

Benefiting from Electronically Blurred Boundaries between Students and Academics in Problem Based Learning

Manish Malik

University of Portsmouth, manish.malik@port.ac.uk

Abstract - This work highlights the difficulties faced by students and academics in constructivist approaches to Problem Based Learning. Here the learners are required to work in groups, which may occasionally have ‘free-riders’ or ‘passenger’ students. Spotting these ‘free-riders’ tends to be difficult, making fair assessment impossible. Using effective communication tutors can engage students better and avoid ‘free-rider’ behaviour. As shown here, this is best achieved through cognitive congruence. However, doing this in person is a resource intensive task. Instead e-logs were used as it helped identify ‘passenger’ students and provided individual contributions. Most students surveyed agreed that the e-logs afforded individual guidance. Also, as e-logs were weighted more than the group assignments, it motivated students to contribute to own and eventually group work. The author draws inspiration from the ancient Indian ‘Gurukul’ system of education. Also presented here, are the similarities and dissimilarities of the ‘Gurukul’ system with the constructivist approaches of today. Both qualitative and quantitative data was collected and analysed for this study (N =40). We show how electronic tools blurred the boundaries, creating an e-Gurukul system to benefit students and academics alike. Finally, the e-Gurukul approach is evaluated for individual engagement, group participation and knowledge creation.

Index Terms – Free-riders, McMaster Approach, Problems in Problem Based Learning, Gurukul

INTRODUCTION

Several implementations of Problem Based Learning (PBL) are described in the research literature [1]-[11] as a result of a widespread adoption in multiple disciplines [18]. There is no one approach that can be claimed as the only successful approach of implementing PBL. Many implementations deviate from the pure constructivist approach, e.g. The McMaster approach [1] and [2], and either use heavy scaffolding or a mix of constructivist and didactical approaches [3], [5]-[11]. Some researchers present evidence that the pure constructivist approach to PBL (uses minimal guidance and) is in conflict with the human cognitive architecture, hence is less effective and efficient [12]. Others counter this thought and suggest that PBL (is not a minimal

guidance approach and) uses extensive scaffolding to reduce the cognitive load [13]. What this suggests is that there are tensions that exist in the understanding what is meant by PBL. However, one thing does seem certain from different implementations of PBL and this is that PBL is resource hungry [12, 13, 19, 20]. That is, it needs more than the minimal guidance, as suggested in [12], perhaps in the form of extensive scaffolding [13] or direct teaching and other means [3], [5]-[11]. However, the original implementation of PBL suggests that, by using tutorial as the workshop of PBL, it can be successful and work as a pure constructivist activity. In reality many tutors new to PBL take to direct teaching as they find it too hard to loose control of the activities they are used to control [4]-[5]. Switching from tutor to teacher at the first hint of a problem, as the trick all tutors new to PBL know too well is direct teaching. The freedom of learning is often lost [4]-[5] over the freedom to teach. This is mainly true where lectures or didactic methods have been a predominant method of delivery [4]. So that the new tutors can avoid this temptation to switch, three important components for managing PBL effectively, namely cognitive congruence, metacognitive/self-directed learning model and group processing skills, are suggested in [4].

PBL - CONSTRAINTS AND BOUNDARIES

The pure constructivist model for PBL relies, amongst other things, on learning through small group interactions (tutorials) with the facilitator and not through lectures [1]. These interactions can be resource intensive and may be difficult to achieve due to space and time constraints. The way modern universities operate set definite space and time boundaries between the students and their academics. Groups of students get to be in the presence of their tutor for a limited time. This puts limits on what can be achieved in the session and may only suite students used to such sessions. Just as there are student roles that need the attention of student, there are tutor roles that need understanding. There are fine boundaries between these roles, especially for the tutor. However, the tutorial is said to be the workshop of PBL [1] for a reason. There are several guidelines on what a tutor needs to do in a tutorial to aid PBL [16].

It is common knowledge that tutors face difficulties in fairly assessing individuals within groups as some students

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choose not to contribute. In the context of PBL and other collaborative learning approaches the problem is known as that of ‘free-riders’ or that of ‘passenger’ students within groups [14]. These students contribute little or nothing to a group’s work and hope for the same group mark will be given to all students in the group. The reasons for such behaviour is manifold, ranging from differences in writing style, opinion on content, living conditions of students, educational background and life or work experiences to disagreement of the roles played within groups [14]. These disagreements may lead to unwanted tensions within groups and may force some students to dis-engage and take the ‘free-rider’ route. Tutorials should address the range of things on which students may disagree [16].

On the other hand there may still be some deliberate ‘free-riders’ in any group, despite best efforts of the tutors to bridge the gaps between students somehow. Not a lot can be done about such students.

This makes the task of identifying and assessing the ‘free-riders’ a difficult one. Perhaps, this is one of the reasons why new tutors switch back to direct teaching as they realise that the constructivist methods have failed to engage students equally.

If however, the tutorial fails to do its job properly, or is missing altogether in an implementation, it then can force create ‘free-riders’ within groups. Tutors cannot physically interact individually with all students equally to help address this either. That would be too time consuming and resource intensive if done face to face. This may also contribute to the feeling that PBL is resource intensive.

Students are sometimes asked to help identify non-contributing team members, but this is not always guaranteed to work and hence the assessment can be unfair to those who do pull their weight along in doing the PBL tasks. Can the identification of ‘free-riders’ or ‘passenger’ students be achieved electronically?

This paper investigates how in the absence of a face to face tutorial, PBL can still work. The existence of free-riders cannot be denied but the identification and assessment can be improved upon.

‘GURUKULS’ AND THE CONSTRUCTIVIST APPROACH

This brings us to the similarities between today’s constructivist approaches and ancient Indian ‘Gurukul’ system of education. A ‘Guru’ is a teacher and ‘kul’ means family – meaning the teacher’s family. A gurukul was a place where the ‘Shishyas’ (small groups of learners) used to live together with their Gurus in a small community. The Shishyas would help the Gurus in their daily chores in return for their ‘Gyanaa’ (knowledge), ‘Sangat’ (company) and a place in the gurukul. The gurukul was seen as a very conducive environment for learning. Learners would choose to go there to become reflective practitioners and as seekers of knowledge. At the Gurukul they would regularly engage in meditation, verbal debates with other learners in the presence of their Guru(s). The Gurus would play the role of a keen listener and a guide in making the discussion reach a

meaningful outcome. Some of these approaches find reflections in the modern constructivist approach where knowledge is constructed by sharing and discussions between the tutor and their students –in tutorial or what is known as the workshop of PBL. In Gurukuls the tutorials happened in the same place the learners lived and worked.

Moreover, as the Guru(s) and the Shishyas lived in the same place, they both could approach each other for one to one discussions any time of a working day. The Guru would thus be aware of each individual Shishya’s progress, their capabilities and contributions they made to group activities. In today’s constructivist approach, of course, not all of this is practiced. Only the group activities seem similar in the two approaches. Space-time and role boundaries along with personal priorities prohibit us from reaching out to the individual learner and practice cognitive congruence for effective communication with them [15]. We seem to stop ourselves at a point at which we only deal with small groups. However small, these may still encourage or even force at times some students to take the ‘free-rider’ route.

THE E-GURUKUL APPROACH

The Department of Electronic and Computer Engineering at University of Portsmouth introduced PBL in some of its courses in 2004-05. Since then, many academics have taken to the instruction free delivery as promised by PBL. As a policy decision the tutorial is replaced by supervised lab sessions for multiple groups doing mainly lab based activities. Tutors, however, have taken to the idea of being a facilitator in these sessions. The difficulty of course is that there is more than one group to facilitate and there is not enough time for that.

The data and its analysis reported in this paper are from a PBL that required students to engage in group research and find answers to some ill-defined problems. Therefore, additionally the students here were not timetabled for any sessions in the labs. They had to plan their own meetings and ‘meet’ the tutor via web forums.

All facilitation for this PBL was afforded via electronic means. The groups engaged in discussions using dedicated asynchronous online forums. The group forums provided an opportunity for the tutor to promote in a group the awareness of its own processes and encouraging peer feedback, both of which are necessary group processing activities [4], [16] and [18]. The forums provided the students in a group a channel to organise and progress their work via informal discussions.

As part of the e-Gurukul approach, the author thought that the forums would afford the much needed group processing component by providing a non-threatening channel of communication where ‘work and fun can be mixed’ [1], [4] and [16]. It would also provide support for the ‘metacognitive model’ allowing tutors to ask questions, without giving answers, in a way a professional would ask themselves at work [4]. However, a forum based group interaction may not necessarily be as effective as an individual guidance when dealing with the problem of ‘free-riders’ in groups. This can be explained with the help of the

term ‘cognitive congruence’ or ‘the ability of the tutor to express oneself in the language of the students, using the concept they use and explaining things in ways easily grasped by students’ [15]. This is because if there are ‘free-riders’ in a group they may only superficially engage in the group forums or even worse, just passively read the posts being made. The later can be said for any student for that matter. Therefore, the forums do not afford the possibility of using cognitive congruence with all students equally. To do this another tool already being used in the department was identified – the learning logs of the student. These logs could easily be shared creating a channel of guidance or feedback also making it ideal for using cognitive congruence [15]. Learning logs have been used in past to study the role of feedback in PBL but not necessarily as a vehicle for one [16] and [17].

When shared with the tutor these logs may be used for the articulation of what an individual student knows and what they need to learn. It is the individual who accepts responsibilities to seek information and bring it back to the group [18]. Therefore a good PBL design should make it possible for the each student to be able do this articulation individually. But sharing of the paper based logs was not possible as the students needed these all the time to make notes and read from it.

In order to address the above concerns the author decided to modify the existing practice from maintaining paper based learning logs to maintaining electronic logs (or e-logs). The reason for this was three folds as detailed below:

- Firstly, any guidance given using these logs were either disruptive to the process of keeping logs (space constraint) or not timely (space and time constraints). Both were considered not acceptable in the e-Gurukul approach.
- Secondly, as it follows on from the first, the department’s practice was to assess learning logs at the end of the semester, it was then often too late for spotting ‘free-riders’ or for the students to benefit from it. This gave some students the opportunity to ‘tidy’ or ‘update’ their logs for gaining higher marks. Defeating the purpose of keeping logs in the first place.
- Finally, if students were to bring the logs at different times and seek feedback individually then there is a danger that not all students will be able to do this in the office hours and hence the guidance will be non uniform. It would be too resource intensive otherwise.

The author spotted the opportunity of using e-logs within the Virtual Learning Environment (Blackboard) hence forth referred to as ‘Victory-VLE’ by its local name. This afforded the author and the students to share their e-logs outside normal space and time constraints with their tutor. The author disallowed the edit of these logs by the students and sharing of it by students with each other. The students were required to update their e-log entries every week. The marking criteria provided guidance on the quality of the entries. The e-logs carried more marks (70%) than the

actual group work (30%), actually putting the onus back on to the individual to contribute and seek new knowledge [1]. As different students updated their logs at different times, work for the academic was spread over the week. Uniform yet individualized guidance was given to all students who update their e-logs. Some students posted very little or none at all. This shows that the e-logs actually discouraged them to take to the practice of ‘tidying’ or ‘updating’ their logs. Having to make weekly entries may be the reason behind the discouragement. Also, the tutor could create a set of comments and questions before hand. They can then modify these for different students, saving them time in going through the e-logs of all students each week. The frequency may also be adjusted in case the activities take longer to progress.

Using the forums and e-logs together the boundaries of space and time were blurred for the benefit of both the students and tutor. For the student it meant that the supervisor (or fellow students) was virtually present all the time for engaging in discussion or for seeking guidance. For the academic this meant that each student’s way of working and the knowledge acquired was known, enabling cognitive congruence and personalised guidance via e-logs.

EVALUATION OF THE E-GURUKUL APPROACH

Data was collected using both qualitative and quantitative methods to help find evidence to support the emergent theory and to refine it further. The aim of the data collection was to evaluate the effect of the e-Gurukul approach on a student’s individual engagement, participation in group work and knowledge creation. Quantitative data from questionnaires, and student performance (marks) were used. There were two questionnaires used, one was distributed electronically and the other was collected by an independent educational consultant in class. Both contained several Likert scale questions. The survey was done after all the assessment was carried out and marked. Qualitative data was taken from the e-logs by extracting representative comments made by students. Equal numbers of sample comments were taken from different mark ranges to get a feel for various comments categories within the e-logs.

I. Findings from the two student questionnaires

Only 11 students completed this questionnaire of the 42 who received it. The response rate being low we remain vary of the findings from this questionnaire in the analysis. The first 6 questions examined the collaboration within groups and revealed that 70% thought that the collaboration was successful in their groups (30% strongly agreed). 60% agreed that forums were the crucial for successful collaboration. Again 60% respondents thought that ‘e-logs aided the collaboration in their groups as individuals were required to keep records of their progresses’. Only 30% agreed that the collaboration failed as they did not have a timetabled event to meet and organize their activities. There was 0% students that blamed the technology used on the failure to collaborate.

TABLE I
PERFORMANCE AND GROUP FORUM USAGE

Group (strength)	Average E-log Mark	Assignment Score	Standard Deviation (E-log Marks)	Normalised Forum Posts (Avg/grp = 8)
A (4)	63	30	15	0
B (4)	44	37	16	.5
C (5)	80	83	0	37
D (3)	73	70	5	14
E (4)	64	65	17	0
F (6)	56	70	18	3
G (7)	57	73	32	6
H (6)	62	43	23	5

Next 8 questions examined the use of e-logs in the PBL work. 80% agreed that ‘e-logs were a good way of being involved with the assignment’. 80% found the ‘feedback and guidance give useful to complete the assignment as required’. 50% found that ‘without the e-logs the dialogue between them and the academic would be stalled greatly’. Another 10 questions examined student expectations and outcomes. 60% ‘expected feedback via e-logs’ (and all got it). Only 50% ‘expected guidance or feedback via the group forums’. 80% were ‘confident that they can do group work both online and face to face in future’. Only 20% (0% strongly) said ‘they do not want to use e-logs in future assignments and 30% remained neutral’.

The second questionnaire was much shorter and had only 4 questions. This was completed by 30 of the 42 students registered for the course. More than 70% agreed that ‘they had received formative feedback via the e-logs’. Other questions on the questionnaire were to do with research activities and learning resources. 90% agreed that ‘the unit provided them with good opportunities to collaborate with other students’.

II. Findings from student performance on the e-logs and group work

Students were marked for their coursework using two elements – the e-logs and the group work assignment. There were 40 students divided in 8 groups of 3, 4, 4, 5, 5 (later 4 and 1), 6, 6, and 7 students. The varying group size was due to incorrect information. Table I, above shows the performance of the teams and their group forum usage. Each student was awarded an e-log mark. An average e-log mark along with its standard deviation is presented in Table I. Each group member was also awarded the same mark for their group assignment work.

Starting with Group A, we notice an average e-log mark of 63 and a standard deviation of 15. This indicates all students made good personal efforts in their logs. However, an assignment score of 30 seems a little odd. Looking at their posts it becomes clear that the students did not engage in forum based collaboration. Clearly, students seem motivated to do their own work. This needed a little further investigation.

Reading the logs suggest that two of the four team members used online chat sessions three times within Victory VLE. This was confirmed by looking at the ‘tool usage statistics’ in victory. It is clear that the two who did engage in some collaboration online did not get enough done. Clearly the tools were there to collaborate but the group chose not to use them for some reason. This reflected in the overall mark for the coursework and the logs differentiated the two who did not engage in collaboration.

Looking at the performance of group B, a low average e-log mark of 44 and a standard deviation of 16 indicates that student e-logs were of varying standards. The assignment score for this group is 37, indicating the standard to be unacceptable. This indicates that perhaps the team did not work well together and or that there were fewer members that did well in individually. The former is reconfirmed by looking at the number of forum posts of only 0.5 (normalised) against an average of 8 per group. The later is also reconfirmed by looking at the e-log marks of group B where only one student had a mark of above 42%. Once again the student who put in their effort were not penalised for the group’s failure.

For group C we see the highest average e-log mark and a standard deviation of ‘0’ along with the highest number of posts. Further, the members of this group made the maximum number of e-log entries. They attained also the highest assignment score of 83. Not much needs saying about this group as it is an example of good students working together to complete their assigned tasks.

For group D we see a very similar picture to group C. They also seem to have collaborated well (14 posts) using the forums. A low standard deviation of 5 marks shows that all students contributed comparably.

In group E we see an average e-log mark of 64 and a standard deviation of 17, indicating that the student e-logs were of varying standards. A relatively higher assignment score shows that some group work did happen. This could mean that some students were engaging while others were not. Clearly the web forums were not being used to achieve the collaboration or knowledge creation. Further looking for evidence in the e-logs of this team of 4 it became evident that three members have been meeting in the cafeteria and elsewhere to advance their work. The e-log marks of this group also say the same story. Only three members of this group had high marks for their logs.

Group F has students with varying abilities as indicated by the standard deviation in the e-log marks. The forum activity is below average. Perhaps that is where this group makes up for a lower average e-log score. In fact in this group all but two members were using the group forums to work together on the assignment. They did manage to put together a group report. As a result the entire group gets a higher assignment score but the e-log marks differentiate students who contributed and who didn’t.

Group G has some very high and some very low e-log scorers as see by the average value of 57 and standard deviation of 32. With forum posts for this group at near

average it indicates that only a handful people were contributing in this group. They manage to submit a decent piece of work as indicated by the marks. Again this case demonstrate that if there were students taking the ‘free-rider’ route they were identified and penalised with a low e-log mark.

With group H we see an average e-log of 62 with a high standard deviation of 23, meaning a range of e-log marks and varying abilities of students in the group. The forum posts indicate partial or low engagement in online collaboration. Further inspection shows that the collaboration took place initially at the start by all members and later mainly by 4 of the 6 members and in the week up to the deadline. Clearly some of the students decided to do complete the assignment that too at the last minute. The other decided to take the ‘free-rider’ route which did not pay off as they got a much lower e-log mark than others. The low assignment mark is due to the other four leaving it too late to put things together effecting the quality of the work.

III. Findings from student’s e-logs

The e-logs proved to be a rich source of data that provided insights into how students engaged with their PBL work. The comments were analysed iteratively to identify the emerging themes. Representative sample comments were extracted from e-logs in different mark ranges, i.e. 20-30%, 30-40%, 40-50%, 50-60%, 60-70%, 70-80% and 80-100%. There were a lot of common themes in this data, like comments on ‘Personal efforts in researching about the tasks’, ‘Personal contributions’, ‘Summaries of resources read and links’, ‘Reflections on the researched information and on the resources used’, ‘Acknowledging other group member’s work and sharing of information with each other’, ‘Planning, managing and doing group work’, ‘highlighting difficulties’, ‘intentions of doing or starting certain activities’ and some ‘general reflections in response to academic’s feedback’.

Majority of the entries in the e-logs were claims of personal efforts and contributions, such as ‘I have typed up a table which I have attached as a picture’ or ‘I have found this technique that transmits multiple copies’. For a group working well or not, each member needed to make personal contributions so the fact that these types of comments were commonly found in a majority of the e-logs is not surprising.

Entries under the category ‘summaries of information read’ were the next most common type of comments in the e-logs. Recording references and links to these resources was a practice observed by those who achieved top marks in their e-logs. This shows commitment to the task at hand and accountability. Also the links or references were later shared with other group members for discussion by the students getting higher marks for their e-logs.

Another comment category was ‘Reflections on the researched information and on the resources used’, examples under this category are ‘IEEE has allow(ed) me to be pointed to and see any flaws in the spec and also be able to understand it at a lot more deeper level than I would, if it

wasn't for this article’ or ‘Because of the nature of Wikipedia, the information contained in these articles cannot be seen as 100% accurate.’ These comments were common in all e-logs that were in mark ranges above 30-40%. Students were repeatedly told in class to be careful in choosing the resources and reflect on the reliability of the same in their e-logs.

Comments about each other’s contribution from time to time and working together at different occasions definitely provided an insight into a group’s working. Some examples of such entries are ‘X has just found a good resource on 802.11n but it focuses mainly on the MAC layer + a link’ and ‘Both me & Z have compiled some great findings and are in the process of uploading each one’. These comments were common in e-logs of students who scored above 60% for their e-logs.

Comments that talked about difficulties were common in student e-logs that were below a score of 40%. So were the comments that showed intentions of starting some activities only to find out that there were no further comments that showed progress.

Planning and doing group work related comments were also common in the e-logs that achieved a score greater than 40% for their e-logs. The higher the e-log marks the more the number of such comments to be found in them.

DISCUSSION

The above findings reinforce the findings [19] that there is a possibility of students taking ‘free-rider’ approach. The e-Gurukul approach may not stop all students from doing this. What it allows is the identification of ‘free-riders’ and a fairer assessment of students. A significant number of students felt that without the use of e-logs their dialogue with the academic would be greatly stalled, demonstrating that the tutor hit a chord of cognitive congruence with these students. The e-Gurukul approach helps engaging individual students in this way. It is perhaps these students who are always at risk of switching sides and become forced to take the ‘free-rider’ route. It will be plainly pointless for anyone to attempt going down this route.

One may argue that the practice of ‘tidying up’ and ‘updating or plagiarism’ of e-logs can be done in this system too. In the current implementation the edit mode to the e-logs was deliberately disabled, however, the students were allowed to make as many posts as they wanted. The e-logs were required to be updated on a weekly basis, and even if someone was to plagiarise these, then they would have to do so each week. Moreover, the marking scheme encouraged the highlighting of contribution from self and others in the e-logs. Making the e-logs difficulty to copy and modify, even more so on an ongoing basis. The marking scheme for the e-logs encouraged collaboration and creating knowledge by engaging in discussions with each other. The guidance students got from their academic via e-logs also helped them identify what mattered for their group work to be successful [21]. Students asked questions to the academic via the e-log, showing that a new channel of communication was setup in

both the directions, and that they were in the knowledge seeking role [1] and [18].

A lot of students agreed that there was opportunity to collaborate with other students in the unit and that this collaboration was successful. Majority of the students thought that this success was due to the use of e-logs and group forums – in effect the e-Gurukul system. Thus the e-Gurukul approach helped students understand the tasks and encouraged group based collaboration. There are a significant number of students in this instance of the PBL who got low e-log marks or got identified as students not contributing (30%). Table I clearly shows that the problem may still exist as the standard deviation on e-log mark greatly varies from one group to another. Those who witnessed a failure of the collaboration (30%) felt that this was due to the lack of timetabled events to allow allocated group members to get to know each other. This feedback has been taken into account and future presentations of the unit will have a session or so to introduce the team members to each other so that they can continue to work online later.

At many occasions the students in the department have even declared the Victory-VLE as ‘useless’ and have shown dislike for it. However, 0% surveyed in this unit has blamed technology or the VLE for the lack of collaboration in their group. Generally, where the standard deviation on e-log mark is low and collaboration is above average the group work assignment also has a higher mark, indicating that the approach promotes the right sort of things that promote knowledge creation.

CONCLUSION

PBL has several successful implementations across many disciplines in Higher Education including engineering education. Similarly it has several problems associated with it, some due to its resource intensive nature and some due to group assessment. Likewise strategies have been proposed before to manage PBL properly [19]. The eGurukul approach detailed here puts the onus on an individual to seek knowledge from various resources [1], including the expert and get rewarded for that. The approach acknowledges the absence of small group tutorial sessions in some implementations of PBL and provides solutions to counter the lack of this otherwise necessary element of PBL.

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