills, such

[2] https://zeeko.ie/

as creatively and problem-solving, to deal with an unknowable future. They wish to place students at the core of this new learning process. This must be done efficiently to maximise students' potential while ensuring teacher burnout is mitigated. This second goal is of particular importance as primary school teachers in Ireland have reported record levels of stress and feel overworked [3].

A teacher is well placed to design individualised learning environments for their students, but a teacher's knowledge of their students' learning needs, speed and capacity cannot be easily scaled. Augmenting teachers with technology to deliver their lessons is scalable, however. A key component of this new technology is that it must efficiently deliver these lessons to all the students. This will allow teachers to focus better on educating and not on administration, behavior correction and would ensure students' potential has the best chance of being achieved. However, to date there has been no work examining how to make the deployment of any technology more efficient in primary education schools.

2.2 Peer Based Learning

Peer based learning is a collaborative form of education in which one or more peers (e.g. students) lead the learning of the group (or class). Peer-to-peer learning has been shown to improve learning outcomes and provides an opportunity for students to practise skills essential for later stages of life, such as team work and communication [6]. There is much overlap between these skills and those the NCAA aim to instill in students in their updated curriculum. Therefore, peer based learning offers itself as an attractive method of content delivery. A flexible paradigm with many ways to be implemented, peer interaction has shown positive effects in enhancing learning in both children and adolescents [8]. It has been shown that peer led learning can be improved upon by adding additional incentives and changing to the needs of the particular group [2].

Indeed, peer-based approaches have been shown to have a large, positive impact on learning, with a potential effect equivalent to approximately 5 additional months' progress for both peer educators and peer-educated pupils according to the Education Endowment Foundation [1].

Some challenges must be overcome to successfully implement such peer based learning systems, however. It can be difficult for peer leaders to maintain discipline within the group and ensure the correct lesson plan is followed. There may also be complicated social dynamics within the class that need to be navigated to ensure tension or other problems in any group are mitigated. Supervision and optimum arrangement of the classroom for the lesson therefore becomes a key concern in many peer learning settings.

2.3 Magical Leaders Programme

The "Magical Leaders" Programme is a peer led education programme for 10–13 year old primary education students developed by Zeeko Education, a Dublin based Eduction Technology company. It focuses on developing transferable,

Fig. 1. Challenge map which is navigated by the Driver. The Driver will move the avatar in the virtual world and enter each phone and uncover the activity to be performed.

Fig. 2. Screen seen entering a phone. The screen describes a challenge or concept that must be performed by the group. Upon successful completion, the driver will exit the phone.

higher order skills and knowledge. Zeeko have shown this knowledge acquisition, complemented by skills practice, progresses young people's skills and fosters positive attributes.

The program aims to complement the new curriculum envisioned by the NCAA, teaching skills such as communication, collaboration, critical thinking, and creativity through the lens of entrepreneurship.

This study examines the introductory programme of "Magical Leaders", consisting of 6 lessons - or 'Challenges'. Each challenge focuses on a particular concept and contains unique learning outcomes, key messages, presentations and discussion activities. Specifically, pupils are presented with details based on real-life situations and are tasked with making decisions based on the evidence given. The challenges are designed to raise questions and to present just enough data to stimulate/engage pupils to find their own answers. Each challenge is navigated virtually through online software and also led locally by peer leaders reading from instructional material. An example of the online software is seen in Figs. 1 and 2. Each challenge ends with a period of self-reflection for the pupils.

The "Magical Leaders" programme has received very positive feedback and has been created to ensure all the knowledge outcomes are met, however, there has been no research done on the optimum environment and classroom setup to achieve these goals.

2.4 Peer Leader Roles Within Magical Leaders

The "Magical Leaders" Programme requires multiple students to perform various roles during each challenge. These roles include:

Presenters are peer educators who facilitate the lesson's key messages to the Pupils via the online software. They are required to stand at the front of the class and deliver the content of the lessons provided to them, aided by the online software that is shown to the pupils on the screen.

Drivers are peer educators who control the online software. They are required to sit at the computer, select the correct lesson, navigate the online software, find the various phones contained in the challenge and navigate and show the slides that the presenters are explaining.

Group Leaders are peer educators who sit at the table with the pupils in their groups and facilitate and lead the discussion about the lesson. They facilitate group discussions when asked to do so by the presenters and ensure discussions remain constructive and on schedule.

3 Experimental Setup

Each "Magical Leaders" challenge is designed to take up 45 min of activity. Before beginning the lesson, the class must be divided into groups of 6 or 7 and the peer leaders chosen. Each peer leader must undertake preparation to ensure they are fully able to fulfil their role. The composition of the groups, the selection of the peer leaders and the amount of preparation done is at the discretion of the teacher. While the "Magical Leaders" instructional manual gives suggestions to teachers of what is best, there has been no research to date investigating how a teacher can most optimally create an environment to efficiently complete each lesson.

This paper analyses the performance of classes undertaking "Magical Leaders" challenges and investigates the effect of three criteria on their outcome. The criteria examined are: Group composition; Peer Leader Selection; and Preparation Time.

Group composition investigates how the groups were chosen. There are three possible approaches to create groups for the challenge: the teacher can select the groups, the peers form the groups themselves or the groups are created randomly. Zeeko does not recommend that the groups be created randomly as students with animosity or some other form of incompatibility may be inadvertently placed into the same group, unsettling the social dynamic and creating a tense atmosphere in which other members may be unwilling to participate fully.

Peer Leader Selection examines how the student presenters, leaders and drivers were selected. Pupils will have different levels of self-confidence, which will be affected differently by the environment and size of the group. Some will naturally want to be a presenter, others may prefer to be a group leader or computer driver. There are three methods to chose the peer leaders: The teacher will select them; the students will volunteer themselves for the various roles; or some other method which could be random or a mixture of the previous two approaches. While the teacher may be best suited to choose which students are best suited to the roles and are primed to develop their presentation, assertiveness, and interpersonal skills it may be that a child's self confidence, illustrated by them volunteering for the roles, is a key factor. Pupils will have different levels of self-confidence and this may be an important factor in fostering efficient peer learning.

Lastly, Preparation Time considers the preparation time undertaken by the peer leaders before commencing the lesson. Zeeko recommends at least 30 min of

preparation time before each challenge for each peer leader to familiarise themselves with the content, their role in the challenge and to answer any questions they may have. This is a binary category: less than 30 min of preparation or 30 min or more of preparation time.

Each of the challenge follows a similar format. The lesson is broken down into sub-parts/ points. Each sub-part/ point corresponds to a phone location in the online programme. Our data capture found the time to compete each phone and aggregated them to find the total time to complete the challenge. This allowed for classes which did not complete the challenge in one block (interrupted by lunch, etc.) to still be included in the final dataset.

4 Results

42 different classes, taking part in 116 challenges were recorded with each class taking part in between 1 and 5 challenges. After data cleaning and removing challenges which had errors or were not fully completed, the final dataset contained 26 classes taking part in 67 challenges.

The summary of the results collected is shown in Table 1. Challenges 1 and 2 are the largest in the dataset, with 15 and 17 classes undertaking them. 5 and 3 have roughly half as many, 7 and 8 respectively. 10 classes completed challenges 4 and 6.

Table 1. Summary of data used in results after cleaning.

Challenge Num	Number	Mean	Median	SD
1	15	57.49	55.5	19.17
2	17	56.67	55.08	17.39
3	8	50.29	48.89	8.79
4	10	58.89	55.53	14.19
5	7	49.74	46.88	15.59
6	10	46.14	47.72	9.81

Challenges 1, 2 and 4 take an average of over 55 min to complete. This is perhaps not too surprising as the first time classes attempt challenges they make take longer. Challenges 3 and 5 take around 50 min to complete while challenge 6 was the quickest, taking just over 46 min. Challenges 1, 2, 4 and 5 show a large distribution of times taken, while challenges 3 and 6 show that most classes took a similar amount of time.

Each challenge is designed to take approximately the same time complete. As our results reflect this design, we combine all challenges for our next stage of analysis. We next investigate the various factors affecting the length of time taken to complete each challenge, as described in Sect. 3.

Some teachers reported that group composition was a mixture of one of the options (i.e. some groups were selected by the teachers, others randomly). These challenges were excluded from analysis, leading to less that 67 challenges included in the analysis.

The overwhelming majority, 43, of groups were composed by the teacher. 4 were composed by the group leader and 8 were randomly put together. Teacher selected groups were much quicker finishing the challenges than both other group selection types. Teacher selected finished in an average of 51.59 min, while Group Leader selected and Randomly selected took 63.41 and 63.93 min to complete challenges, respectively. Wilcoxan signed rank tests were performed to assess the significance of the difference between Teacher selected and the other methods. The results of these tests, as well as other results, are shown in Table 2

Table 2. Experimental Results. Results which are bolded indicate significance according to our Wilcoxon tests.

Type	Selection	Number	Mean Time	Median Time	p-value
Group Composition	Teacher Selected	43	51.59	49.73	–
	Group Leader	4	63.41	59.98	0.2908
	Random	8	63.93	59.53	**0.0882**
Presenter, Leader	Teacher Selected	23	58.03	55.50	–
and Driver	Volunteered	29	54.31	53.63	0.4355
Selection	Other	3	48.57	45.75	**0.0786**
Preparation Time	$< 30mins$	23	48.98	50.05	
	$> 30mins$	30	57.73	55.38	**0.0220**

The number of challenges that finished on time and those that did not, split by each factor, is shown in Table 3. The results further reinforce the conclusion that challenges are completed more efficiently when the teacher selects the groups. 53% of teacher-selected groups finish the challenge on time, while other methods only finish on schedule 17% of the time.

Volunteered leaders and drivers are seen to finish challenges on time 44% of the time, while teacher selected only finish on schedule 30% of the time.

Finally, when the preparation time exceeds 30 min 60% of the time the challenge finished on schedule, compared to only 52% when the preparation time is less than 30 min. This is despite the average time taken for groups with more than 30 min preparation time being far larger (and statistically significantly longer) than those with 30 min or less preparation time.

Table 3. Experimental Results on Time Keeping.

Type	Selection	Times Over Schedule	Times On Schedule
Group Composition	Teacher Selected	20	23
	Group Leaders	3	1
	Random	7	1
Presenter, Leader and Driver Selection	Teacher Selected	16	7
	Volunteered	16	13
	Other	1	2
Preparation Time	$< 30mins$	11	12
	$> 30mins$	12	18

5 Conclusion and Future Work

We analysed the performance of various primary school classes in Ireland completing the "Magical Leaders" programme, a peer led interactive learning course. Specifically, we considered three factors (group composition, peer leader selection and preparation time) and investigated their influence on the successful and efficient completion of challenges within the programme. Keeping to the prescribed schedule and completing the challenges in an efficient way results in each child maximising their personal reflection time.

We found that teachers overwhelmingly chose the members of groups and those groups were seen to more efficiently complete the program, taking on average 10 min less to complete each challenge than peer-selected or randomly assigned groups.

There was no difference in mean time to complete a challenge found between peer leaders that were selected by the teacher and those who volunteered for the position. However, when analysing the number of challenges that remained on schedule, we see that teacher-selected leaders remained on schedule 30% of the time while leaders that volunteered stayed on schedule 45% of the time.

Leaders who undertook less than 30 min of preparation time were seen to complete challenges faster than leaders who undertook more than 30 min of preparation. The reasons for this are an open question and an avenue for future work. Interestingly, despite having a lower mean and median time to complete each challenge, the number of challenges completed on time when having less than 30 min of preparation was 52%. The number of challenges completed on time when leaders had more than 30 min preparation time was 60%. The amount of preparation time needed is an open question and may be influenced by other factors not examined in this study.

The next step of this work is to investigate the effectiveness of the peer learning environments, which can only be measured using student post-challenge surveys and feedback. These surveys will measure how much a student's skills have improved after completion of each challenge and will allow more context to be placed on the information captured.

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