Innovate - Educate

Conference Proceedings

Annual Conference of the South African Computer Lecturer’s Association

July 6 – 8, 2011
Fairmont Zimbali Resort
Ballito, KwaZulu-Natal
South Africa

Editors: Manoj S Maharaj & I Govender
Colleagues,

Welcome to SACLA2011.

I trust that you will all have an exciting and fruitful conference at this excellent venue.

As always, it is intended that SACLA will provide participants with an opportunity to interact and share ideas in an informal environment, while maintaining a high level of academic input from all involved. You are encouraged to participate fully at the conference and to use the breaks and evenings to meet new, and reacquaint yourselves with old colleagues.

The year we have 27 peer reviewed papers as well as 4 papers for which the authors have not requested a peer review. All 27 papers are of the highest quality, having passed through a rigorous double-blind peer-review process. In addition we have scheduled a workshop that will probe the meaning and value of an IS/IT/CS graduate. This promises to be an interesting discussion and you are encouraged to participate should your schedule allow.

In any conference, the quality of the outcome rests on the shoulders of the organising committee. I wish to extend to all members of the committee my sincere thanks and congratulations for a job well done. I am sure that you will not be disappointed.

Also, on behalf of the SACLA community, I wish to express our deepest appreciation to all our sponsors.

Once again, welcome to the warm Durban winter. Enjoy the sun, sea (beware of the sharks), and the beautiful Fairmont resort.

Manoj Maharaj
SACLA2011, Conference Chair
Message from the Academic Subcommittee Chair

Colleagues,

It is with great satisfaction that I compile the papers after an intense period of reviewing. I extend my thanks and appreciation to the reviewers who provided timely and insightful reviews without complaint and little credit. The authors were amenable and willing to meet the deadlines that are so important for the smooth running of the process of submissions and review. I thank the authors for using this forum to share and participate in the event as well as their patience for awaiting their feedback. I am looking forward to meeting all of you at the conference.

The selection of papers reflects and promotes current trends in technology and teaching methodologies in Computer Science and Information Systems. This is in keeping with the theme Innovate-Educate from which emerged a varied and interesting mix of research papers. To further enhance the conference experience, a panel discussion on Graduateness of computing students in South Africa has been planned and will be led by Prof Jan Kroeze from UNISA. The discussion includes panel members from different universities.

**Paper submissions**

SACLA 2011 received an initial submission of 56 abstracts which were reviewed by a core academic committee and subsequently 41 abstracts were accepted for expansion into full papers. These papers were then submitted and underwent a double blind, peer review process. Thirty-two reviewers from all over the country were involved in the review process. Twenty-eight papers were finally accepted for the conference proceedings on the basis of the double blind, peer review process. Twenty-seven papers appear in these proceedings as one paper was withdrawn. These papers came from all parts of South Africa and abroad.

Four extended abstracts were submitted for the non-peer review stream and these were accepted in the final programme for presentation only.

Irene Govender
SACLA2011, Academic Subcommittee Chair
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Rocking the boat
An approach to facilitate formation of effective student teams

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ABSTRACT
Teamwork has been identified as an important skill for Software Engineering. Apart from being a skill required by industry for Software Engineering, teamwork is extensively applied in educational settings to support collaborative learning in all disciplines. We describe a process we applied for teaching teamwork in a Software Engineering module. We dubbed the process rock the boat.

Our objective with this process was to create an opportunity for our students to experience some of the advantages and problems of working in a group before they formed teams in which they had to work for the rest of the year. This is done to equip students with experience and knowledge about teamwork. After completing this process, the students are expected to form their own teams. We believe that the skills and knowledge they acquired through this process supported them in forming teams that are likely to succeed. We hope that the work they do in the rock the boat process also contributed to their experiencing the work they do in their teams thereafter, as plain sailing.

The process entails expecting students to work on well defined assignments for short periods in teams where high risk factors were induced. Through experiencing these short bursts of intense team tribulation students are prepared to handle events and situations related to team dysfunction. Students are also exposed to working with a large number of classmates. This enables them to meet and work with many of the students among whom they had to select their final team members.

We describe the theories that contributed to the design of this process and how we implemented the process. We then describe how we gathered information about student behaviour and discuss our observations. We conclude with remarks about the potential success and possible improvement of the process, as well as future research directions.

Categories and Subject Descriptors

General Terms
Team formation, Social loafing, Diligent isolate, Teaching teamwork

1. INTRODUCTION
Equipping students with effective teamwork skills is crucial in all disciplines. Consequently, many Software Engineering (SE) programmes include team projects [8]. Team projects in SE education provides training in collaborative project development [3]. The success of teams is related to the level of interdependence experienced by the students. It often happens that group projects in tertiary education are assigned without providing students the information and guidance prescribed by cooperative learning advocates [4]. Koppenhaver and Shrader [12] cite a wide variety of research that addresses the problem of facilitating effective cooperative learning, but contend that the creation of effective workteams has not been adequately addressed.

The process, which we call rock the boat (RTB) was applied to teach teamwork and to facilitate the formation of effective student work-teams for a third year SE module. RTB exposed the students to situations where they could learn social skills required for teamwork in a protected environment. Students were expected to make errors related to inexperience within teams ad learn from these mistakes. However, the long term negative impact that may be caused by such errors, was obviated.

2. AIM OF THIS ARTICLE
This paper reports our teaching experience in implementing a process to teach teamwork and to guide our students to form teams which are likely to be successful. It can be classified as action research within the interpretive paradigm. We explain our actions and the rationale behind them and report our observations of student behaviour.
We hope that other educators can apply what we have learned through this experience. The process as well as the techniques used during the process may have reusable elements. Our opinions related to the occurrence of social loafing and diligent isolation may stimulate further debate and research.

3. GROUP DEVELOPMENT STAGES

A theory that describes a developmental sequence that can be observed in small groups of all kinds in various settings and with diverse goals was proposed by Tuckman [18] in 1965. It is currently widely accepted and applied. An appreciation of this theory is needed to recognize the rationale behind RTB. Tuckman identified the following four stages:

3.1 Forming

This is an orientation phase during which the members get acquainted. It is characterized by testing that serves to identify the boundaries of both interpersonal and task behaviors.

3.2 Storming

This is a phase during which relationships are established and the goals and roles of the members are agreed. It is usually characterized by interpersonal conflict and tension especially if the situation requires members to tread unfamiliar terrain, for example to follow if one is used to leading and vice versa.

3.3 Norming

During this stage the conflicts are resolved. It is characterized by acceptance of the idiosyncrasies of fellow members and the emergence of group cohesion. Group norms are established and the task goals are clearly defined and agreed upon.

3.4 Performing

At this stage the group has become an entity through the successful completion of the previous phase. It is characterized by the emergence of solutions and successful task completion through the effort of the team as a whole rather than by the combination of a number of solitary efforts.

4. TEAM SIZE

Two problems caused by large teams have been noticed. The one being increased occurrence of social loafing and the other increased difficulty in coordinating interaction and collaboration.

Ingham et al. [10] established that social loafing (also known as the Ringelmann effect) positively correlates with group size. Colbeck et al [4] report that students noticed that the potential for slacking increased as team size increased. It is more likely that social loafing may go unnoticed as team size increases [11].

The interaction costs increase as team size grows [1], making it more difficult to coordinate the efforts of the team. In larger teams, it is more difficult to reach agreement on objectives and engage all members adequately. Curra et al [5] mention decision making, achievement of consensus on quality issues, and elicitation of unanimous support for innovation as areas where it is crucial that members be engaged. Colbeck et al. [4] observed that some students who were expected to work in teams larger than four or five, initiated a strategy where they subdivided into groups of two to four members[4].

Conner states that the ideal team size for student teams is four [5], while Boehm et al [2] observed that teams with five members were more efficient than teams with six members. Steenkamp [17] also cautions that student team size should not exceed five.

5. ACADEMIC ALIGNMENT

The distribution of the academic ability of team members may influence team success. A team where the members are homogenous in terms of academic abilities, skills and goals is said to be academically aligned [15]. Academic alignment can be expressed in terms of the standard deviation of a standardized aptitude measure of the individuals in the team. Consensus on the relation between academic alignment and team success has not yet been established. Often un-aligned teams are deemed the standard without considering the implications.

When teams are formed with inter-team balance in respect of academic abilities, the intra-team academic abilities are often unaligned. In cases described in the literature, the reason for forming teams with a balance of inter-team academic abilities is to have equity in the distribution of team experience. We agree that in doing so, the chance of success is equal for all students. However, we maintain that this chance is equally low for all. Smith et al. [16] observed that more able students tend to become frustrated by the inability of some team members to contribute in accordance with their expectations.

Smith et al [16] and McKinney and Denton [13] observed higher occurrences of conflict experienced by teams with unbalanced skills. Because conflict may have a negative impact on team performance, we are convinced that academically aligned teams are more likely to succeed.

On the contrary Koppenhaver and Shrader [12] hypothesized that academically unaligned teams will perform better. In their study they established support for this hypothesis. This anomaly can possibly be explained by their team assignment heuristic. All the teams in their study were unaligned. Furthermore, the teams that were assigned the strongest students were more likely to be less aligned because they aimed to equalize the average grade point of the teams. This may have contributed to better team performance of the less aligned teams caused by the presence of academically stronger individuals.

6. PARTICIPATION LEVELS

RTB was designed to instigate the prevalence of unequal participation levels. The intention was to provide for maximal learning opportunities. The students are confronted to deal with such situations and through such experience learn how to avoid it.

Here we specify some of the prominent eccentricities of the levels of participation we have observed. We use this specification to analyse the levels of participation of the students. We acknowledge that the level of participation of one individual is dependent on many factors and may change from one situation to another. It is also important to take note that these levels are not discrete. The level of participation of an individual is on a continuum between social loafing on the one extreme and diligent isolation on the other.

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6.1 Diligent Isolate
The term diligent isolate is used to refer to an individualistic member that relies only on himself/herself to complete the tasks at hand. A diligent isolate dislikes team work [9] and willingly increases his or her effort, not only to complete his or her own tasks exceptionally well but also endeavor to redo or improve the work of other members. A diligent isolate sees others as ineffective and incapable [9] and as a result may discourage the participation of other members [14].

6.2 Worker prepared to do more (W1)
In our setting W1 refers to a member who takes a great deal of responsibility to ensure that the required work gets done and usually works harder than is expected. Unlike a diligent isolate who is usually unwilling to delegate some of the work, a W1 succeeds in motivating and allowing the other team members to participate.

6.3 Worker does only what is expected (W2)
W2 refers to an individual who is likely to accept the decisions of others without consideration. This is usually done to avoid conflict, or extra work. A W2 will not disappoint the team if he/she is expected to complete specific tasks, but lacks initiative.

6.4 Social Loafer
The term social loafer refers to an individual whose contribution is perceived to be inferior to that of others in a team. The social loafer delivers less than is required. They often take credit for work that others have done [16].

7. SETTING
This research was conducted during the first six weeks of a SE module presented at the University of Pretoria. The module is presented on third year level. There were 64 students registered for the module. In this module the students are required to form teams in which they work on a fairly large industry based software product. One of the goals of the module is that students should experience the planning, design and implementation of a year long project.

Before work on the project commenced, RTB was applied. During the implementation of RTB the students were expected to create the deliverables associated with the waterfall model of software development. This was required for a medium sized project. This project involved the design and implementation of a system to manage a gardening service. The system should enable mobile communication between a large number of task teams in the field with the head quarters of the company. Among a variety of management functions, it was deemed important that it should support the automation of real time scheduling of gardening tasks that have to be performed in the field.

RTB was implemented in four rounds. Students were expected to work in teams that were assigned by the lecturers. New teams were assigned for each round. Each time ten teams, each with six or seven members, were formed. For each round all teams had to complete the same assignment.

For each following round the deliverables of the previous round served as the specifications for the round. All teams had to use the same model solution of the previous round. Each round also had clearly specified deliverables.

8. THE DESIGN OF RTB
Our main concern is facilitating the creation of effective student teams. The collaborative learning environment of teams supports the students in learning the content of our SE curriculum. The process we designed and applied to achieve this was dubbed rocking the boat. This is a metaphorical description of the most prominent feature of this process, namely the unsettling of the students. We deem this unsettling beneficial for creating opportunities for learning teamwork skills through experience.

We base the design of RTB on our understanding of the levels of student participation in teams as described in Section 6 as well as the factors that contributes to these phenomena that were mentioned in Sections 4 and 5.

The ability to be an effective team member comes more naturally to some students than others. The behaviour of a student in a team is related to existing knowledge and skills, personal preferences, and experience. The behaviour of the other members of the team may also play a role.

One of the symptoms of ineffective teams is the occurrence of social loafing. Social loafing is problematic because a student does not learn or practice the technical skills required for the task involved [15]. Furthermore, the marks of social loafers may not reflect their abilities. Donnan [7] highlighted how institutional assessment policies are devised to counter this.

Our intention is to address the causes of the problem rather than treating the symptom. It is possible that social loafing is caused by the occurrence of diligent isolation [15]. The occurrence of diligent isolation is problematic because it has a demoralising effect. Diligent isolates also run the risk of burn-out. For this reason we aim to create an environment in which a student who is inclined to diligent isolation can realise how his/her behaviour has a negative effect on the team and how it can be avoided.

Having the aim of unsettlement in mind, RTB was designed with the intention of maximising both social loafing and diligent isolation.

Tuckman’s [18] theory of the development stages of groups as discussed in Section 3, suggests that teams can reach their performing stage sooner if they know how to move faster through their storming and norming stages. Therefore, the development of norming skills is bound to enhance the ability of the students to work effectively in teams. With RTB we intend to create multiple storming stages and norming opportunities to facilitate the acquisition of the skills the students need to move into the performing stage.

The storming stage of team development requires reasons for conflict. We achieve this through the introduction of factors known to contribute to team conflict. The intention is to expose the students to as many situations as possible, where they are forced to learn conflict resolution skills. We also provide a structured method of reflection as a norming opportunity in the form of a peer reviews.

8.1 Risk factors
The essence of RTB is the introduction of risk factors to maximise opportunities to learn teamwork skills. The different risk factors are introduced to varying degrees as shown in Table 1.

As discussed in Section 4 team size is a risk factor. Larger teams are more at risk of failure than smaller teams. Every round the students were assigned to teams of six or seven
members. These teams were deliberately larger than the ideal. By doing this we introduced the same high risk to all teams in all the rounds. This is represented by a ● for the large team size factor for each round in Table 1.

Koppenhaver et al [12] associated the occurrence of change of team members with instability. They identified instability as being detrimental to team performance. Regular reassigning of teams created high degrees of instability. In all rounds, except the third round, all the students were assigned to teams with members they had not worked with before. In the third round some pairs who had previously worked together were assigned to the same team. This is indicated by a ● for the first, second and fourth round, and a ○ for the third round for the instability factor in Table 1.

The risk factor of academic diversity was different from round to round and is discussed in more detail in Section 9. It should be noticed that overt attributes such as gender, race, culture and age were not used as criteria for team selection. However, it is likely that the teams contained a fair mix of these in every round, because of the diversity of our student body.

### 8.2 Peer reviews

At the end of each round the students were expected to complete a peer review. The main purpose of the peer reviews was to provide a structured opportunity to reflect on their teamwork experiences of the round. Drake et al [8] report that students learn a great deal by reflecting on themselves as individuals within a team environment. Our students could use these peer reviews to identify and reinforce their experiences within their teams.

The questions that they had to answer were intended to guide them to reflect on their own contributions as well as those of the other members. These questions were exactly the same for all four rounds.

Firstly they were asked to select one of the following options to describe their participation.

- The members of my team should be aware that I have worked hard.
- The members of my team may think that I have slacked.

They were required to give a reason for their selection in a written paragraph. They had to think about how their peers had experienced their level of contribution. It often happens that students do not realise what impression they make on their peers if they are not forced to think about it themselves.

Next they were required reflect on their commitment to the team. In our experience, students tend to report equal contribution and commitment for all members when asked to quantify member contribution or commitment. This happens even if they are aware of different levels of contribution. In order to force the students to think more deeply about the commitment of each member and provide more useful information, they were asked rank their team members in order of dedication to the project. This action required them to reflect more on the attitude of the members than their actual contribution. It also required self-reflection because the students had to include themselves in the ranking.

They were asked to write a paragraph about each member saying something positive about him or her. It is easy to criticise. Consequently students often fail to observe positive attributes. This question was included to help students develop the habit of looking at others in a positive light.

They had to evaluate each member’s contribution quantitatively as well as qualitatively. They were also expected to do this for themselves. The quantitative measure was in terms of the time they estimate the person spent on all the tasks allocated to him/her regardless of the nature of these tasks. Their perception of the quality of the the work was measured in terms of assigning a mark out of 10 to specific tasks. They had to nominate two tasks that each member had performed, selecting ones that represented that member’s best and worst contributions. They had to assign a qualitative mark as well as estimate the time it took the person to complete each of these tasks. The average quality of the total contribution of each member could thus be determined by taking the time consumed by the nominated tasks in relation to the total time into account and calculate a weighted average.

By doing this exercise we hope that the students could compare their own contribution to those of the other members. They could also compare the contributions of the other members. Such reflection should reveal possible disparities and may also create more appreciation for work others might have done. Often students value work that is academically challenging and dismiss tasks that are difficult to complete owing to other reasons. For example a student might think that the contribution made by the arrangement of team meetings is worthless, but may gain appreciation for it if he/she thinks about the time consumed by doing it.

### 9. THE IMPLEMENTATION OF RTB

#### 9.1 Round 1

Members were allocated randomly. According to Bacon et al [1], random allocation creates an equal chance of teams being functional or dysfunctional. We deliberately did so in order to create some dysfunctional teams. While there may be other factors contributing to this dysfunction resulting from random allocation of members to teams, we consider only the academic diversity risk factor in this context.

As can be seen in Table 1 the risk factors of large teams, and of instability was maximally introduced in this round. Through random allocation a 50% chance of having academic diversity was also introduced. This is represented by a ● for the academic diversity factor and a ○ for the other two factors Table 1 for this round.

These teams worked together for two weeks. They were expected to produce a team portfolio by the end of the first week and a requirement specification document by the end of the second week.
9.2 Round 2

Again, the members were allocated randomly. The only difference being that we ensured that no two members in any team of the second round had worked together in the first round.

As can be seen in Table 1 the risk factors induced in this round were the same as those for the first round.

These teams were expected to produce an architectural design for the system within a week.

9.3 Round 3

We used the answers to the first question of the peer reviews (discussed in Section 8.2) to classify the students into categories in terms of their level of participation described in Section 6. We created teams with members that had similar levels of participation. The result of this allocation is shown in Table 2.

Students who did not participate in round 1 were classified as absent. These students did not complete the peer evaluation questionnaire and also did not feature in any evaluation completed by other students. Consequently they were assigned to the same team.

Of the ten identified diligent isolates the six most obvious were allocated to a team. The remaining four were then assigned to a second diligent isolate team. Two students who were bordering on diligent isolation were added to this team.

Next we allocated the 13 self-reported social loafers to two teams. These are the students who selected the option that states that others may think that they had slacked when they completed the peer review at the end of round 1. By looking at the reasons they gave for selecting this option, we assigned the six most obvious cases to one team and the rest to another team.

We then identified six students who were not yet assigned to teams who were unanimously ranked as least dedicated to their academic ability. These students were added to a team of peer reported social loafers.

Next we allocated the 13 self-reported social loafers to two teams. These are the students who selected the option that states that others may think that they had slacked when they completed the peer review at the end of round 1. By looking at the reasons they gave for selecting this option, we assigned the six most obvious cases to one team and the rest to another team.

We then identified six students who were not yet assigned to teams who were unanimously ranked as least dedicated to their academic ability. These students were added to a team of peer reported social loafers.

Next we identified nine W1’s and 19 W2’s. We assigned the seven most typical W1’s to a team. The remaining two W1’s were then grouped with five W2’s who were bordering on W1’s to a second team of W1’s. The remaining 14 students were then assigned to two teams of W2’s.

We swapped people around where the assigned teams consisted of too many people who had previously worked together. Where necessary, we re-classified borderline cases. We ended up with four teams that had new team mates for all the members and five teams that each contained one pair who had previously worked together, and one team with two such pairs. Therefore, the instability risk factor for these teams were slightly less than in the other rounds.

The participation levels of students tend to correlate with their academic abilities. Diligent isolates tend to be academically strong while social loafers tend to be weaker. Therefore, the team allocation, based only on participation levels, lead to the creation of teams that were more likely to be academically aligned than in the previous two rounds.

Apart from the constant maximal risk of large teams, the risk factors introduced in this round was less severe than in the previous two rounds. This is indicated with a ◆ for instability and a ◆ for academic diversity in Table 1.

Table 2: Classes of students’ level of participation in their randomly allocated teams during round 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Number of students</th>
<th>Number of teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Diligent isolate</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Self reported social loafer</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Peer reported social loafer</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>W1</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>W2</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>10</td>
</tr>
</tbody>
</table>

lenged differently. A team of diligent isolates were challenged by being placed in a situation where their team members would be less inclined to accept their decisions without offering their own opinions. Therefore, they would not be able to dominate as usual. A team of social loafers were challenged by removing the opportunity to get carried. These students, who are likely to depend on others to prescribe what needs to be done, were placed in a situation where all members may wait for someone else to make the decisions. Therefore, they were forced to take action.

In this round the teams were expected to compile a detailed design specification for the project according to a model architectural design that was compiled by the teaching staff.

9.4 Round 4

We used the content of the first peer evaluation combined with the evaluation of the first assignment to form teams with inter-team balance. All the teams that were formed had similar internal structure. Each team had both diligent isolates and social loafers and also members that cover the full spectrum academic ability.

Each student was classified using two orthogonal classifications, one according to his/her level of participation (leader/worker/slacker) and one according to his/her academic ability (strong/average/weak).

We used the classification shown in Table 2 to classify the students according level of participation. We group all students in three groups. The first group was the 26 students that were in the two diligent isolate and the two W1 teams. We called them leaders. We also formed a group of 25 students who have tendencies towards social loafing, called the slackers, by combining all the social loafers and the members of the absent team. The remaining 14 students we called the workers.

We used the marks that were allocated to the team assignments of the first round to classify the students according to their academic ability. We calculated a weighted mark for each student based on how his/her peers rated the quantity and quality of his/her contribution to this assignment. We then classified the students in three groups based on these marks. The top third called the strong group, the middle third, called the average group, and the bottom third the weak group.

We sorted the whole class in a single queue primarily in order of academic ability and secondary in order of level of participation. i.e. first all strong-leaders, followed by the strong-workers and then the strong-slackers, thereafter the average-leaders followed by the average-workers and so
forth. We then assigned the students to the ten teams in this order starting with the strong-leaders. Thus the first ten students in our ranking were number one in each of ten teams. We continued to assign the next ten students in this ranking. Each of them were assigned to one of these teams ensuring that he/she had not worked with the person already assigned to the team. We continued in this fashion. At times we had to backtrack if a student that was next in line could not be assigned to any of the existing teams. When we got to the stage where we had formed ten teams of six members each, a seventh member was added to a team if it was more likely to succeed than the other teams. Teams who had members that has been flagged as difficult to work with, were deemed less likely to succeed. By doing this we balanced the risk of failure among teams. Those teams that had to accommodate hard-headed members were smaller and thus were challenged differently than the teams that had more accommodating members but were larger.

The resulting teams mainly consisted of two members in each class of each of the two orthogonal classifications. For example a team could have two strong-leaders, two average-workers and two weak-loafers. However, a team could be formed with the following members: One strong-leader, one strong-worker, one average-leader, one average-loafer, one weak-worker and one weak-loafer.

This team allocation resulted in the introduction of maximality in all risk factors. This is shown by the in Table 1 for all the factors. Apart from the usual large team risk, our method of team allocation also ensured that students were not placed in a team with anybody with whom they have worked in any of the previous rounds accounting for maximal instability. Furthermore, low academic alignment was achieved by placing strong, average and weak students in each team. This high risk was combined with the high likelihood of diligent isolation and social loafing because students who have been identified as inclined to such behaviour were placed in a situation that may be conducive to this behaviour. Thus, we anticipated that all our teams had an equal and highly likely chance of being dysfunctional.

These teams were expected to implement a working prototype of the system with functionality showing proof of concept of the most important aspects as required by the given detailed design that was the outcome of the previous round. They had two weeks to complete this assignment. The teams had to demonstrate their implementations. The teams were interrogated by a panel of three assessors. When we got to the stage where we had formed ten teams in line could not be assigned to any of the existing teams. We continued in this fashion. At times we had to backtrack if a student that was next in line could not be assigned to any of the existing teams. When we got to the stage where we had formed ten teams of six members each, a seventh member was added to a team if it was more likely to succeed than the other teams. Teams who had members that has been flagged as difficult to work with, were deemed less likely to succeed. By doing this we balanced the risk of failure among teams. Those teams that had to accommodate hard-headed members were smaller and thus were challenged differently than the teams that had more accommodating members but were larger.

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9.5 Summary

We introduced different levels of some risk factors known to contribute to team dysfunction. In all rounds teams were larger than the norm introducing the risk factor of large teams. By regularly changing the teams, the factor of instability was kept high. The factor of academic alignment was manipulated by using different strategies for the allocation of teams as follows:

- Round 1: Random
- Round 2: Random
- Round 3: Homogeneous with respect to participation levels reported in round 1
- Round 4: Academically diverse according to individual achievement in round 1

10. DATA GATHERING

The data that was used in order to establish the levels of participation in each round, originated from the peer reviews mentioned in Section 8.2. Figure 1 shows the response rates for the four peer reviews. As can be seen in this figure the response rate declined over time.

![Figure 1: Percentage students who completed the peer reviews at the end of each round of RTB](image)

Figure 1 shows the average time students spent in completing the peer reviews. It is evident that they spent significantly less time in the later rounds. The sharp decline from the first to the second round can possibly be attributed to familiarity with the questions. Students had time to think about their responses to these questions beforehand. It is possible that the students were reflecting on their team experience while they were busy with the assignments. However, it is disappointing that the number of students who participated in the peer reviews were relatively low and declined.

The decline in time spent on the peer reviews could indicate that the quality of their reflection could also have declined. It may be that they are not interested in learning from their experience. It could also indicate that they had gained the necessary skills and consequently needed less time for reflection.

11. DATA ANALYSIS

Within the interpretive paradigm, we used the information provided by the students in the peer reviews. We used the responses to the same questions that were used to allocate teams in the third round (See Section 9.3).

Classification of students into the categories described in Section 6 was done by two of the authors. Together we read each comment and based on this, classified each student to one of the categories. We did this for each of the four rounds.
While doing this we gained deeper insight into the nature of the categories. Two days later we revisited our analyses. Without looking at our initial classification, we repeated the process using the same method. Then we compared the two sets of results. In each case where there was a difference, we reconsidered the classification and made a final decision.

We observed that the participation level of most of the students was consistent. However, there were cases where the participation level of a particular student changed from round to round. For instance the following two comments were given by the same student who changed from a diligent isolate in round 1 to a social loafer in round 3:

\textbf{Round 1:} I have done almost the entire Requirements Document on my own. I put it together with only about 50% coming from others

\textbf{Round 3:} To a degree, I would agree. I believe I could have done more and better

The following is an example of a comment that was made by a student that we classified as a diligent isolate:

I was lenient on there submissions, and fixed all there faults, adn sacrificed my own sleep and stress levels to get the work in on time.

The distinction between diligent isolates and W1’s was not always clear. For example we had difficulty in deciding where to classify the following:

I provided most of the work

Owing to the brevity of the quote it was unclear whether or not he/she took over or was assigned most of the work. We eventually classified this student as a diligent isolate.

In some cases the classification of a W1 was obvious as can be seen in the following example:

I was partly responsible with bringing the group together and dividing up tasks. I also helped other people out when i had completed my assigned section.

The following quote by a W2 fits our definition very well:

I did all tasks that were delegated to me.

Sometimes the tone of the comments guided our decisions. For instance a W1 might say I did what I said I would do, whereas a W2 might say I did what they said I should do.

There were different reasons for classifying a social loafer because sometimes they offered excuses while in other cases they simply admitted that they could have done better as can be seen in the following:

I didn’t have access to a computer the whole weekend, therefore I couldn’t do everything I was supposed to.

The task I was assigned to do was too much work

The following comment is interesting:

I was supposed to be helping for the development of the android application and nothing was working so I was told leave it as a result, so instead of just sitting back and saying nothing is working, I decided to help my group members who were implementing the HQ system.

It reinforces our theory that sometimes diligent isolates cause social loafing. Because this student experienced difficulty with his task, he was told not to bother. A student placed in such a position may opt out. Such a student is carried by the rest of the team. However, in this case he/she voluntarily assisted with a different task and was consequently classified as a W1.

12. OBSERVATIONS

The number of respondents that were classified in each of the levels of participation for each round was determined. Figure 3 shows the percentage of respondents in each class for each round.

As can be seen, the variance of the first and the last round is visibly larger than the variance of the middle two rounds. This shows that fewer of the extreme cases occurred during the middle rounds. We assume teams are less successful where higher numbers of social loafers and diligent isolates occur.

Students who lack skills such as the ability to be open to suggestions, plan ahead, delegate work, trust their peers, and communicate clearly are likely to revert to diligent isolation. When looking at the occurrence of diligent isolation, the first round stands out. The occurrences of diligent isolation diminished overall.

When the first and second rounds are compared, it is apparent that the teams fared better during the second round. This happened despite both rounds having the same risk factors. A possible explanation is that the students were more experienced during the second round and were able to rectify some of the mistakes they had made previously.

The teams were the most successful during the third round. This is the round where we clustered students with similar levels of participation. We expected that groups consisting of social loafers might not be able to function and also that a team of diligent isolates might generate extreme conflict that would ultimately render the team dysfunctional. Thus, the success of the third round was contrary to our expectations.

A possible explanation for this is that these teams were actually likely to be academically aligned. Another factor that could have contributed to this success was a slight reduction in instability when compared with the other rounds.

During the final round the teams were the least successful. This came as no surprise owing to the fact that this is the round where all the risks were maximised. In this round the highest number of social loafers occurred. In comparison with the third round there was also a sharp increase of occurrences of diligent isolation. This is the round where teams had members that were academically unaligned as well as diverse in terms of their levels of participation. Combined with the higher success during the third round, we interpret this as evidence of our theory that academic diversity is a prominent factor leading to the occurrence of diligent isolation and social loafing in teams.

13. CONCLUSION AND FUTURE WORK

We believe that experiential learning is powerful. Students develop insights on how to work collaboratively from both positive and negative group experiences. We applied a process we dubbed rocking the boat to provide intense experiential learning opportunities for our students. During this experience they encountered diligent isolation and so-
cial loafing in teams and had to find ways to mitigate them. They were also required to regularly reflect on their team experiences which could in turn assist them to better learn from their experiences.

With respect to the formation of teams for the year-long project, RTB provides for a number of extremely turbulent storming phases during which all students are subjected to discovering their own strengths and weaknesses. The students also had experience of making mistakes without having a lasting impact on the functioning of the team that is formed after RTB. The application of peer reviews was implemented to guide the students to reflect on the functioning of their teams. These experiences enhanced students’ communication, planning, and technical skills and hence broadened the skills set with which they enter their project.

We deliberately formed dysfunctional teams for the last round. In retrospect we should have formed teams for the last round to be more likely to be functional. Thereby laying the groundwork for final team formation. This can be done by assigning the teams for the four rounds as follows:

- Round 1: Random
- Round 2: Academically diverse according to achievement in a prerequisite module
- Round 3: Homogeneous with respect to participation levels reported in round 1
- Round 4: Minimal risk factors

We suspect that if we are able to assemble teams that are successful during the final round of RTB, it is more likely that students will remain in those teams for their year-long project. Consequently most students will already work with their final team mates during the final round of RTB. This can allow the teams to enter the norming and performing phases sooner.

In our upcoming research we will monitor the teams that were formed after applying our process. We intend to conduct a survey to determine the success of RTB. The survey will ascertain how the students experienced social loafing and diligent isolation in their formed teams as well as their impressions of the influence of RTB on the prevalence of these phenomena in their teams.

We also intend to conduct a research comparing these teams with teams that were formed without having gone through the introduction offered by RTB. These research opportunities also allow for the exploration of the influence of factors such as personality, academic alignment and team management skills on these phenomena.

14. REFERENCES


