A STUDY OF SOCIAL FACTORS IN ACTIVITY-BASED ACTIVE LEARNING CLASSROOM CORRELATED TO STUDENTS' PERFORMANCE

by

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ABSTRACT

RANJITH KUMAR RAVIKUMAR. Study of social factors in activity-based active learning classroom correlated to students' learning performance. (Under the direction of DR. MOHSEN DORODCHI)

Social behaviors of students play a significant role in classroom atmosphere and also the way it impacts students' learning interests. In addition, socially acceptable behaviors are generally preferred by students in group-based classes. But on the other hand, students' socially disruptive behaviors lead to different kinds of problems, such as: a) Interfering in classroom learning and learning environment; b) Weakening students' respect for the academic environment; c) Impairing students' academic and intellectual development; d) Decreasing students' engagement, commitment and retention; e) Finally, worst case scenarios - social isolation, depression and other mental problems. Considering the issues, the study of social behaviors of students in an ABAL (Activity-based active learning) class is an important research subject. Unfortunately, not much attention has been given to the study of social factors impacting students' learning. Therefore, in this work, we are going to study the social factors of students in an ABAL class that could impact students' performance.

In our study, we formulated and evaluated Group Cohesion score along with its traits (Goal Settings, Communication, Trust, Accountability and Recognition), social factors (from open-ended answers) and sentiment analysis (from LIWC tool). By taking into consideration of our ABAL classroom approach, we provided results correlating these points with academic performance. In addition, we found that Trust trait and three

social factors (C1, A1 and R3) collectively, had a high and positive correlation with academic performance, while the remaining factors had a less significant correlation, from the observations we have conducted in our ABAL class. However, when we analyzed data sample with a weekly comparison of student's performance with the independent variables from our study, we found that there exists no strong correlation between them.

ACKNOWLEDGMENTS

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In addition, I would like to thank all my committee members who helped me with their insights and suggestions into my work. In addition, the members of Writing Resource Center (WRC) of University of North Carolina at Charlotte (UNCC), who helped me write this thesis study report.

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CHAPTER 1: INTRODUCTION

Active learning is a learning approach in which students learn through more direct involvement in the class by performing various activities rather than passively listening to lectures, as in traditional lecture-based learning. The traditional lecture-based approach has been shown to have students exhibit passive, apathetic and ineffective learning whereas an ABAL (Activity-based Active Learning) approach has shown to shift students' passive learning into unconventional, interactive, fun and disciplined activities. This learning approach has shown improvements in various teaching disciplines such as science, math and computer science.

There are many active learning approaches among which activity-based active learning (ABAL) is one, which focuses on activities as the core of the active learning. In other words, a student's learning process is mainly organized around activities with goals. One of the models of ABAL is based on design patterns (Dehbozorgi, Maher, Dorodchi, & MacNeil, 2017) and ot particular implementation in introductory programming (Dorodchi, Dehbozorgi, Benedict, Desai, & Mahzoon, 2017). In this model students are engaged in individual pre-class and post-class activities as well as in-class activities. In addition, this approach also provides a multi-step active learning experience by enforcing preparation before each class and applying those learned concepts in the class.

Researchers have found the following reasons for aforementioned improvements through ABAL (Dehbozorgi et al., 2017); (Dorodchi & Dehbozorgi, 2017): a) Fostering group interaction and collaboration; b) Enforcing and encouraging student participation

and engagement; c) Decreasing students dropout rate; d) Improving student learning and self-learning skills; e) Removing limitations of cognitive processing; f) Improving student metacognition; g) Improving student understanding of concepts; h) Teaching students to think like programmers; i) Improving students' performance and perception about learning experience.

In addition to the reasons, we believe that the social behaviors of students seem to have an impact on their academic performance. As noted by researchers[1] - socially acceptable behaviors are generally preferred by students in a group-based class. On the other hand, students' socially disruptive behaviors lead to different kinds of problems, such as: a) Interfering in classroom learning and learning environment; b) Weakening students' respect for the academic environment; c) Impairing students' academic and intellectual development; d) Decreasing students' engagement, commitment and retention; e) Finally, worst case scenarios - social isolation, depression and other mental problems (Trice, 2004). Considering the aforementioned issues along with the social factors of students' learning in groups seems to be an important factor in the ABAL classes[2]. Therefore, this study becomes more important.

Unfortunately, not much attention has been given to the study of social factors impacting students' learning. Therefore, in this work, we are going to study the social factors of students in an ABAL class that could impact students' performance.

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[1] (Bjorklund & Rehling, 2009; Durlak, Weissberg, & Dymnicki, 2011; Hirschy & Braxton, 2004),

[2] (Dehbozorgi, Maher, Dorodchi, & MacNeil, 2017; Dorodchi & Dehbozorgi, 2017; Prince, 2004),

In our study, we formulated and evaluated Group Cohesion score along with its traits (Goal Settings, Communication, Trust, Accountability and Recognition), social factors (from open-ended answers) and sentiment analysis. By taking into consideration of our ABAL classroom approach, we provided results correlating these points with academic performance. In addition, we found that Trust trait and three social factors (C1, A1 and R3) collectively, had a high and positive correlation with academic performance, while the remaining factors had a less significant correlation, from the observations we have conducted in our ABAL class. However, when we made a weekly comparison with student's performance with independent variables, we found that there is no strong correlation.

CHAPTER 2: LITERATURE REVIEW OF ABAL CLASS

This chapter gives us insight about a) ABAL definition; b) Why is an ABAL preferred; c) Anatomy of ABAL; and finally, d) Overview of different ABAL approaches. These sections would help us understand ABAL approaches in much more detail and how it is needed for understanding the problem of our research.

2.1 What is an ABAL?

To give a brief explanation of an ABAL, it is referred to as a subset of active learning approaches in which students' learning is split into three closely-knit iterative activities: a) Pre-class activities; b) In-class activities and c) Post-class activities.

In this learning approach, students come prepared by performing different pre-class activities such as reading instructional materials and watching videos to be ready to perform in-class activities. In-class activities include hands-on small projects in small groups combined with either individual or group quizzes that reflects on the students' learning from the pre-class activities. In addition, students would follow up on in-class activities with small activities after the class, which leads into the post-class activities. This continuity of activities helps students with the necessary iterations to achieve the proper state of learning (Dehbozorgi et al., 2017; Dorodchi & Dehbozorgi, 2017; Dorodchi et al., 2017; Hakimzadeh, Adaikkalavan, & Batzinger, 2011).

2.2 Why is an ABAL preferred?

To understand why an ABAL approach is preferred, firstly, we need to understand the motivation behind it. Based on the work from different researchers[3] - an ABAL's focus is on students learning new topics via activities and not passively watching slides and listening to lectures. In other words, an ABAL approach shifts class time from passive lecture-based learning to interactive, fun, disciplined, often social activities, in which students apply concepts introduced prior to coming to the class. The class time serves to identify student understanding and address gaps in that understanding. In addition, this class time is used to apply newly learned concepts on more complex problems, which is especially important in learning computer programming. In addition, students also continuously go through low-stakes assessments to evaluate their learnings, which helps to identify and address any problems early on. Whereas in traditional lecture-based learning, assessment occurs only after several lectures, or worse at the end of the semester. This leads to the problem of not addressing any issues sooner during the course.

2.3 Anatomy of an ABAL

This section describes various approaches involved in an ABAL, definitions of each those approaches and then their core values. In addition, this section also serves the purpose of shedding some light on the nuts and bolts of an ABAL.

To understand ABAL from the ground level, an ABAL approach is a subset and a collective combination of the following four learning approaches: a) Active learning; b) Collaborative learning; c) Cooperative learning and d) Problem-based learning.

[3] (Dehbozorgi et al., 2017; Dorodchi & Dehbozorgi, 2017; Dorodchi, Dehbozorgi, Benedict, Desai, & Mahzoon, 2017; Hakimzadeh, Adaikkalavan, & Batzinger, 2011)

Since it is not possible to define a universally acceptable definition for these learning approaches, as different researchers interpreted these terms differently (Prince, 2004), we provide a general explanation of the above learning approaches that helps us understanding ABAL better. The following section contains each learning approaches' definition and its core values.

a) Active learning: This learning refers to as any instructional method that engages students in the learning process, meaningful activities and emphasis on students' thought process of what they are doing. The core elements of active learning are student activity and engagement in the learning process (Dehbozorgi et al., 2017; Dorodchi & Dehbozorgi, 2017; Dorodchi et al., 2017; Prince, 2004).

b) Collaborative learning: This learning refers to the situation in which students work together in small groups towards a common goal and the main emphasis is on students' interactions rather learning as an individual/solitary activity (Dehbozorgi et al., 2017; Prince, 2004).

c) Cooperative learning: This learning refers to the situation in which students work in groups towards some common goals. However, students' work will be assessed individually rather than assessing them. In addition, students' efforts will be rewarded for their cooperation rather than competition. (Dorodchi & Dehbozorgi, 2017; Prince, 2004).

d) Problem-based learning: This learning refers to an instructional method in which relevant problems are introduced at the beginning of the class to provide the context and motivation for the learning that follows (Dorodchi & Dehbozorgi, 2017; Prince, 2004).

The above learning approaches are categorized and listed in the table below to give us a better picture about the various learning approaches that are involved in an ABAL approach.

Table 1: Various learning approaches, definitions and core values of ABAL

Learning approaches	Definitions	Core values
Active Learning	Engaging student in the learning process, meaningful activities and students' thought process	Students' activities and engagement
Collaborative Learning	Students working together in group towards a common goal	Focus on students' interaction rather than learning individually
Cooperative Learning	Students working in groups while assessed individually	Cooperative incentives over competition
Problem-based Learning	Introducing relevant problems for motivation	Enhancing student's motivation through problems

2.4 Various ABAL approaches

This section gives a history of the different ABAL approaches based on the work from three papers. In addition, this section also focuses on the problems presented and solutions offered in each of those approaches.

In the work of Dehbozorgi et al., (2017), researchers have reviewed works from multiple papers about existing active learning approaches. They list various benefits of following different active learning approaches in Computer Science (CS) education, which are categorized in the table below:

Table 2: Various benefits of active learning methods in CS education

Various benefits of active learning methods in CS education (Dehbozorgi et al., 2017)**.**
Fostering group interaction and collaboration
Improving student participation and engagement
Decreasing dropout rate
Improving student learning and self-learning skills
Removing the limitations of cognitive processing
Improving student metacognition
Improving student understanding of concepts
Teaching students to think like programmers
Improving student mathematical and algorithmic thinking and enhancing student problem solving skills
Improving student's performance and perception about learning experience

Even though there exist various benefits from following different active learning approaches, this creates an ambiguity and difficulty to an instructor to which active learning method to choose from, such that their chosen instructional approach could provide the benefits (Table: 2) needed for their class.

Consequently, this leads to a need for reviewing and categorizing many pedagogical design patterns. Fortunately, some researchers also (Dehbozorgi et al., 2017), reviewed and categorized 235 pedagogical design patterns into six general pattern categories. These six categories are based on each design pattern's focus, which are

relevant to active learning in CS education. In addition, these categorizations are also based on the instructor's preference of their design pattern focusing on either single or multiple categories (Table: 3).

Table 3: Categorization of 235 pedagogical patterns into 6 categories (Dehbozorgi et al., 2017)

Categorization of various pedagogical patterns		
Pattern category	**Pattern focus**	**Focused (%)**
Lecture design	Delivering "good lecture"	74.0
Feedback and assessment	Improvements from experts' feedback and observations	8.9
Course design	Self and external, observations and data analysis of various courses	8.5
Diversity imbalance	Gender imbalance	3.4
Teamwork and group work	Group discrepancies	3.0
Class activities and assignment	Analysis of different class activities and assignment content and delivery	2.1

These patterns are categorized and listed as follows: a) Feedback and assessment patterns: feedback and observations from expert teachers (Bergin, 2006); b) Course design patterns: based on a mix of self and external, observations and data analysis (Holden, Schadewitz, & Rapanta, 2010); c) Lecture design patterns: based on the findings from a good lecture design (Köppe & Schalken-Pinkster, 2015); d) Class activities and

assignment patterns: analysing different in-class activities and evaluation of assignments and its content (Bergin, 2006); e) Teamwork patterns: analyzing discrepancies in teamwork or group-based classes (Köppe, 2012) and f) Diversity imbalance patterns: imbalance in gender ratio (Bartilla & Köppe, 2015).

Based on the researcher's' observations, 74% of the patterns were focused on lecture design while the remaining five areas had less than 9% each. In addition, we notice that minor attention is given to the areas in diversity imbalance, teamwork and group work and class activities (Table: 3). This implies that most pedagogical design patterns were concentrated on the lecture design and emphasized delivering good lecture content to a class. An active learning approach will not work at its best if these other design categories are not emphasized or addressed.

To help address the above issue, (Dehbozorgi et al., 2017) proposed a new template called "Active learning multidimensional design pattern model" which encourages the adoption of active learning that could react to the problems of CS1 classes. In other words, this proposed model offers a solution to help instructors choose their own active learning approach in a much more easy and flexible way.

The core of this proposed model is categorized into three areas - a) Preparation design patterns: This pattern shows different preparation methods done by students learning in active learning classes - Short lectures before class, short online video lectures, collaborative online videos and reading instructed materials. b) In-class activities: Meaningful activities that encourages student engagement in the activities -

Clicker questions activity, analytic quizzes and short lectures on demand. c) Teamwork and collaborative problem solving: This pattern focuses on different methods available in teamwork and group-based activities.

A better understanding of each option will consequently help instructors choose any method. In other words, these patterns help instructors to choose when, where and why to apply any of those proposed methods and what they could expect in return from the class.

Another approach was proposed to integrate ABAL with students' self-assessment/reflection to adaptively fine-tune the activities based on students' performance (Dorodchi et al., 2017). This approach tries to address the fundamental problem in traditional lecture-based learning, which is that the students' reflection/self-assessment are not considered in parallel with class time. In addition, they were not given much importance either, as it could be utilized to track students' performance from a early on in of the course timeline.

Fortunately, the focus of this approach is to continuously assess students' learning and the effectiveness of the course content and interventions. The core of the proposed model is based on applying Kolb's experiential learning theory ('do', 'reflect' and 'apply') into the class activities. By mapping and splitting the activities into pre-class/lab, in-class/lab and post-class/lab activities, students would gradually learn the concepts. The 'do' phase is done through students' preparation work before coming to class (or lab), the 'apply' phase is through practical and in-depth hands on activities in the class (or lab),

and ‘reflect’ phase is through students working on post-class activities/homework. In addition, students fill out online reflections forms including open ended questions reflecting on their learnings.

Through the above approach, researchers were able to discover key information and positive correlations based on students’ responses, such as: a) Student's’ success vs confidence; b) Students’ success vs negative attitude; c) Students’ performance vs aptitude; d) Effect of group activities on learning; and finally, e) Making new friends throughout the course.

Finally, Dorodchi & Dehbozorgi, (2017) discuss, other issues of an active learning model, namely two important issues regarding students’ performance/satisfaction in an ABAL approach. These include: a) Lack of continuous discipline in the course impacts students’ performance negatively and b) Lack of students’ overall satisfaction affects course retention of students.

Based on their literature review, a team-based learning model is shown to increase students’ satisfaction and retention while making the course a fun experience. Therefore, to address the above two issues, disciplined sets of activities before, during, and after each class are proposed which are also integrated with students’ self-assessment and reflection on their learning and activities. To enforce continuous discipline and satisfaction of students, the activities were designed as pre/in/post class or lab activities. This study was shown to improve students’ problem-solving skills which led to higher performance in an ABAL (Dorodchi & Dehbozorgi, 2017; Dorodchi et al., 2017).

To summarize, there are multiple ABAL approaches each with different core values. Although revolve around class activities, students' interaction. Yet no one addressed how social factors may play a role.

CHAPTER 3: LITERATURE REVIEW OF STUDENTS' SOCIAL PROBLEMS IN CLASSROOM

An area that could use more study in an ABAL seems to be the impact of social interactions on students' learning. In the previous chapter, we have noticed that how social interaction among students in activities was presumed to affect their performance. However, several problems have been reported in active learning classes and traditional lecture-based classes regarding student's social behaviors in groups and in class. Therefore, this chapter focuses on existing work regarding social factors.

To start with, we believe that some of the issues that have been observed in traditional lectured-based classes could still be similar in an ABAL class. For example, Sorcinelli, (1994) have shown some key findings about student's disruptive behaviors which are categorized into three areas based on their behaviors, as listed below in the table.

Table 4: Disruptive behaviors from traditional lecture-based class (Sorcinelli, 1994).

Disruptive behaviors (Traditional lecture-based class)	
Immature behaviors	Talking during lectures, chewing gum, being late and creating disturbances

Inattentive behaviors	Sleeping during class, cutting class, acting bored/apathetic, not paying attention, being unprepared and leaving class before it is finished
Miscellaneous behaviors	Cheating and showing interest towards trivial things

Next, continuing down the line of finding more social problems, from the study of uncivil behaviors of lecture-based class (Bjorklund & Rehling, 2009), that could be still observed for our ABAL class, is listed in the below table. To further help our study, we categorized those factors into immature, inattentive and indiscipline behaviors.

Table 5: Uncivil behaviors in lecture-based class

Uncivil behaviors (Bjorklund & Rehling, 2009)		
Immature	**Inattentive**	**Miscellaneous**
Distracting Behaviors: Sleeping, eating, drinking, yawning, nose-blowing, fidgeting and swearing	Using a palm-pilot/iPod or computer for non-class activities. Reading non-class material and doing homework for other classes. Displaying inattentive posture or facial expressions.	Continuing to talk after being asked to stop and conversing loudly with the class. Non-verbally showing disrespect for others and making disparaging remarks.
Discarding trash after class has begun	Getting up during class, leaving and returning. Allowing a cell phone/text messaging to ring during the class	Questioning the value of an assignment or activity. Nonverbally indicating dissatisfaction with an assignment,

		activity or grade
Arriving late/leaving early	Packing up books before the class is over.	Coming to the class under the influence of drugs or alcohol

Lastly, based on students' evaluation of their group members in team-based learning (Stein, Colyer, & Manning, 2015), we have listed the social problems (Table: 6).

Table 6: Disruptive behaviors in Team-based Learning (Stein et al., 2015)

Disruptive behaviors (Team-based learning)
Not showing signs of preparedness before coming to the class
Not able to participate/contribute in group discussions
Not taking individual/group responsibility
Dominating by doing group's major work by a group member
Group member's unilateral decision that affects the whole group
Not showing up for the classes
Unequal contribution in group
Signs of stubbornness/arrogance by group member
Lack of seriousness in the class (using phones, disrupting other people during lecture, creating disturbances, missing deadlines etc.)
Lack of initiation
Shyness/introverts by a member in group's communication
Group communication is restricted/unable to freely move and interact with the group

To conclude this chapter, we have reviewed at all the students' social behaviors from different years of work and learning approaches. This chapter leads us to how studies from different periods of time were focused on three primary categories – Immature, Inattentive and Miscellaneous. However, in our study, we focus categorizing social factors based on group cohesiveness traits – Goal Settings, Communication, Trust, Accountability and Recognition with a positive, negative or possibly a neutral factor.

Keeping in mind of the above social behaviors we move forward to our next chapter, where we discuss about the observations we have conducted in our ABAL class.

CHAPTER 4: STUDY METHODOLOGY

The research goals of our study are described as follows.

- What are the scores of group cohesiveness traits of students in an ABAL class and how do we measure each of those traits?
- What are the social factors of students in an ABAL class?
- What is the correlation between group cohesiveness traits and social factors of students in an ABAL class with group performance?

This chapter describes about the observation studies we have performed in the ITCS 1212 class of University of North Carolina at Charlotte (UNCC) under the supervision of Dr. Mohsen Dorodchi along with the assistance of his Teaching Assistants (TA). This study was initiated in the Fall 2017 semester and the classes took place twice weekly, one on Mondays and another on Wednesdays, from 1:00 PM to 3:15 PM.

The survey used in this study is based on measurements of team cohesiveness which consists of the traits: a) Goal setting; b) Communications; c) Trust; d) Accountability; and e) Recognition (Fragale, 2013). The below table consists of objectives and core values for each trait. Keeping in mind only the above category of traits, we formulated a survey that was observed in students for our ABAL class.

Table 7: Group Cohesiveness Traits

Traits	Objective	Core Values
Goal Setting	To develop a shared vision, mission and set of values	Specific, measurable, attainable, realistic and timely

Communication	Means of accomplishing goals	Emphasis on quantity and quality Clearly define and delegate responsibilities Exchange ideas and information
Trust	Self-knowledge and competence	Greater commitment Greater effort Greater corporation
Accountability	Holding each member responsible	Individual and Group accountability
Recognition	To appreciate each other's roles and responsibilities	Trusting each other to do their job and accomplishing the task

In this survey we used close-ended questions for each category of the traits that helps us to evaluate their score. In other words, these close-ended questions are based on Likert scale ranging from one to seven. In which, one being the least value and seven being the highest corresponding to each question. In addition, we provided an open-ended question at the end of each traits as well, that helps us observing any social patterns in students (See Group cohesion survey in Appendix-1).

The study is conducted in an undergraduate CS class, which consists of 91 students split across 11 tables. For these 11 tables, we had six observers who were TAs of this class. The observations occurred while the class was in session, noticing for any students' behavior that corresponded to the traits (Table: 7). By the end of the class, observers filled out the questionnaire (See Group cohesion survey in Appendix-1).

Next, regarding the dependent variables which signifies students' academic performance in an ABAL class is based on two in-class activities. Firstly, we had, which

students' work together as a group solving a problem/assignment given in the class, which is called group-based activities. Secondly, we had other group activities in which students answer quizzes based on the concepts they have learned before the class. These quizzes were conducted in the class through a fun and game-based learning platform called Kahoot.

The timeline considered for our observation study started from September 13th, 2017 to November 1st, 2017. In addition, the class timings were on Mondays and Wednesdays from 1:00 PM to 3:15 PM. Considering the above dates, we had 21 group-based activities and 14 Kahoot activities spread over eight weeks of classes.

To conclude this chapter, we assume that students' group cohesion and their social factors could impact students' academic performance. In other words, students' academic performance through their grades in group-based activities and Kahoot activities could be dependent on group's cohesion and students' social factors.

CHAPTER 5: DATA ANALYSIS

In this chapter, we provide a detailed data analysis of students' social factors and group cohesion score based on each trait. This data analysis will be based on the information presented in previous chapter's observations study and from the in-class group activities.

To start off with, all the close-ended questions (Likert-scale questions) in each of the traits (See Appendix 1: Group cohesion survey) were considered to evaluate each group's score for each trait. In other words, we had 4 questions each in Goal Setting, Communication, Trust and Recognition. And 3 questions for the Accountability trait. Consequently, these 19 questions from 5 traits constitutes to form the Group Cohesion score of a group.

From these questions, we then formulated average and standard deviation score in each of these traits for every week, starting from week-1 to week-8. In addition, we then analyzed the open-ended answers from each group cohesion trait (Goal Setting, Communication, Trust, Accountability and Recognition) based on a code book we created. Finally, we used the LIWC tool for emotional analysis (positive emotions and negative emotions) of these open-ended answers as well.

Each of the above score evaluations and analysis are subdivided and then compared with Group-based in-class activities and Kahoot activities. In addition, we also check for any correlation between these variables. To get a better understanding, we

divided these chapters into twelve areas explaining about each of the above score evaluation and its analysis.

5.1 Scores of Group Cohesion traits

For every class, we have gathered data from the observation study through the survey (See appendix 1: Group Cohesion Survey). After the data gathering, we evaluated scores of group cohesion traits for each group. And then, we also evaluated standard deviation score in addition to the average score to further remove any bias gathered through our survey. Below are the visualizations of each group's traits.

Figure 1: Goal Settings score for each group

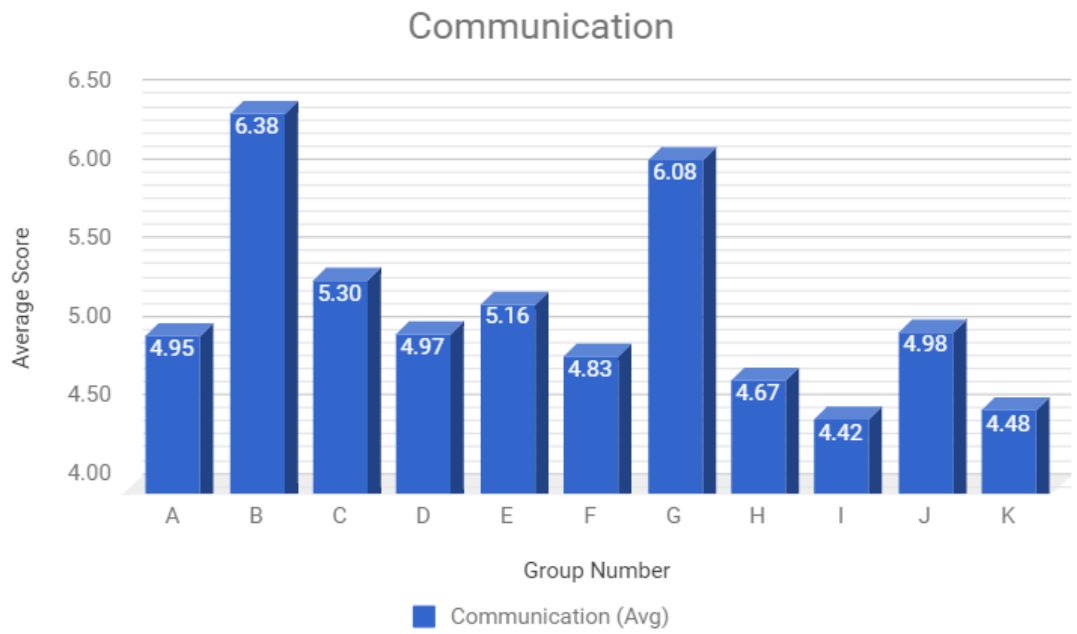

Figure 2: Communication score for each group

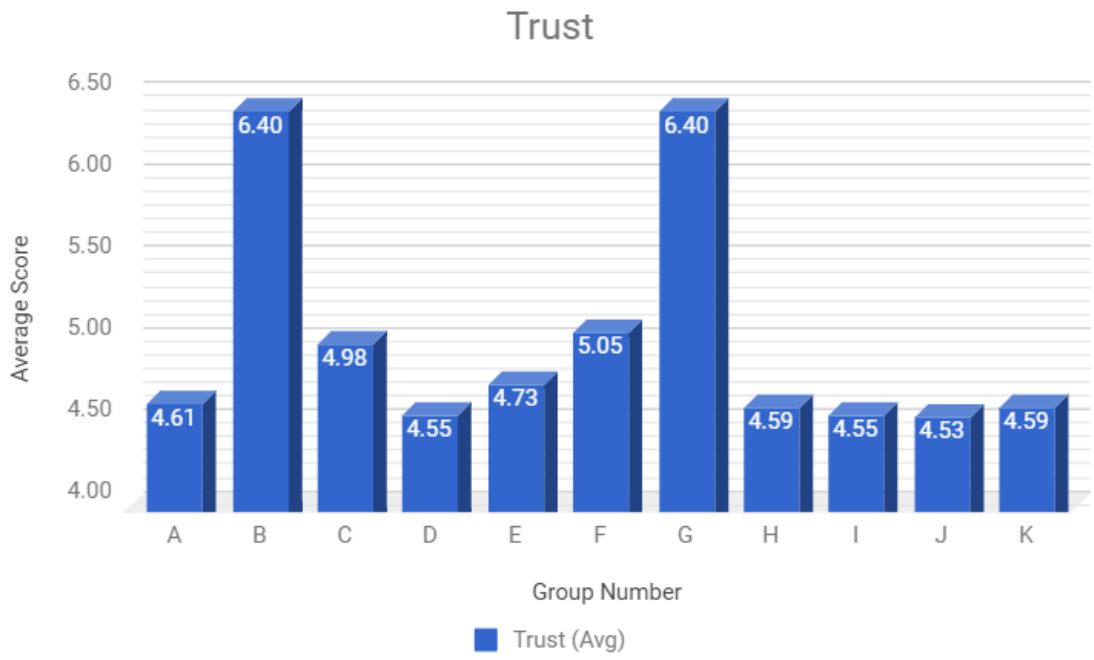

Figure 3: Trust score for each group

Figure 4: Accountability score for each group

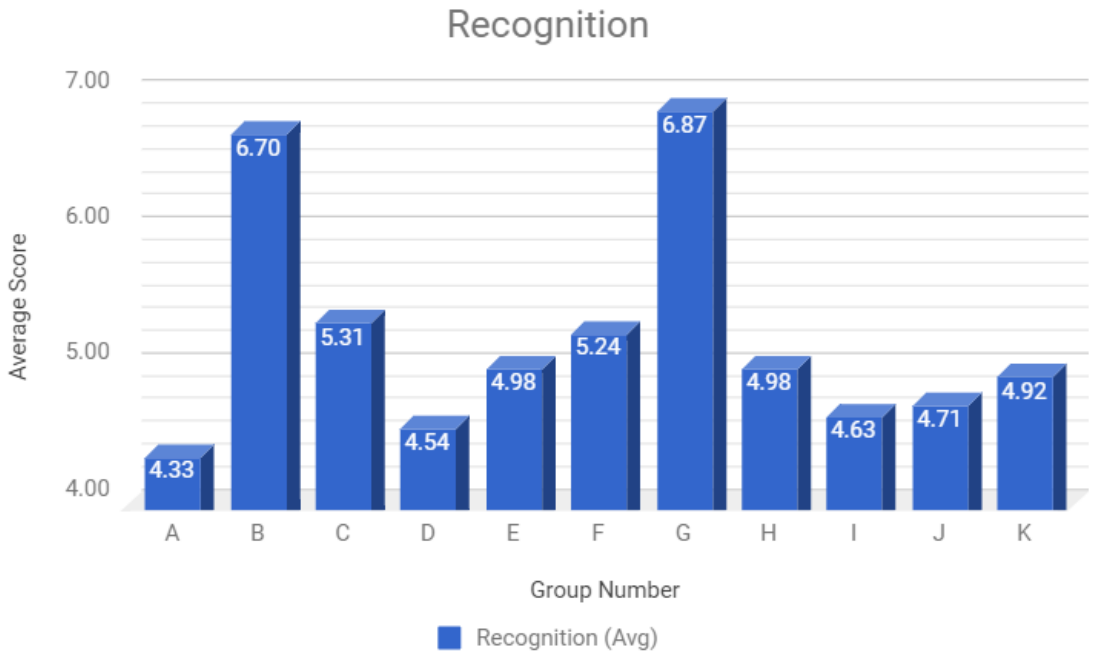

Figure 5: Recognition score for each group

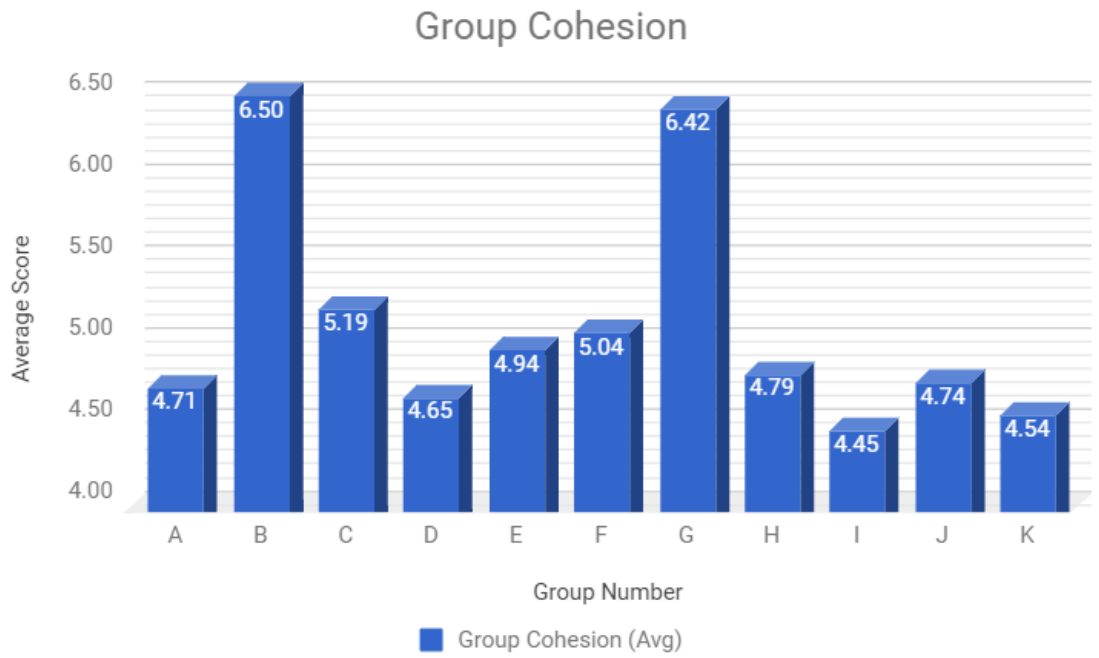

Figure 6: Group Cohesion score for each group

The above figures (Figures 1-6), have group numbers in the horizontal axis and their corresponding trait's average score on the vertical axis. Finally, all the traits score is averaged to give us the Group Cohesion score.

Table 8: Standard deviation of Group Cohesiveness traits

Table #	Group Cohesion (STD)	Goal Settings (STD)	Communication (STD)	Trust (STD)	Accountability (STD)	Recognition (STD)
A	0.79	0.84	0.95	0.60	1.02	0.87
B	0.35	0.34	0.55	0.44	0.28	0.23
C	0.54	0.31	0.70	0.53	0.86	0.80
D	0.51	0.62	0.34	0.56	0.67	0.91
E	0.38	0.42	0.46	0.69	0.58	0.35
F	0.70	0.51	0.30	0.86	1.21	1.19
G	0.21	0.48	0.38	0.41	0.25	0.23

H	0.25	0.40	0.35	0.61	0.53	0.40
I	0.34	0.44	0.43	0.40	0.60	0.45
J	0.86	0.83	0.96	1.25	0.97	0.81
K	0.56	0.72	0.59	0.52	0.86	0.79

5.2 Scores of Social Factors

This section describes the social factors we derived from the open-ended answers from the group cohesion survey. For each trait from the group cohesion survey, we had one open-ended question which helped us to formulate our code book. In addition to the 5 open-ended questions from each trait, we also included one additional open-ended question which corresponds to the observation process.

This code book (Table: 8) starts off with the analysis of good, bad and neutral responses for Communication, Trust, Recognition and Observation process. However, we have Entire-group, Half-group and No-group for the Accountability trait. In addition, we have only bad responses for the Observation category, hence it has neither good nor neutral responses.

Table 9: Code Book

Goal Settings	Communication	Trust	Accountability	Recognition	Observation
Active and engaged (GS1)	Good (C1)	Good (T1)	Entire-group (A1)	Good (R1)	
Inactive and disengaged (GS2)	Bad (C2)	Bad (T2)	Half-group (A2)	Bad (R2)	Bad (O2)
	Neutral (C3)	Neutral (T3)	No-group (A3)	Neutral (R3)	

In addition, the reasons for narrowing down our open-ended analysis to the above book comes from the below 43 social factors. We were only able to come up with the above code book after categorizing the below 43 factors into the above code book.

Table 10: Reasons for the Code Book

Code	Reasons
A1	Responsible discussion about class activities
	Concluding discussion to a common solution
	Motivating themselves when they answered wrong
	Discussing where they made a mistake
A2	Less participation
	Less discussion incorrect answers/understanding
	Less responsibilities delegation
A3	Not paying attention
	No discussion
	No participation
C1	Discussion about class activities
	Signs of leaderships
C2	Discussion about non-class activities
	Signs of Domination
	Working alone
	Group is mostly silent
	Signs of Shyness
	Group members are completely silent
C3	Discussion in pairs
GS1	Focused, engaged and interactive
	Raising doubts/questions to TA
	Effective use of class resources
	Group enjoyed Kahoot
GS2	Asked off-topic questions to TA

	Dependency (Unable to function without leader of the group)
	Didn't ask TA any questions
	Distracted in non-class activities
	Free-riding group members (Relying on group to get the work done with min/zero contributions)
	Not listening to instructor/TA
	Unable to ask TA any questions even when struggling with the activities
	Signs of cluelessness about the activity
	Disrespecting TA (Being condescending/rude to TA)
O2	Group member absent
	Group member came late
R1	No signs of disapproval (Happy, excited, compassion towards the group and/or the activities)
R2	Signs of disapproval (Unhappy and hopeless towards the group and/or the activities)
R3	Neutral appreciation (No signs of positive/negative emotions towards the group and/or the activities)
	Preparedness
T1	Signs of leadership
	Healthy arguments
	Unable to challenge the group opinions
T2	Unable to trust the group opinions

Based on the above reasons for analyzing the code book, we were able to code each answer from each open-ended question and then visualize it in the below figures.

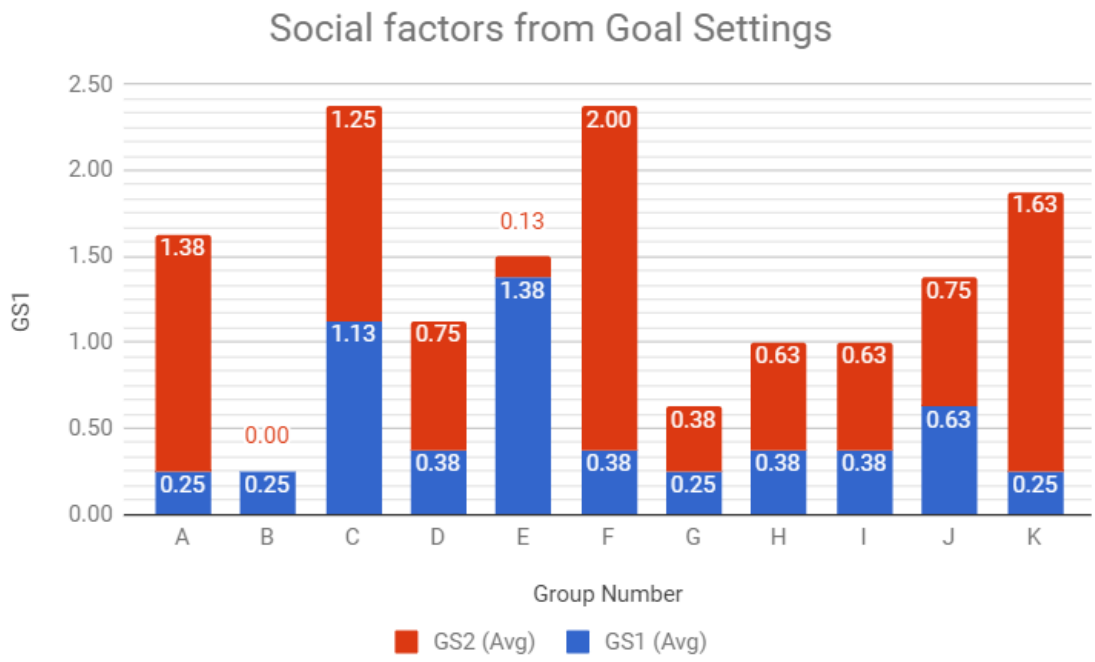

Figure 7: Social factors from Goal Setting

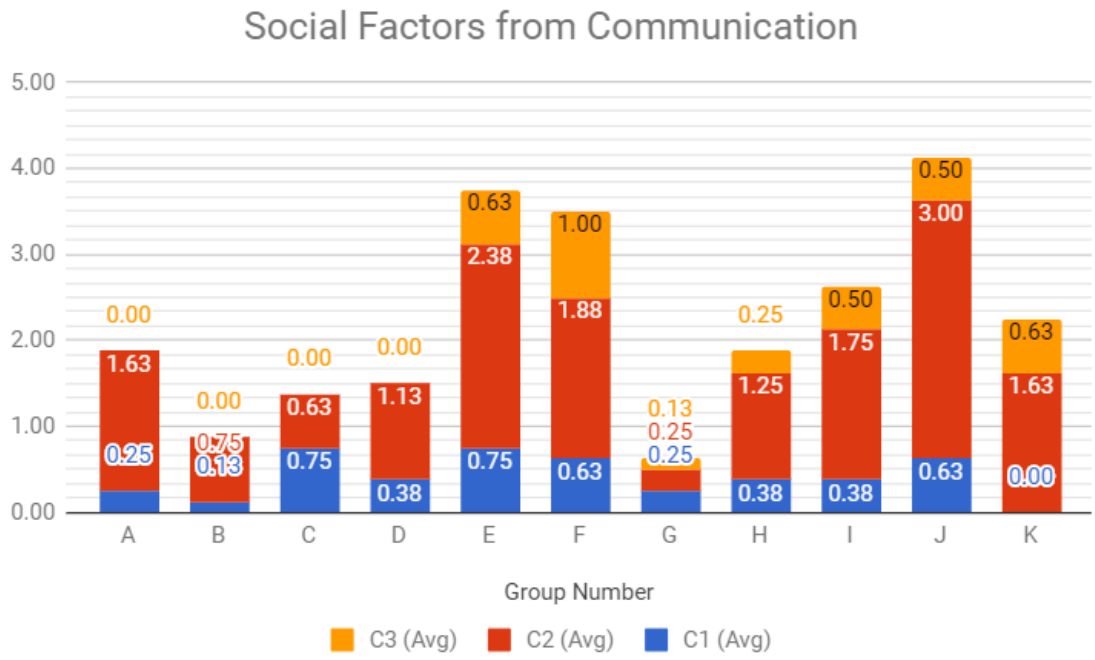

Figure 8: Social factors from Communication

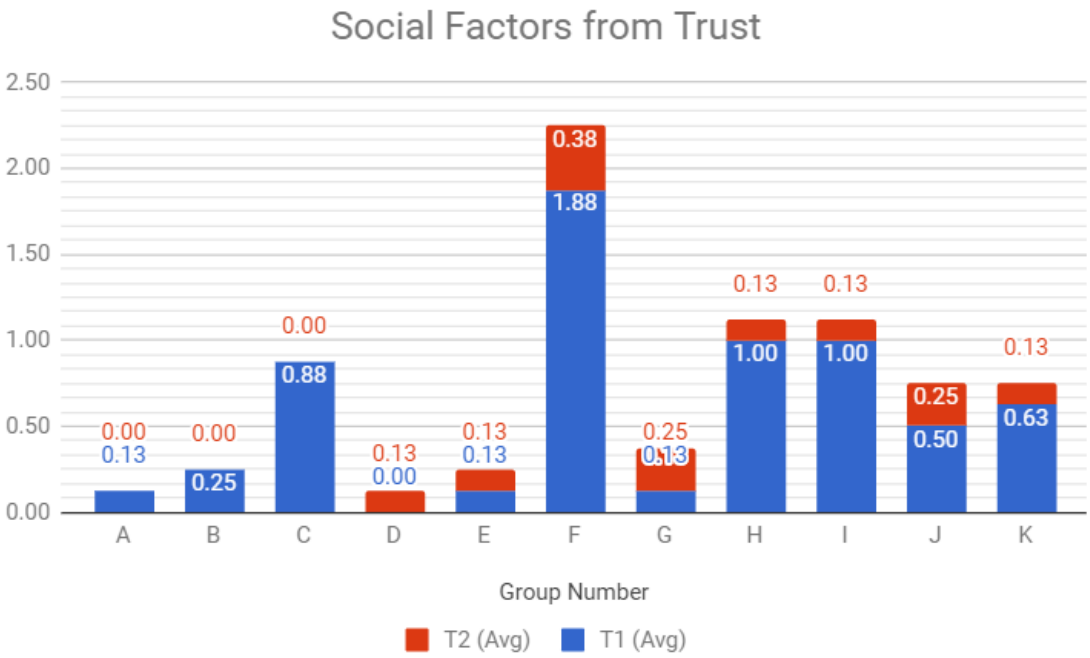

Figure 9: Social factors from Trust

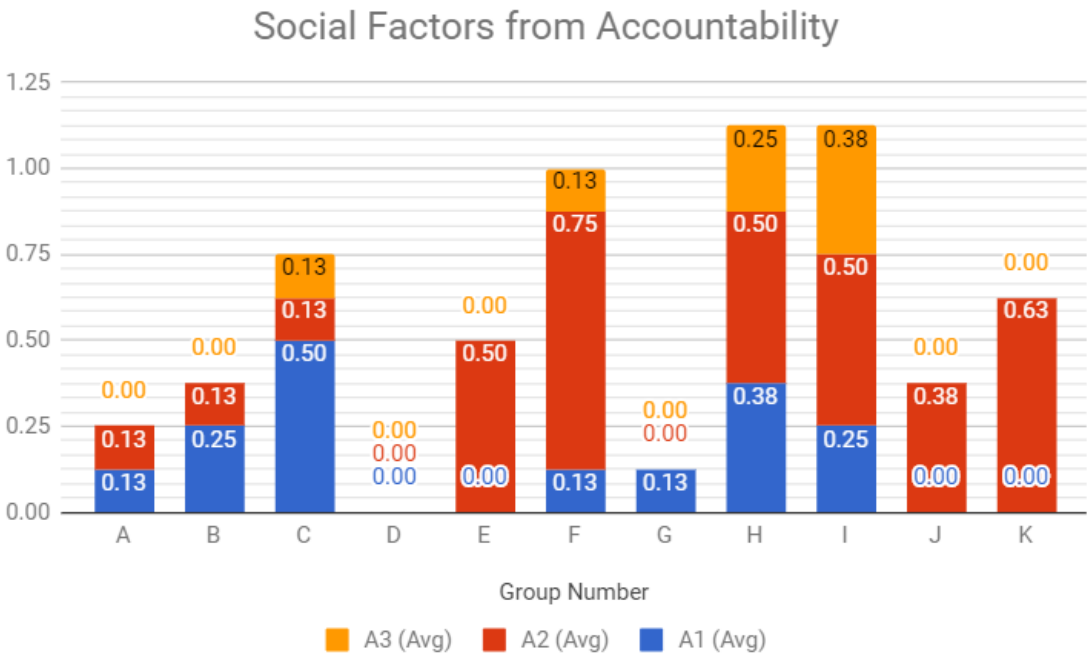

Figure 10: Social factors from Accountability

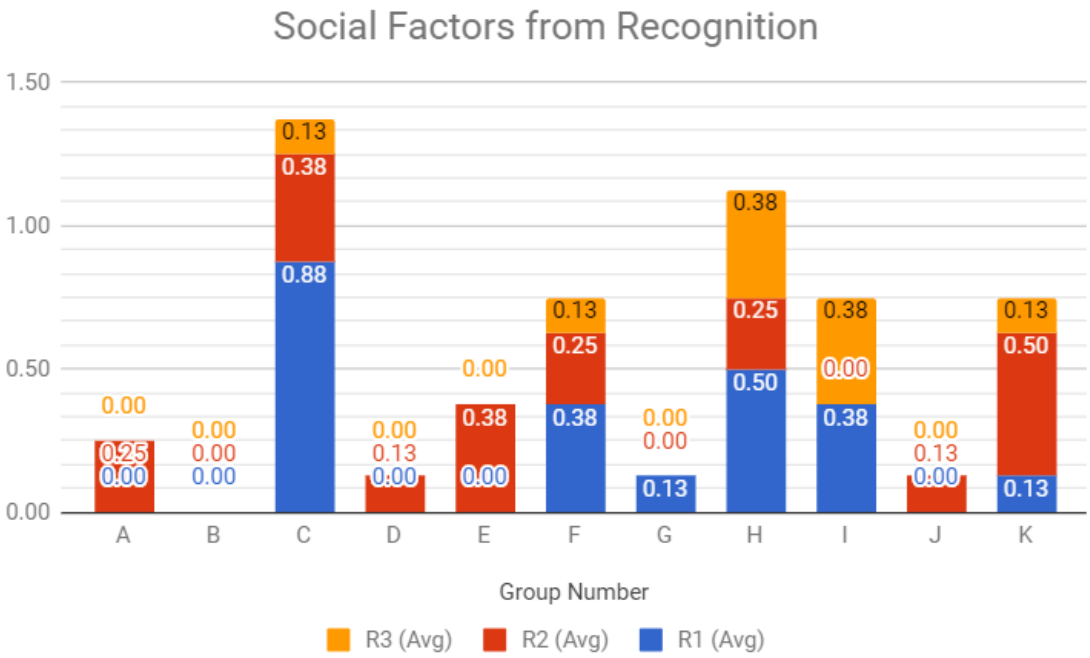

Figure 11: Social factors from Recognition

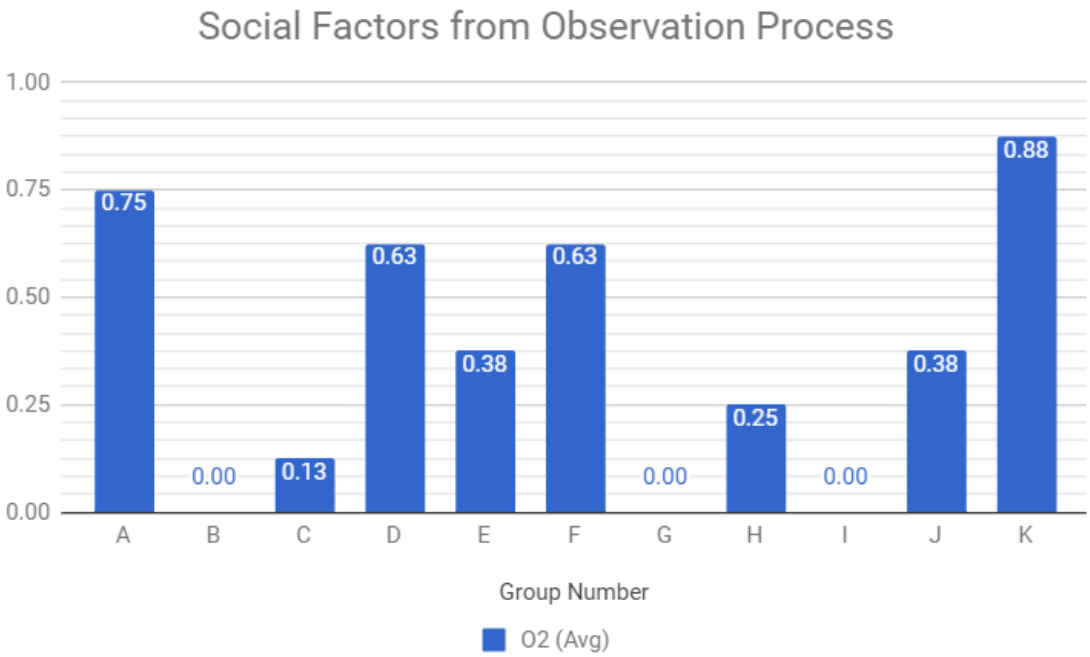

Figure 12: Social factors from Observation Process

The above figures (Figures 7-12), have group numbers in the horizontal axis and their corresponding trait's positive, negative and neutral social factors to their vertical axis.

5.3 Scores of Sentiment Analysis

For the sentiment analysis of the open-ended answers, we took the help of LIWC tool which gave us the result for positive emotions and negative emotions. Later these scores were then mapped to each group and the results are produced in the following figure (Figure: 15).

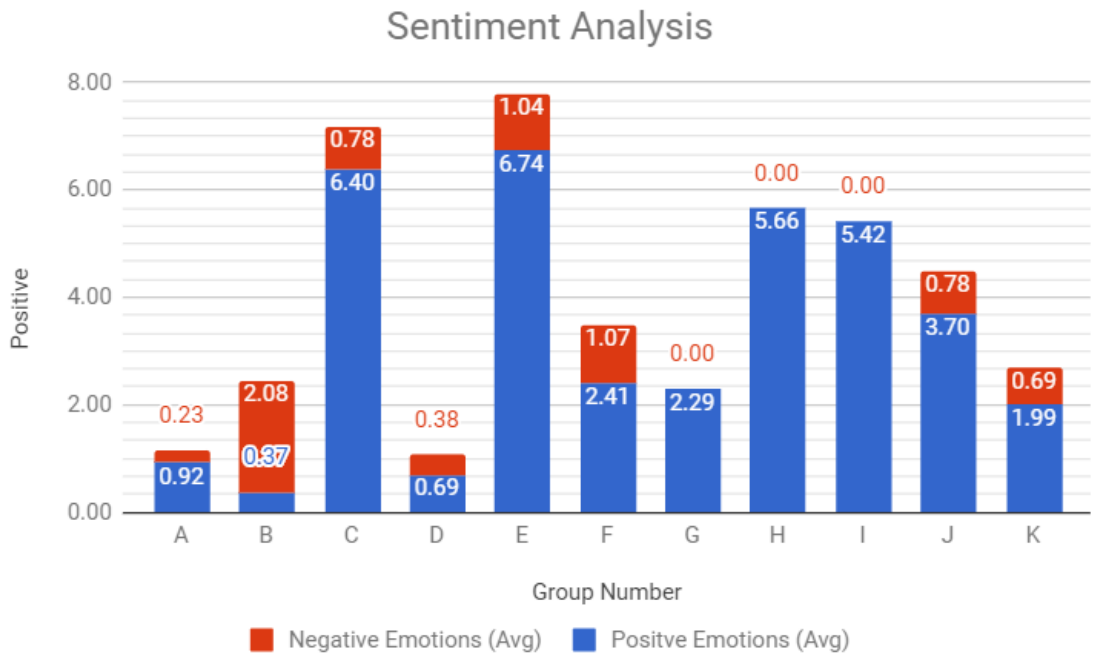

Figure 13: Sentiment Analysis

5.4 Scores of Kahoot

For the 14 Kahoot activities that occurred during our data gathering timeline, the grades of each Kahoot activity were considered. For these grades, we then formulated the average score and the standard deviation score for each group. The visualization for these Kahoot scores are shown in the below figure.

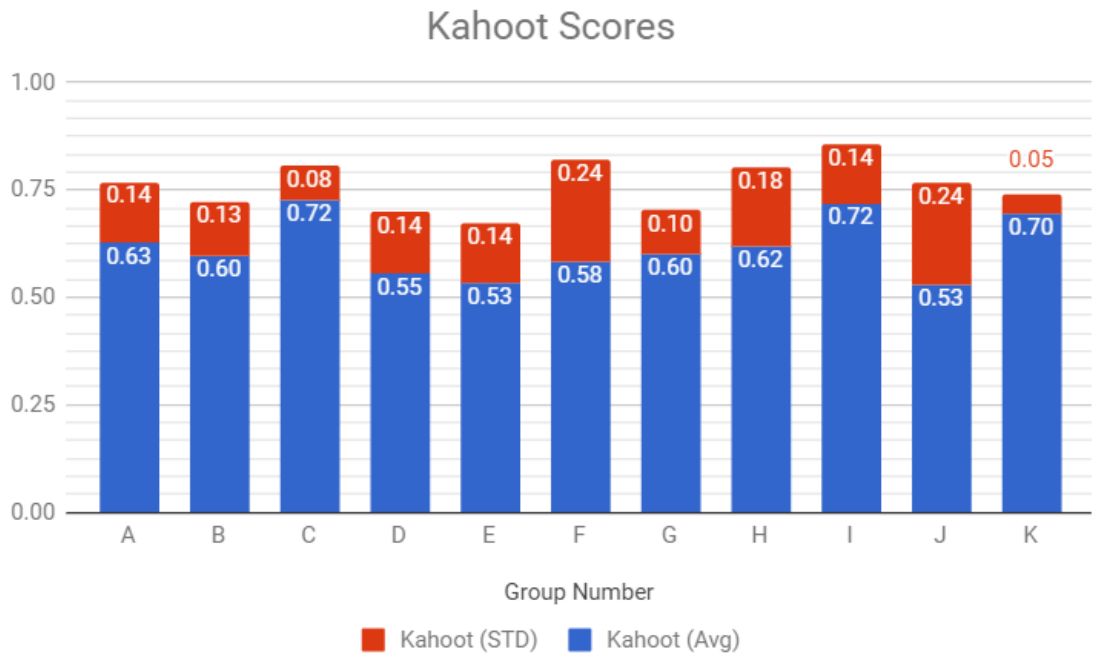

Figure 14: Kahoot Scores for each group

5.5 Scores of Group-based in-class activities

For the 21 Group-based in-class activities, that occurred during our data gathering timeline, the grades of each Kahoot activity were considered. For these grades, we then formulated their average score and their standard deviation score for each group. The visualization for these Kahoot scores are shown in the below.

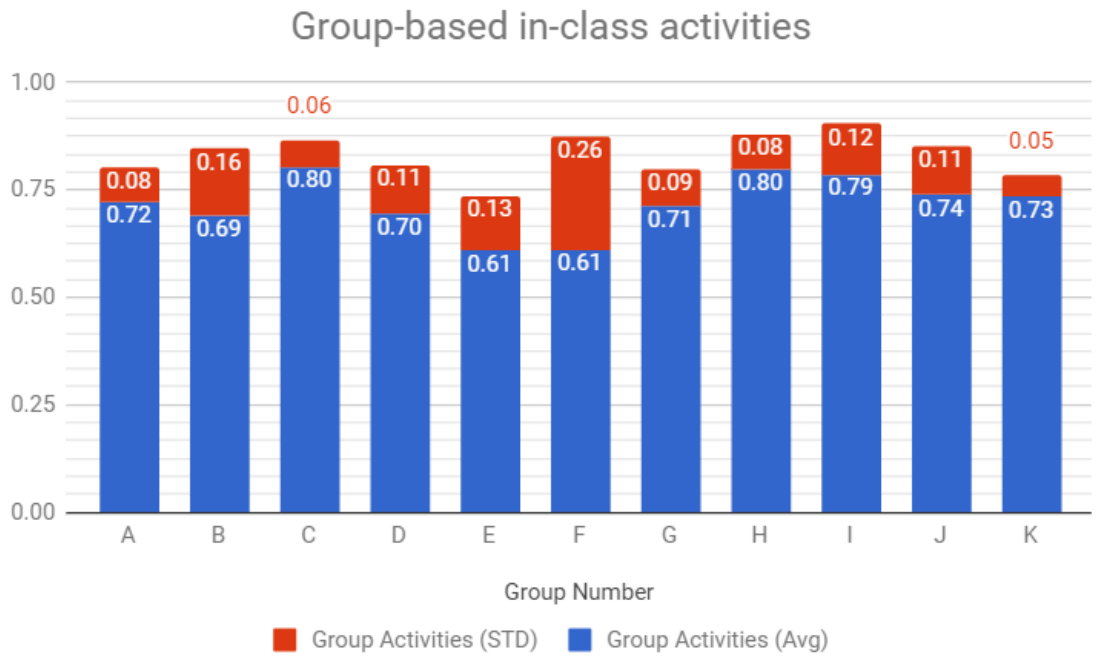

Figure 15: Group-based in-class activities scores for each group

5.6 Correlation between Kahoot vs Group Cohesion

By considering Kahoot grades (Average Scores) and Group Cohesion score (Average Scores), we can visualize the two variables as below figure.

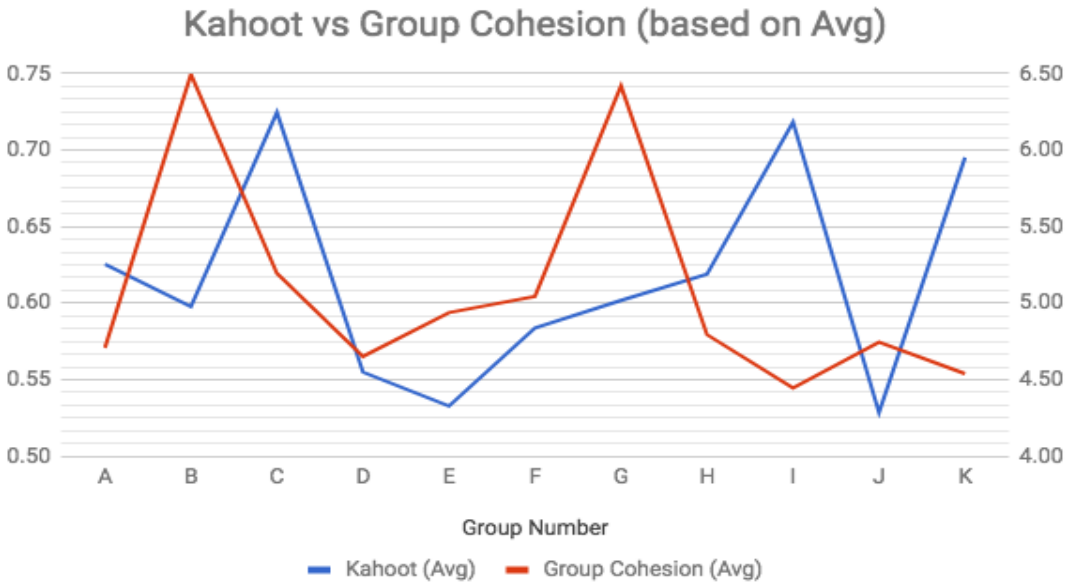

Figure 16: Kahoot vs Group Cohesion (based on Average)

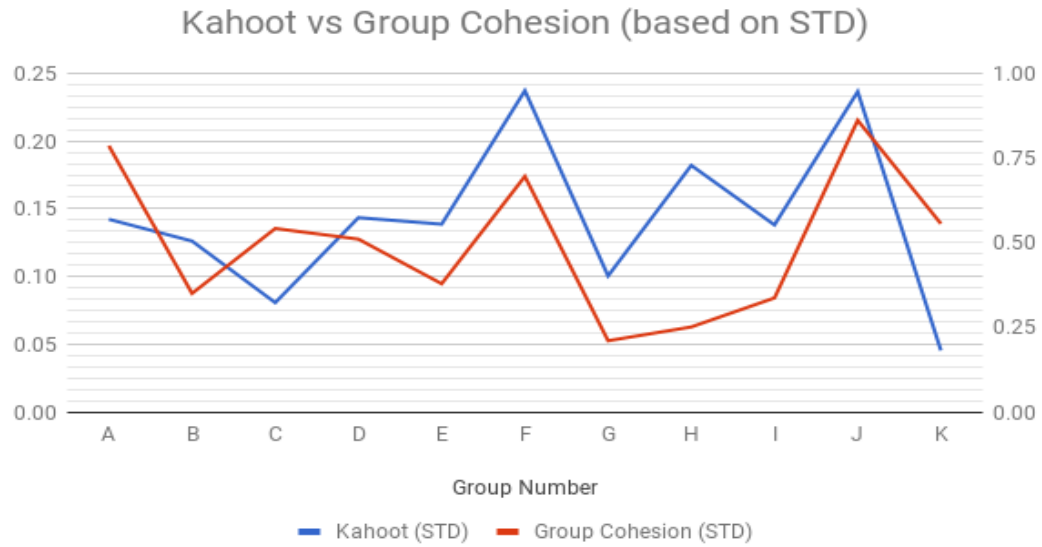

Figure 17: Kahoot vs Group Cohesion (based on Standard Deviation)

However, for considering the correlation between Kahoot and Group Cohesion, we have used the Pearson's coefficient correlation and Spearman's Rho correlation. This correlation is presented in the below table.

Table 11: Correlation between Kahoot and Group cohesion

		Pearson Coefficient (based on average)		Pearson Coefficient (based on std)		Spearman's Rho (based on avg)		Spearman's Rho (based on std)	
		R value	R^2 value (coefficient determination)	R value	R^2 value (coefficient determination)	R value	Two-tailed value of P	R value	Two-tailed value of P
Kahoot	Group Cohesion	-0.15	0.02	0.40	0.16	-0.22	0.51	0.27	0.42
	Goal Settings	-0.19	0.04	0.20	0.04	-0.14	0.69	0.27	0.43
	Communication	-0.27	0.07	0.01	0.00	-0.37	0.27	-0.26	0.45
	Trust	-0.09	0.01	0.75	0.56	0.05	0.89	0.73	0.01
	Accountability	-0.23	0.05	0.38	0.15	-0.20	0.55	0.35	0.30
	Recognition	-0.05	0.00	0.32	0.10	-0.02	0.95	0.43	0.19

From the above table, we could notice that correlation between Kahoot and the Trust trait shows a positive and high correlation both in Pearson's coefficient and Spearman's Rho. And thus, we can say that student's Kahoot score is dependent on the Trust variable. To be more precise, the more trust score deviates, the more Kahoot score deviates in the positive direction.

5.7 Correlation between Kahoot vs Social Factors

For considering the correlation between Kahoot and Social Factors, we have used the Pearson's coefficient correlation and Spearman's Rho correlation. These correlations are presented in the below table.

Table 12: Correlation between Kahoot and Social Factors

		Pearson Coefficient (based on average)		Pearson Coefficient (based on std)		Spearman's Rho (based on avg)		Spearman's Rho (based on std)	
		R value	R^2 value (coefficient determination)	R value	R^2 value (coefficient determination)	R value	Two-tailed value of P	R value	Two-tailed value of P
Kahoot	GS1	-0.12	0.01	-0.03	0.00	-0.30	0.36	0.36	0.28
	GS2	0.33	0.11	-0.17	0.03	0.25	0.46	-0.10	0.77
	C1	-0.26	0.07	0.77	0.59	-0.31	0.36	0.80	0.00
	C2	-0.40	0.16	0.43	0.18	-0.40	0.23	0.56	0.07
	C3	-0.13	0.02	0.29	0.08	-0.20	0.55	0.34	0.31
	T1	0.32	0.10	0.00	0.00	0.42	0.19	0.03	0.92
	T2	-0.41	0.16	0.42	0.18	-0.50	0.12	0.49	0.12
	A1	0.60	0.36	-0.11	0.01	0.64	0.03	-0.12	0.73
	A2	0.08	0.01	0.39	0.15	0.07	0.83	0.45	0.17
	A3	0.54	0.29	0.21	0.04	0.52	0.10	0.26	0.44
	R1	0.21	0.04	0.00	0.00	0.63	0.04	-0.08	0.82
	R2	0.21	0.04	-0.24	0.06	0.12	0.72	-0.18	0.60
	R3	0.57	0.33	-0.04	0.00	0.64	0.03	0.04	0.90

From the above table, we could notice that correlation between a) Kahoot and C1; b) Kahoot and A1; c) Kahoot and A3; and finally, d) Kahoot and R3 shows a positive and high correlation both in Pearson's coefficient and Spearman's Rho.

5.8 Correlation between Kahoot vs Sentiment Analysis

For considering the correlation between Kahoot and Social Factors, we have used the Pearson's coefficient correlation and Spearman's Rho correlation. These correlations are presented in the below table.

Table 13: Correlation between Kahoot and Sentiment Analysis

		Pearson Coefficient (based on average)		Pearson Coefficient (based on std)		Spearman's Rho (based on avg)		Spearman's Rho (based on std)	
		R value	R^2 value (coefficient determination)	R value	R^2 value (coefficient determination)	R value	Two-tailed value of P	R value	Two-tailed value of P
Kahoot	Positive Emotions	0.22	0.05	-0.12	0.02	0.05	0.87	-0.08	0.81
	Negative Emotions	-0.26	0.07	0.01	0.00	-0.42	0.20	0.03	0.94

From the above table, we could notice that there exists no such correlation where it is both high and positive, both in Pearson's coefficient and Spearman's Rho correlations.

5.9 Correlation between Group-based in-class activities and Group Cohesion

By considering Group-based in-class activities grades (Average Scores) and Group Cohesion score (Average Scores), we visualized the two variables as below (Figure: 18 and 19).

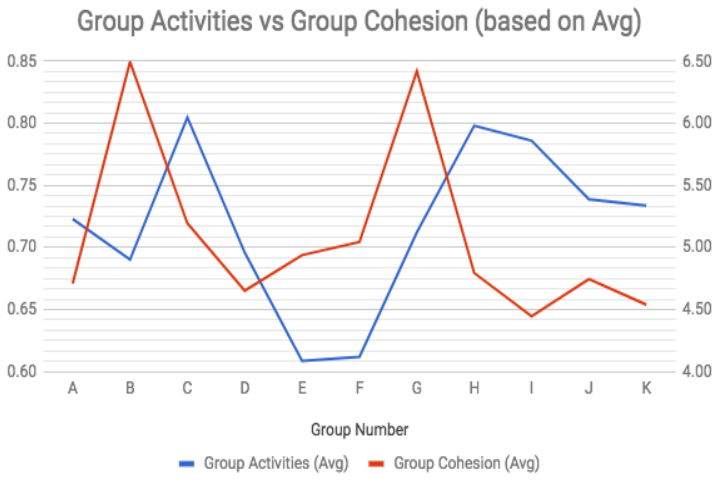

Figure 18: Group-based in-class activities and Group Cohesion (based on Average)

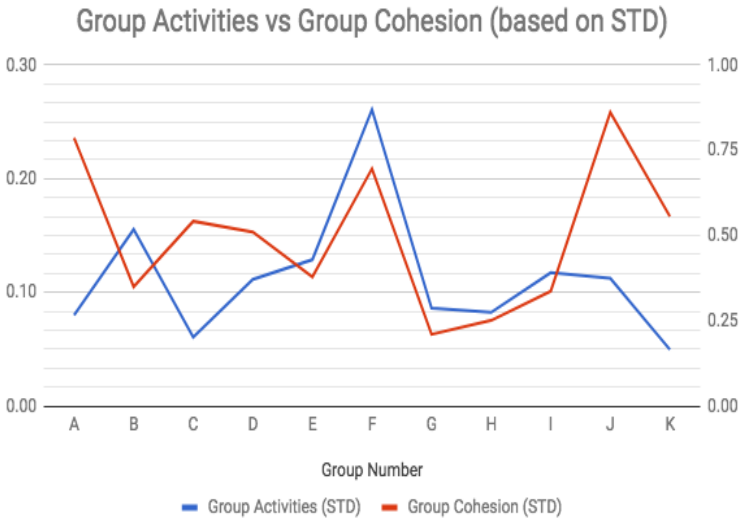

Figure 19: Group-based in-class activities and Group Cohesion (based on STD

For considering the correlation between Group Activities and Group Cohesion traits, we have used the Pearson's coefficient correlation and Spearman's Rho correlation. These correlations are presented in the below table.

Table 14: Correlation between Group-based in class activities and Group Cohesion

		Pearson Coefficient (based on average)		Pearson Coefficient (based on std)		Spearman's Rho (based on avg)		Spearman's Rho (based on std)	
		R value	R^2 value (coefficient determination)	R value	R^2 value (coefficient determination)	R value	Two-tailed value of P	R value	Two-tailed value of P
Group Activities	Group Cohesion	-0.20	0.04	0.16	0.03	-0.31	0.35	-0.08	0.82
	Goal Settings	-0.10	0.01	-0.17	0.03	0.01	0.97	-0.15	0.67
	Communication	-0.22	0.05	-0.38	0.15	-0.33	0.32	-0.41	0.21
	Trust	-0.20	0.04	0.31	0.10	0.45	0.17	0.18	0.59
	Accountability	-0.31	0.09	0.25	0.06	-0.49	0.13	-0.08	0.82

From the above table, we could notice that there exists no such correlation where it is both high and positive, both in Pearson's coefficient and Spearman's Rho correlations.

5.10 Correlation between Group-based in-class activities and Social Factors

For considering the correlation between Group Activities and Social Factors, we have used the Pearson's coefficient correlation and Spearman's Rho correlation. These correlations are presented in the below table.

Table 15: Correlation between Group-based in class activities and Social Factors

		Pearson Coefficient (based on average)		Pearson Coefficient (based on std)		Spearman's Rho (based on avg)		Spearman's Rho (based on std)	
		R value	R^2 value (coefficient determination)	R value	R^2 value (coefficient determination)	R value	Two-tailed value of P	R value	Two-tailed value of P
Group Activities	GS1	-0.15	0.02	0.05	0.00	0.12	0.73	0.29	0.39
	GS2	0.00	0.00	-0.12	0.01	0.14	0.68	-0.47	0.15
	C1	-0.17	0.03	0.83	0.68	0.03	0.93	0.61	0.04
	C2	-0.27	0.08	0.21	0.04	-0.17	0.61	0.18	0.59
	C3	-0.45	0.21	0.33	0.11	-0.20	0.55	0.34	0.30
	T1	0.06	0.00	0.01	0.00	0.40	0.22	-0.27	0.43
	T2	-0.42	0.18	0.32	0.10	-0.24	0.47	0.32	0.33
	A1	0.62	0.39	-0.09	0.01	0.50	0.12	-0.12	0.73
	A2	-0.21	0.04	0.38	0.14	-0.02	0.96	0.30	0.36
	A3	0.50	0.25	0.17	0.03	0.51	0.11	0.04	0.91
	R1	0.54	0.29	0.21	0.04	0.57	0.07	-0.22	0.51
	R2	-0.06	0.00	-0.26	0.07	0.08	0.81	-0.47	0.15
	R3	0.56	0.32	-0.02	0.00	0.58	0.06	-0.22	0.52

From the above table, we could notice that there exist high and positive correlations between a) Group Activities and C1; b) Group Activities and A1; c) Group Activities and A3; d) Group Activities and R1; and finally, e) Group Activities and R3, both in Pearson's coefficient and Spearman's Rho correlations.

5.11 Correlation between Group-based in-class activities and Sentiment Analysis

For considering the correlation between Group Activities and scores from Sentiment Analysis, we have used the Pearson's coefficient correlation and Spearman's Rho correlation. These correlations are presented in the below table (Table: 15).

Table 16: Correlation between Group-based in class activities and Sentiment Analysis

		Pearson Coefficient (based on average)		Pearson Coefficient (based on std)		Spearman's Rho (based on avg)		Spearman's Rho (based on std)	
		R value	R^2 value (coefficient determination)	R value	R^2 value (coefficient determination)	R value	Two-tailed value of P	R value	Two-tailed value of P
Group Activities	Positive Emotions	0.28	0.08	-0.10	0.01	0.36	0.28	-0.21	0.54
	Negative Emotions	-0.48	0.23	0.41	0.17	-0.56	0.07	0.48	0.13

From the above table, we could notice that there exist high and negative correlations between Group Activities and Negative Emotions, both in Pearson's coefficient and Spearman's Rho correlations.

5.12 Final correlation between dependent variables and independent variables

To understand if there exists any correlation we collected so far from our earlier section, we took only those factors which has a high r-value (r-value > 0.50). Therefore, we get Trust trait, C1, A1 and R3 factors. In addition, we also combined the Kahoot and Group-based in-class activities as Over all grades. Then we ran a correlation, in which overall grades were considered as dependent variables and Trust, C1, A1 and R3 as independent variables.

Table 17: Final correlation between dependent variables and independent variables

Based on Average					Based on STD				
Dependent Variables	Independent Variables				Dependent Variables	Independent Variables			
Over all grades(y)	Trust	Good Communication (C1)	Entire-group Accountability (A1)	Neutral Recognition (R3)	Over all grades(y)	Trust	Good Communication (C1)	Entire-group Accountability (A1)	Neutral Recognition (R3)
Multiple R	**0.865487**				**Multiple R**	**0.890138**			

From the above table, we could notice that, students' academic performance is highly and positively correlated to Trust, C1, A1 and R3 factors collectively. However, we observed only low and insignificant values to all the remaining other traits and factors.

5.13 Correlation between students' performance vs independent factors on weekly basis

This section describes weekly comparison between the students' performance and all the other independent variables we have discussed so far. To be more specific, we compare Student's grades (Group-based activities score and Kahoot score) with Group Cohesion traits (Goal Settings, Communication, Trust, Accountability and Recognition), Social Factors and Factors (Positive emotions and negative emotions) from sentiment analysis.

Table 18: Weekly correlation of students' performance with independent variables

Dependent Variables	Independent Variables	R value	R^2 value
Group Activities	Group Cohesion	0.07	0.00
	Goal Settings	0.13	0.02
	Communication	0.04	0.00
	Trust	0.01	0.00
	Accountability	-0.02	0.00
	Recognition	0.11	0.01
	GS1	-0.17	0.03
	GS2	-0.16	0.03
	C1	0.06	0.00
	C2	-0.04	0.00
	C3	0.04	0.00
	T1	-0.22	0.05
	T2	0.12	0.02
	A1	-0.20	0.04
	A2	-0.05	0.00
	A3	-0.11	0.01
	R1	0.11	0.01
	R2	-0.02	0.00
	R3	0.14	0.02
	O2	-0.42	0.18
	Positive Emotions	0.10	0.01
	Negative Emotions	0.10	0.01
Kahoot	Group Cohesion	0.00	0.00
	Goal Settings	-0.06	0.00
	Communication	-0.15	0.02
	Trust	0.06	0.00

	Accountability	0.02	0.00
	Recognition	0.08	0.01
	GS1	-0.13	0.02
	GS2	0.30	0.09
	C1	-0.24	0.06
	C2	-0.16	0.03
	C3	-0.03	0.00
	T1	0.11	0.01
	T2	0.12	0.01
	A1	0.09	0.01
	A2	0.05	0.00
	A3	0.19	0.03
	R1	-0.31	0.10
	R2	-0.13	0.02
	R3	0.01	0.00
	O2	-0.05	0.00
	Positive Emotions	0.12	0.02
	Negative Emotions	-0.23	0.05

Although, the data sample we have used in our earlier sections was a final score between data timeline from Sep 13th, 2017 - Nov 1st, 2017, this weekly data comparison increases the data sample from comparing 11 pairs of data (Total number of groups) to 88 pairs of data (11 Groups times 8 weeks). This increased sample will give us an insight on how our independent variables are correlated with student's performance.

This data from the above correlation table gave us no strong correlation between the independent variables and dependent variables. To be more precise, there exists no strong correlation between students' performance and with Group Cohesion traits (Goal Settings, Communication, Trust, Accountability and Recognition), Social Factors (from code book) and Factors from sentiment analysis.

CHAPTER 6: CONCLUSION AND FUTURE WORK

From the data correlation, we have found that there exists a strong and positive correlation between student's performance with "Good Trust" trait from group cohesiveness, "Good communication (C1)" social factor, "Entire-group accountability (A1)" social factor and "Neutral recognition (R3)" social factor. However, when the data sample is increased to a weekly basis we found that there exists no such positive and strong correlation between student's performance and the independent variables.

In other words, the findings from our study means that student's performance has shown to increase with the collective increase of Trust, C1, A1 and R3. But the correlation derived from these factors are considered collectively and when these factors are considered individually, they did not show any strong and positive correlation.

So, to answer our research question: "What is the correlation between group cohesiveness traits and social factors of students in an ABAL class with group performance?", based on the observation methodology we have chosen, we can say that, there is no strong correlation between group cohesiveness traits and social factors of students in an ABAL class with group performance.

Our work can be further extended to include observation training to observers on how to measure the group cohesiveness and social factors for a better accuracy. In addition, our work can also further extend to correlate between students' and TAs' perspective with Group Cohesion, social factors and factors from sentiment analysis.

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APPENDIX I: Group Cohesion Survey

Goal Setting	
GS1	Team demonstrates good understanding and planning of the goal/objectives of the activity.
GS2	Effective use of time.
GS3	Effective Use of Resources ex: TV / Google Docs / Board
GS4	The group asked beneficial questions to TA's and between themselves about the activity.
GS5	Notes on staying on task (engaged and active):

Communication	
C1	Direct, open, honest
C2	Group communicates changes in plans clearly prior to implementation.
C3	Good listening skills
C4	Members interact primarily to share information
C5	Notes on Communication (Interaction):

Trust	
T1	Each member believes what other members are saying
T2	Group seems to share a common goal and works towards it.
T3	Delegate responsibility instead of “I’ll take care of it” (Group work ex: Flowcharts)
T4	Group views disagreements as positive OR The team overall seems to get over disagreements pretty well (during Kahoot)

T5	Notes on Trust:

Accountability	
A1	Share decision-making (during Kahoot)
A2	Accept feedback from each other (during Kahoot)
A3	Group members have objective conversations and the members don't take the conversations personal. (Programming Tasks / Group Work)
A4	Notes on Mutual Accountability:

Recognition	
R1	Genuine appreciation of each other’s accomplishments. (during Kahoot)
R2	Recognize and appreciate complimentary role functions. (Group work)
R3	Accepts feedback from TA's / Instructor
R4	Notes on Recognition of Each other:
O1	Notes on the Observation Process: