

Designing a Mobile Academic Peer Support System

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In this paper, we discuss work in progress into the design of a mobile academic peer support system that enables 11-to-14 year old children to request and provide academic help to each other. Our proposed system was designed based on background research into the areas of peer learning, child development, help-seeking and academic motivation. Several methods, such as focus groups, interviews and Wizard of Oz, were used during the requirements gathering and initial testing stages. The proposed system is currently under development and will be tested in a study with school-pupils, over an extended period of time, in the next few months.

Mobile learning, academic support system, peer learning, motivation, help-seeking behaviours.

1. INTRODUCTION

The current growing usage of social media has caught the attention of children, with around 65% of 9-16 year olds who use the Internet in the UK, having their own profiles on social networking sites (Livingstone *et al.*, 2010). This use of social networking along with the high ownership of mobile phones in UK school-aged children – 85.5%, according to the National Literacy Trust – has provided them with ample opportunities to socialise with their peers. It is believed that this social interaction between peers has a positive effect on their cognitive development (Amigues, 1988; Forman, 1989; Manion and Alexander, 1997; Vygotsky, 1978). This association has been exploited in modern educational systems through the encouragement of cooperative work, project-based learning and peer tutoring systems. Furthermore, this area has also been the focus of many research projects that aim to provide technologically enhanced tools to support those activities (e.g. Bouvin *et al.*, 2005; Mandryk *et al.*, 2001; Silva *et al.*, 2008).

This research aims to investigate whether mobile devices and peer generated content could play a role in supporting learning in Key Stage 3 pupils in the UK. Firstly, we give a brief introduction to peer learning and motivation, before then presenting current work being carried out with 11-14 year old pupils. Our study presents the design, evaluation and ongoing development of a prototype mobile app that is aimed

at providing peer support for school pupils in out-of-classroom learning scenarios.

2. BACKGROUND TO THE WORK

2.1 Peer learning

The effect of peers' social interaction on their cognitive development has long been of interest to researchers. According to Vygotsky (1978), a child's cognitive development can only occur if 'the child is interacting with people in his environment and in cooperation with his peers' (p90). Furthermore, according to Damon's (1984) analysis of developmental theories, peer interaction has many benefits such as encouraging the development of accurate and superior understanding and creative thinking. These views have encouraged researchers to investigate the effect of peer interaction on learning and development. In a study performed by Amigues (1988) on school pupils, they were found to perform better on a post-test if they had interacted with their peers during an assigned task than if they had worked on the task individually. Sporer and Brunstein (2009) looked at learning of reading comprehension in 12-13 year old pupils and found that those who learned from their peers performed better in post tests than those who had learned through traditional methods of teacher-facilitated instruction. Moreover, according to a study by Manion and Alexander

(1997), children also benefit from peer interaction by adopting their peers' strategies in solving a task.

2.2 Developmental considerations

An important skill for a child to develop is the ability to seek and acquire help from peers and adults (Nelson-Le Gall, 1981). This is considered a sophisticated skill as it depends on viewing others as potential resources and on learning how to interact with those resources to achieve the ultimate user's goal. Research has suggested that children's orientation shifts from family to peers as they grow older. In a study with 9-15 year old children, a clear increase was found in the children's preference of associating with peers more than with family members (Bowerman and Kinch, 1959). In another study with 10-13 year old children, it was found that at the age of 11, dependence starts to shift from parents to peers and that 13 year olds were found to be the most peer oriented of the group (Steinberg and Silverberg, 1986). Nelson-Le Gall and Gumerman (1984) observed that children aged 3 to 11 showed an increasing trend towards asking peers for help, both academic and social. However, the study also found that until the age of 11, peers were considered mainly as a source of social support with teachers providing the main source of academic support.

Research has also indicated that older children consider their peers of the same age as potential helpers more often than younger children do with their peers (Good *et al.*, 1987; Myers and Paris, 1978; Nelson-Le Gall and Glor-Scheib, 1985). Myers and Paris (1978) found that 11-12 year olds were more likely to report seeking help as a strategy for managing difficulties compared to their younger peers. Additionally, an observational study carried out in classrooms of different levels found that 10-11 year olds sought their peers for help in the classroom more often than they sought the teacher's help (Nelson-Le Gall and Glor-Scheib, 1985).

Therefore, it can be established from the research above that at the age of 11, a child's dependence starts to shift from family to peers and that peers are considered as potential sources for academic help. As a result of this initial research, we decided to target our research at pupils aged 11 and above.

2.3 Academic motivation

Research has broadly distinguished two types of academic motivation: **intrinsic** (a learner's inner self-motivation for engaging with a learning activity, such as enjoyment and general interest) and **extrinsic** (where there are external incentives such as rewards, or penalties that occur if the learner fails to complete a task) (Ryan and Deci, 2000a). High intrinsic motivation has been shown to foster high academic achievement (e.g. Gottfried, 1985), however, the effect of extrinsic motivation on achievement has not been as clear-cut.

In addition, motivation can be viewed as a continuum ranging from intrinsic at one end to extrinsic at the other, with learners shifting position according to their personal circumstances, rather than a binary state of either one or the other. This continuum is the view adopted by the Self-Determination Theory (SDT), which suggests that some forms of extrinsic motivation can be integrated and adopted within a person until it eventually becomes part of their intrinsic motivational values. This proposed integration must be aided by the person's sense of relatedness within the environment, of perceived competence and of experienced autonomy (Ryan and Deci, 2000b). We use the term relatedness to mean the user's sense of connectedness to others within a community whilst competence is the capability in a task and autonomy is the 'feeling of volition that can accompany any act' (Ryan and Deci, 2000b, p.74). Therefore, it can be surmised from the previous discussion that the prototype being trialled here should aim to develop intrinsic motivation through the use of extrinsic motivators (such as rewards) alongside features that encourage the user's sense of relatedness, competence and autonomy in an attempt to encourage the development of intrinsic motivational values.

This focus on enhancing academic motivation is of particular relevance to this research as it has been established that children's intrinsic motivation linearly declines as they grow older (Corpus *et al.*, 2009; Gottfried *et al.*, 2001; Gottfried *et al.*, 2009; Lepper *et al.*, 2005). Since the age group targeted here, 11 to 14 year olds, is considered to be less intrinsically motivated than their younger peers, it is of utmost importance that both methods of motivation (intrinsic and extrinsic) are employed in the design of the system.

2.4 Factors influencing help-seeking

Several studies attempted to examine the effects or impact of pupils' perceived competence, being social or academic, on their help-seeking behaviours. Newman (1990) found that intrinsically motivated pupils and those with greater perceived competence were more likely to seek help when needed. Ryan and Pintrich's (1997) finding that perceived social and academic competence was negatively related to help-seeking avoidance further emphasized this. These findings were also supported by Ryan and Shin (2011), who identified a positive correlation between perceived self-efficacy and adaptive help-seeking i.e. asking for help when needed. They also reported a positive correlation between adaptive help-seeking and achievement.

Newman (1990) theorized that pupils who perceived themselves as competent were less affected by the potential costs associated with help seeking, such as appearing inadequate, than those pupils who perceived themselves less competent. His theory was later confirmed by Ryan and Pintrich (1997), who

found that perceived social and academic competence threatened by peers' potential negative views of help-seeking behaviour. More importantly, where help-seeking behaviour was perceived in a negative manner, there was (not surprisingly) an increased likelihood of help-seeking avoidance.

As a result of reviewing the relevant literature in the fields of peer learning, academic motivation and help-seeking, we propose to design and implement a mobile system that would enable 11-to-14 year old pupils to seek and provide academic support to each other. The proposed system will route questions asked by the pupils to their choice of knowledgeable peers. The peers' level of knowledge or expertise on a topic or subject will be determined based on factors such as their previous answers to questions in the same area and the ratings received for those answers. The system will thereby attempt to intrinsically motivate pupils through fostering their sense of competence (as suggested by Ryan and Deci, 2000a) through the calculation and display of the members' expertise as part of each member's profile. Moreover, the pupils' sense of relatedness is fostered by the system through the creation of a connected society of learners who aim to support each other academically. Furthermore, the system will be fully driven by the pupils to encourage their sense of autonomy which is thought to enhance intrinsic motivation (Ryan and Deci, 2000a). The actual design process of the proposed system is discussed in detail in the following section.

3. DESIGN

We have adopted a pragmatic, mixed methods approach to the design, development and evaluation of this study, to give comprehensive insights into pupils' behaviour and their interactions with the planned prototype. We used a grounded sequential design, where the completion of one stage would result in the identification of questions to be investigated further through the next stage. This design enabled further investigative work on any unexpected findings, to help us refine our research questions and methodologies employed at each stage of the work (Mertens, 2010). We started the design of the prototype by carrying out a requirements gathering phase, that is detailed here next, before engaging in low-fi testing and evaluation.

3.1 Gathering Requirements

3.1.1 Focus Groups

Two focus group sessions (N=34) were conducted with pupils aged 11-14 at a local secondary school with the aim of investigating their current help-seeking practices and the tools they utilized to achieve those. A thematic analysis approach was adopted for the coding of the sessions' transcription and two main findings emerged: a) pupils seek support from external sources when faced with difficulties and b)

pupils' expressed a preference for direct one-to-one communication with their potential helpers. However, 14.7% of participants reported attempting to solve their problems individually without seeking any external support. This finding does not align with research in the area of help-seeking (e.g. Good *et al.*, 1987; Myers and Paris, 1978; Nelson-Le Gall and Gumerman, 1984; Silva *et al.*, 2008). We theorized that this contradiction could be either due to the nature of the method used (i.e. focus groups, where pupils might have adopted the opinions voiced by their peers) or there could actually have been a change in the help-seeking trends amongst the age-group being investigated. Therefore, further investigation was required and we subsequently conducted individual interviews with pupils in an attempt to control any peer influences that might have been present in the focus group sessions.

3.1.2 Interviews to Investigate Help-Seeking Behaviours

A total of eight 11-14 year old pupils took part in individual semi-structured interviews where the main topic of discussion was their help-seeking practices. One of the main findings that emerged from the interviews was that all eight participants reported adopting help-seeking as a strategy for overcoming difficulties with academic tasks. This finding corresponds to that stated by Myers and Paris (1978) and therefore confirms our suspicion of peer presence affecting some pupils' claims of not seeking help. Furthermore, several other findings emerged from the analysis of the interview transcriptions:

- (i) A preference for one-to-one communication when seeking help;
- (ii) The need to feel in control over choosing potential helper;
- (iii) Availability of potential helper affects help-seeking decision;
- (iv) The potential helper's subject specific knowledge plays a role in choosing him/her.

3.1.3 Interviews to Investigate Motivational Features in Games and Social Networking Sites

We realised early in this research, the vital role motivation played in the potential success of our proposed system. Therefore, we decided to carry out interviews with pupils to supplement the findings from the literature in motivation (as discussed in 2.3). The main aim of the interviews was to discuss the motivational features of computer and mobile games, social networking sites and a reward scheme in place at their school. This reward scheme was used by the school as an external motivator to encourage better behaviour and performance by the pupils.

Three interview sessions were conducted with groups of three or four 11-14 year old pupils (N=10). A small group approach was adopted as an endeavour to overcome the pupils' self-consciousness and hesitation that was sometimes present in the

individual interviews. It was also hoped that by having a small group, the effect of peer presence, as observed in the focus groups, would be avoided. The interviews resulted in several main findings:

- (i) Pupils had mixed feelings towards the school's existing reward scheme;
- (ii) A preference shown for mobile access to games and social networking sites;
- (iii) The mobility of devices plays a role in recurrent engagement with their games;
- (iv) The importance of sharing game achievements with peers;
- (v) Virtual rewards and achievement indicators can encourage engagement;
- (vi) There was a drive to excel in game skills and achievements;
- (vii) Privacy of communication is vital for help-seeking interaction.

3.1.4 Findings from requirements analysis

The methods discussed above showed a clear preference for direct one-to-one communication between pupils and their potential helpers. They also demonstrated the pupils' need to feel in control of the help-seeking interaction. This need for control was also cited in the academic motivation literature (e.g. Ryan and Deci, 2000b) as a factor that facilitated intrinsic motivation. Furthermore, the interviews discussed in section 3.1.3 demonstrated that extrinsic motivators – the school's reward scheme – need to be used cautiously in order for them to yield the desired effect on behaviour and performance. This was especially apparent as some pupils resented the reward scheme used and considered it to be employed by the school as a means of controlling their behaviour; thereby diminishing their sense of control. The pupils' sense of lack of control, along with other factors, resulted in some (N=4) losing all motivation in interacting with that reward system.

The findings from each of the methods discussed above were translated into a list of user requirements for the proposed system, namely, mobile one-to-one communication with helpers and profiles displaying users' pseudo or real names, school year and expertise level for each subject. Those requirements were the basis for the prototypes discussed in the following section.

3.2 Initial Testing

3.2.1 Low Fidelity Prototype Testing

Two versions of a low-fi prototype were designed, using Microsoft PowerPoint, based on the requirements gathered from the focus groups (section 3.1.1) and the interviews (section 3.1.2); an SMS version and a smart-phone application (Figure 1 and Figure 2, respectively).

Both demonstrated the same functionalities of sending a question, receiving a question, browsing similar questions and updating and viewing profiles.

The two versions differed in the manner of interaction: the SMS-based version required sending and receiving mobile text messages containing simple request codes (such as **Q** for asking a question and **A** for answering one) whilst the smart-phone application version had a more graphical interface that consisted of buttons and text-boxes for performing the same functions.

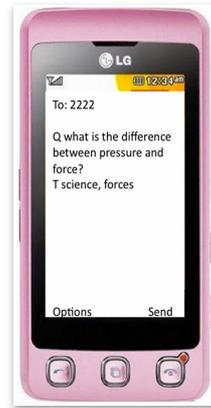


Figure 1: SMS-based prototype



Figure 2: smart-phone application prototype

Both versions were tested by three 11-14 year old pupils, with the SMS-based prototype being tested first. All of the pupils demonstrated a preference for the smart-phone application, although they reported being familiar with using interactions similar to the SMS-based version through their participation in confectionary and soft-drink marketing competitions. As a result, our research efforts were focused on the design of a smart-phone application for our proposed system.

3.2.2 Mobile Prototype Testing

After gathering a more comprehensive set of requirements, following the interviews discussed in 3.1.3, an interactive mobile prototype (Figure 3) was designed using Justinmind (2012).

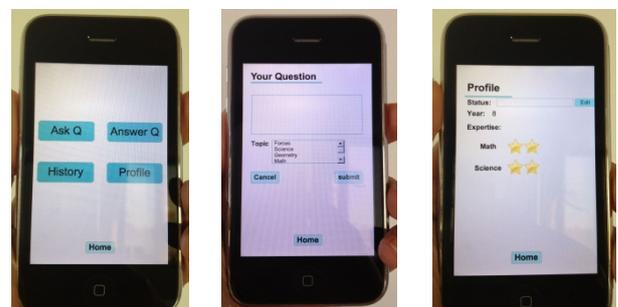


Figure 3: images of the mobile prototype

The prototype was tested by six 11-14 year old pupils using a Wizard of Oz approach (Gould *et al.*, 1983; Kelley, 1984) where the pupils were asked to complete a set of tasks; asking a question, browsing similar questions, updating their profile and searching

for a peer's profile. The pupils had full control over the prototype; the researcher present only simulated the sending of a question from a hypothetical peer and an answer for their question.

Participants were also asked to evaluate the usability of motivational elements visible in the design (i.e. visible expertise levels and rating of received answers). All of the participants stated that they found these useful and four of them stated that having them would motivate them to use the system. Moreover, all of the participants expressed their liking for the '*social networking features*' (as phrased by one of the pupils).

3.2.3 Findings from prototype testing

Testing the first version of the prototype (shown in section 3.2.1) resulted in further requirements for the system that were more in terms of functionality than interface. However, analysing the screen recordings taken during the mobile prototype's testing sessions (section 3.2.2) revealed some interface design flaws such as the inability to browse questions without asking one, the inappropriate positioning of some buttons and the sometimes unclear menu structure. Both of the prototypes' testing sessions have resulted in a more rounded list of requirements that includes both functionality as well as interface elements.

3.3 Summary of findings from design phase

The completion of the design stage of our proposed system has resulted in a complete set of requirements for our proposed system. Additionally, it has provided us with a better understanding for the methods suitable for gaining 11-to-14 year olds' opinions on their practices and behaviours. This understanding will be utilized further along in this research; when evaluating the fully implemented system.

4. CURRENT STATE OF THE WORK

The academic peer support system is currently under development for browser-based access from pupils' mobile devices. Once it is fully implemented, the system will be tested with 11-14 year old pupils over an extended period of time. The numbers of participating pupils as well as the actual length of the study are still to be determined.

5. DIFFICULTIES ENCOUNTERED

The most challenging part of this research has been researching motivation: it is an extensive field with literature in the areas of psychology, educational psychology and computer games. Furthermore, weaving the findings from that research into the core design of our system was another challenge. This challenge was addressed through the grounded sequential design approach adopted in this research.

The interviews (discussed in section 3.1.3) provided insights into the pupils' own experiences towards motivation and helped supplement the findings from researching the literature, which ultimately led to the design of the mobile prototype (section 3.2.2).

6. PLANNED DEVELOPMENTS AND FUTURE WORK

The implementation of our proposed system is planned for the next few months and will be followed by some initial user testing to uncover any implementation or design flaws. This will be followed by a study with 11-14 year old pupils using the system for an extended period of time. The analysis of the data gathered from this study could help inform a further design cycle for the system.

Currently, the system is designed for use by a single school; however, future work could extend this network to include pupils from around the world. Furthermore, the parameters used for calculating users' expertise could be extended to include factors such as response time and frequency of logging on to the system. Another opportunity for extension would be to include contextual information about the users such as their location or their average response time to questions. This could be used by the system upon which to base its suggestions of potential helpers and also potentially to provide pupils with the opportunity to meet their helpers and discuss their queries face-to-face with them.

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REFERENCES

- Amigues, R. (1988). Peer interaction in solving Physics problems: sociocognitive confrontation and metacognitive aspects. *Journal of Experimental Child Psychology* 45: 141-158.
- Bouvin, N. O., Brodersen, C., Hansen, F. A., Iversen, O. S. and Norregaard, P. (2005). Tools of contextualization: extending the classroom to the field. Proceedings of Proceedings of the 2005 conference on Interaction design and children, Boulder, Colorado, pp.24-31. ACM.
- Bowerman, C. E. and Kinch, J. W. (1959). Changes in family and peer orientation of children between the fourth and tenth grades. *Social Forces* 37: 206-211.

- Corpus, J. H., McClintic-Gilbert, M. S. and Hayenga, A. O. (2009). Within-year changes in children's intrinsic and extrinsic motivational orientations: Contextual predictors and academic outcomes. *Contemporary Educational Psychology* 34: 13.
- Damon, W. (1984). Peer Education: The untapped potential. *Journal of Applied Developmental Psychology* 5(4): 331-343.
- Forman, E. (1989). The role of peer interaction in the social construction of mathematical knowledge. *International Journal of Educational Research* 13(1): 55-70.
- Good, T. L., Slavings, R. L., Kathleen Hobson, H. and Emerson, H. (1987). Student Passivity: A Study of Question Asking in K-12 Classrooms. *Sociology of Education* 60(3): 181-199.
- Gottfried, A. E. (1985). Academic Intrinsic Motivation in Elementary and Junior High School Students. *Journal of Educational Psychology* 77(6): 15.
- Gottfried, A. E., Fleming, J. S. and Gottfried, A. W. (2001). Continuity of Academic Intrinsic Motivation From Childhood Through Late Adolescence: a Longitudinal Study. *Journal of Educational Psychology* 93(1): 11.
- Gottfried, A. E., Marcoulides, G. A., Gottfried, A. W. and Oliver, P. H. (2009). A Latent Curve Model of Parental Motivational Practices and Developmental Decline in Math and Science Academic Intrinsic Motivation. *Journal of Educational Psychology* 101(3): 11.
- Gould, J. D., Conti, J. and Hovanyecz, T. (1983). *Composing letters with a simulated listening typewriter*. Communications of the ACM. New York, NY, USA, ACM. 26: 14.
- Justinmind (2012). *Justinmind Prototyper*.
- Kelley, J. F. (1984). An iterative design methodology for user-friendly natural language office information applications. *ACM Transactions on Information Systems (TOIS)* 2(1): 16.
- Lepper, M. R., Corpus, J. H. and Iyengar, S. S. (2005). Intrinsic and Extrinsic Motivational Orientations in the Classroom: Age Differences and Academic Correlates. *Journal of Educational Psychology* 97(2): 13.
- Livingstone, S., Haddon, L., Gorzig, A. and Olafsson (2010). *Risks and Safety on the Internet: The perspective of European children*. London, EU Kids Online.
- Mandryk, R. L., Inkpen, K. M., Bilezikjian, M., Klemmer, S. R. and Landay, J. A. (2001). Supporting children's collaboration across handheld computers. Proceedings of CHI '01 extended abstracts on Human factors in computing systems, Seattle, Washington, pp.255-256. ACM.
- Manion, V. and Alexander, J. M. (1997). The benefits of peer collaboration on strategy use, metacognitive causal attribution and recall. *Journal of Experimental Child Psychology* 67(2).
- Mertens, D. M. (2010). Research and Evaluation in Education and Psychology: Integrating Diversity with Quantitative, Qualitative and Mixed Methods. London, SAGE Publications.
- Myers, M. and Paris, S. G. (1978). Children's metacognitive knowledge about reading. *Journal of Educational Psychology* 70(5): 680-690.
- Nelson-Le Gall, S. (1981). Help-seeking: An understudied problem-solving skill in children. *Developmental Review* 1(3): 224-246.
- Nelson-Le Gall, S. and Glor-Scheib, S. (1985). Help seeking in elementary classrooms: An observational study. *Contemporary Educational Psychology* 10(1): 58-71.
- Nelson-Le Gall, S. and Gumerman, R. A. (1984). Children's perceptions of helpers and helper motivation. *Journal of Applied Developmental Psychology* 5(1): 1-12.
- Newman, R. S. (1990). Children's Help-seeking in the Classroom: The Role of Motivational Factors and Attitudes. *Journal of Educational Psychology* 82(1): 10.
- Ryan, A. M. and Pintrich, P. R. (1997). "Should I ask for Help?" The Role of Motivation and Attitudes in Adolescents' Help Seeking in Math Class. *Journal of Educational Psychology* 89(2): 13.
- Ryan, A. M. and Shin, H. (2011). Help-seeking tendencies during early adolescence: An examination of motivational correlates and consequences for achievement. *Learning and Instruction* 21: 10.
- Ryan, R. M. and Deci, E. L. (2000a). Intrinsic and Extrinsic Motivations: Classis Definitions and New Directions. *Contemporary Educational Psychology* 25: 14.
- Ryan, R. M. and Deci, E. L. (2000b). Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist* 55(1): 11.
- Silva, M. J., Pestana, B. and Lopes, J. C. (2008). Using a mobile phone and a geobrowser to create multisensory geographical information. Proceedings of International Conference for Interaction Design and Children, Chicago, USA, pp.153-156. ACM.
- Sporer, N. and Brunstein, J. C. (2009). Fostering the reading comprehension of secondary school students through peer-assisted learning: Effects on strategy knowledge, strategy use, and task performance. *Contemporary Educational Psychology* 34(4): 289-297.
- Steinberg, L. and Silverberg, S. B. (1986). The vicissitudes of autonomy in early adolescence. *Child Development* 57(4): 841-851.
- Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. London, England Press.