

Group Discussion in a Blended Environment in Engineering Education

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Abstract - Group work is a necessary element of engineering education and group members need information about one another, group process, shared attention and mutual understanding during group discussions. There are several important elements for establishing and maintaining a group discussion such as participant's role, seating arrangement, verbal and non-verbal cues, eye gaze, gestures etc. The present study investigates these elements for identifying the behavior of group members in a blend of traditional face-to-face discussion along with computer supported cooperative work (CSCW) setting. The results of this study have shown that, speaking duration is the key factor for identifying the leadership in a group and participants mostly used eye gazes for turn taking. Although this study is a mix of face-to-face and CSCW discussion setting, participants mostly behave like face-to-face group discussion. However, unlike the previous studies involving face-to-face discussion, the relation between seating arrangement and amount of attention is not apparent from the data during this study.

Keywords - Engineering education, Group work, Group Discussion, Computer supported cooperative work, Role, Backchannel, Grounding, Turn taking.

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1. Introduction

Teamwork or group work is increasingly seen as an important component of engineering education therefore many courses in engineering education involve projects or assignments requiring group work. Team/group work helps students in developing skills such as conflict resolution, soft skills, and teamwork skills and prepare them to face the challenges for their future professional lives. In a collaborative group environment, there are several factors which are important for establishing and maintaining the discussion such as roles, seating arrangement, verbal and non-verbal cues, eye gaze, gestures, etc.

In a face-to-face setting, participants use a variety of speech and visual cues to achieve mutual understanding among conversational participants as well as awareness about the shared task and other participants' activities. However, Gergle, et al. [1] demonstrated that pairs with a shared visual workspace are less likely to explicitly verify their actions with speech. Rather, they rely on visual information to provide the necessary communicative and coordinative cues [1]. A shared visual workspace is one where multiple people can see the same objects at roughly the same time [2].

Roles are important in teams because they represent patterns of behavior that are interrelated with the activities of other team members in pursuit of the overall team goal [3]. Roles can be defined as stated functions/duties or responsibilities that guide individual behavior and regulate intragroup interaction [4]. The use of roles appears to be most relevant when a group pursues a shared goal that requires a certain level of task division, coordination and integration of individual activities [5] which is usually the case in group projects and assignments in engineering education. People whom other group members perceive as leading the task or influencing the group are also looked upon more often [6]. Additionally, it has been found that seating position along with talking time influence the attention given

to each target [6]. Targets who sat in the center and spent more time talking are looked most often [6].

During a conversation, a speaker makes attempts to find out whether listeners are attending and understanding what they are saying. As a result, listeners regularly make appropriate responses such as eye-gaze, nods, different facial expressions, vocal expression such yeah, etc. while listening to the speaker during a conversation. These responses are called back-channels [7]. Listeners provide evidence to speakers to show that they are being heard and understood [8]. The process of going back and forth, speaking and listening, exchanging evidence and repairing breakdowns, is called grounding [8]. What is more, conversation is governed by turn-taking conventions which determine who talks, when, and for how long [9]. Turn-allocation techniques are used to steer the conversation forward. A current speaker may select a next speaker as when he/she addresses a question to another party; or a party may self-select in starting to talk [10]. Turn-taking strategy involves taking the turn, holding the turn, and yielding the turn [11].

Several studies discussed the importance of eye gaze in a discussion with the research on analysis of conversations, human-computer interaction and psycholinguistics [12] [13]. The main reason of this interest on eye gaze is that it has an important role on the establishment of a communication [14]. According to the study by Gerpott, et al. [15], eye gaze as a social signal in a group discussion helps individuals to communicate by establishing joint attention. Also, eye gaze combined with expressions like facial or vocal as well as gestures and orientation of the body gives information about what individuals are thinking and saying [16]. Therefore, gestures can increase the perceived influence that group members have of one another [17]. Gestures benefit both the speaker and listeners. Gestures can take the form of language to convey meaning that helps both listeners understand, and speakers explain and form new ideas to enrich communication between the two. Goldin-Meadow [18] discusses two types of gestures: gestures that substitute speaking, and gestures that accompany speech.

Previous studies have often examined the behavior of participants either in the traditional face-to-face discussion environment or in a virtual environment in which participant are not physically present at the same place. Currently various technology/tools are available that can help people to collaborate on shared tasks. Many of these tools were initially created for people who are not present in the same location. However, a blended setting, where collocated participants having their individual devices and performing collaborative tasks using tools which can help them to share/modify each other work products, is currently prevalent due to the

benefits and flexibility it provides to the team. This study is a blend of traditional face-to-face discussion and the concept of computer supported cooperative work (CSCW).

Even though it is important to understand the behavior of the participants in a blended environment, it is not explored substantially and there are not many studies in this area. The study of Gross, et al. [19] stated that although users can collaborate synchronously with a real-time conferencing system in a shared virtual space, they lack the rich communication and consciousness of face-to-face interaction. Therefore, the novelty of this study is that it presents a blended group discussion environment that includes both conventional group discussion and CSCW. Participants of this study had both the setting of face-to-face conventional discussion environment as well as the facility of working on their own computers with shared visual information like in a dispersed CSCW environment.

According to the literature, participants show their awareness, interest and attention with different kinds of information in face-to-face conversations [19] using both verbal and nonverbal cues through back-channel, eye gaze and gesture. Also, in a group discussion environment the roles, responsibilities, status or the positions on a certain issue influence the understanding. However, most of these findings are from face-to-face discussion settings and there is a need for understanding the behaviors of the participants in a group discussion in a blended environment.

2. Research Methodology

This section outlines the methodology of this study with details of participants and data analysis.

2.1. Research Questions

This work was focused on providing answers to the research questions (RQ) formulated below:

RQ1. Can individuals' role be identified through their patterns of participation or backchannels towards them during collaborative interaction?

RQ2. Do seating plan (sitting across, next to, diagonal, etc.) and/or predetermined roles decide the amount of attention earned by an individual during a discussion?

RQ3. Do speakers track their listeners' backchannels for ensuring mutual understanding?

RQ4. How do listeners respond when the speakers use eye gaze and/or gestures during collaborative interaction?

RQ5. Is there a relation between uses of backchannels including eye gaze with turn taking?

2.2. Participants

Two groups consisting of 3 or 4 participants from engineering degree programme were observed in this study. When the observations began, the groups were already established, started working on their projects and group members knew each other to a certain extent.

2.3. Procedure

Each group was observed a total of three times and researchers used a video camera to capture groups' technology usage, eye gaze, participant signals, and back-channels. During each observation, the groups were able to discuss and work on any tasks necessary for the completion of a project that they were working on. The groups were encouraged to use technology and tools they found necessary such as phones and laptops. Participants sat around a table in their choice of position and the sitting arrangement was noted. All equipment used during the observations was portable and observations were scheduled around when and where the groups planned to meet to make each observation as natural and unobtrusive as possible.

The first observation for each group was used as a practice test. The remaining observations (two per group) were observed and recorded. One of the observations had technical difficulties, resulting in data being collected from three of the four remaining observations. During the observations, the observers were not aware of which roles each participant had taken nor did they ask the participants.

During Observation-1 (O1) and Observation-2 (O2), all group members were on their laptops and they were all looking at a shared document (Table 1). During Observation-3 (O3), all group members were on their laptops and one group member set up their computer to project onto a larger screen for the whole group to see. All members were looking back and forth between their personal screen and the projection. Mobile phones were also used briefly by participants throughout the observations.

Table 1. Observation Conditions

	Group-1	Group-2
Observations	Observation-1 (O1): Practice	Observation-1(O1): Practice
	Observation-2 (O2): Recorded (Working on laptops)	Observation-2 (O2): Recorded (Working on laptops)
	Observation-3 (O3): Not recorded due to recording device failure	Observation-3 (O3): Recorded (Working on laptops and using a projector)

3. Data Analysis and Results

The findings pertinent to the research questions 1-5 are supplied below.

RQ1. Speaking duration and visual attention (or gaze) is considered strong indicators of leadership. Table 2 presents the speaking frequency and duration of each participant.

Table 2. Participants' speaking frequency and duration

Group	Observation	Group Member	Number of Times Speaking	Speaking Duration
G1	O2	P1	78	10:25
		P2	38	02:57
		P3	75	10:42
		P4	37	01:42
G2	O2	P1	89	09:54
		P2	49	04:08
		P3	75	07:14
G2	O3	P1	77	06:36
		P2	29	02:27
		P3	75	09:52

It can be seen that there were two active participants with substantial speaking time during each discussion whereas other participants mostly listened with considerably less speaking time. Participants P3, P1, P3 spoke most followed by P1, P3, and P1 in terms of speaking duration during observation G1O2, G2O2, G2O3 respectively. Therefore, participants P3, P1, P3 appear to be the leaders whereas sub-leaders are participants P1, P3, P1 during observation G1O2, G2O2, and G2O3 respectively. On the other hand, sub-leaders with regard to speaking duration i.e. participant P1 spoke a greater number of times than the leaders during observation G1O2 and G2O3.

Table 3. Eye gaze and back-channels

Grp.	Obs.	Group Member	Gestures	Gazes towards them	Gazes towards others	Nods towards them	Nods towards others
G1	O2	P1	10	204	112	9	17
		P2	10	95	202	6	32
		P3	37	219	176	53	3
		P4	7	135	163	4	11
G2	O2	P1	9	169	102	3	33
		P2	6	80	139	15	2
		P3	7	132	140	23	6
G2	O3	P1	10	96	53	8	23
		P2	7	33	63	10	9
		P3	21	66	79	22	8

Table 3 reveals that participant P3, P1 and P1 received most visual attention (or gazes) during observation G1O2, G2O2, G2O3 respectively. In the matter of leadership, the results are consistent with regard to speaking time and visual attention for observation G1O2 and G2O2. However, results are not conclusive for observation G2O3 as participant P3 spoke most in terms of speaking duration but gazed upon the second most whereas participant P1 (sub-leader) got the most visual attention in terms of gaze. It should be noted that this participant spoke highest number of times and second highest in terms of speaking duration.

It can also be seen from Table 3, that participant P3 elicit most nods in every observation. The results are consistent for observation G1O2 and G2O3 with regard to leadership. On the other hand, sub-leader received the highest number of nods during observation G2O2.

RQ2. This question examines if seating arrangement significantly affect the visual attention given to a person or just speaking duration/speaking frequency are the major factor(s) in determining the attention. Previous studies have established that both speaking duration and seating position determines the amount of attention given to a person. The sitting arrangements of participants during the observations are shown in Figure 1. RQ1 found that participant P3, P1, P3 spoke most followed by P1, P3, P1 during observation G1O2, G2O2, and G2O3 respectively.

It can be seen from Figure 1 that during observation G1O2, participant P2 is adjacent to participant P3 (who spoke most) therefore not in a favorable position to look at participant P3. Participant P1 spoke most during observation G2O2. Did he/she get the most attention from participant P2 who was sitting next to him/her (unfavorable position for communication)? Who got the most attention from participant P2 – participant P3 who spoke most in terms of speaking duration or participant P1 who spoke most in terms of speaking time? Both participants sat in front of P2 but side-ways.

Table 4 presents the participants’ amount of attention (gaze and nods) towards each other. It can be observed from the observation G1O2 data that participant P2 gazed more towards P1 (spoke the second most but highest number of times and sat in front of P2) than P3 (spoke most but second highest with regard to number of times and sat adjacent to P2). *This suggests that number of times a person spoke and/or seating plan played more significant role than speaking duration to grab visual attention from participant P2. However, there is little difference (17 seconds) between P1 and P3 in terms of speaking time. Also, even though participant P1 spoke few seconds less than P3 but he/she spoke slightly greater number of times than participant P3.* If both gaze and nods are considered, then participant P2 gave more attention to P3 (spoke most but second highest with regard to number of times and sat adjacent to P2). *This implies speaking duration was the main determinant to elicit the attention.*

During observation G2O2, participant P2 gave highest attention to participant P1 (spoke most and also highest number of times but sat adjacent to P2). *This means that speaking time and number of times a person spoke were more important factors than seating plan in order to draw attention from participant P2.* During observation G2O3 participant P1 paid higher visual attention to participant P3 (who spoke most and sat opposite to P1) than participant P2 (who spoke least and sat on the side). Similarly, participant P3 paid higher attention to participant P1 (who spoke the second most but highest number of times and sat opposite to P3) than participant P2 (who spoke least and sat on the side). On the other hand, if both gaze and nods are considered, participant P2 paid slightly more attention to participant P3 (who spoke most in terms of speaking duration but second highest number of times) than participant P1 (who spoke highest number of times but second most in terms of duration). *This implies that during this discussion, speaking duration played a significant role to draw attention from participants.*

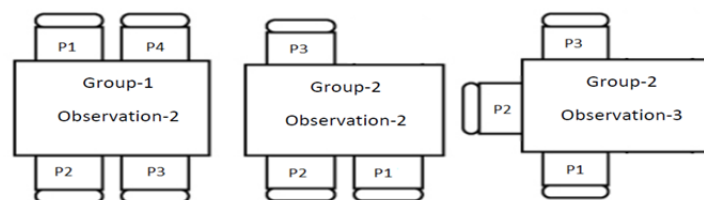


Figure 1. Sitting arrangement of participants

Table 4. Participants’s use of back-channels

Group	Observation	Group Member	Towards P1	Towards P2	Towards P3	Towards P4
G1	O2	P1		17 Gazes 0 Nods	71 Gazes 17 Nods	24 Gazes 0 Nods
		P2	79 Gazes 8 Nods		64 Gazes 29 Nods	59 Gazes 3 Nods
		P3	93 Gazes 1 Nods	31 Gazes 2 Nods		52 Gazes 1 Nods
		P4	32 Gazes 0 Nods	47 Gazes 4 Nods	84 Gazes 7 Nods	
G2	O2	P1		33 Gazes 12 Nods	69 Gazes 21 Nods	
		P2	76 Gazes 0 Nods		63 Gazes 2 Nods	
		P3	93 Gazes 3 Nods	47 Gazes 3 Nods		
G2	O3	P1		18 Gazes 7 Nods	35 Gazes 16 Nods	
		P2	32 Gazes 3 Nods		31 Gazes 6 Nods	
		P3	64 Gazes 5 Nods	15 Gazes 3 Nods		

RQ3. Table 5 shows some of the instances of validation by speakers when they tracked their listeners backchannels to ensure mutual understanding. As can be seen, speakers predominantly used eye contact, which was sometimes accompanied by a gesture, to check if the listeners are following what they said. A majority of grounding instances can be seen to be between the two members who spoke most often, and in these

observations those members were the leader and sub-leader. Nods followed eye contact in several of the listed examples of grounding, which was used by listeners while maintaining eye contact as well as while not maintaining eye contact. Nodding and acknowledging what was said with a “yes” or “yeah” were used by listeners while they were looking at a screen and maintaining eye contact.

Table 5. Grounding by speakers

Group	Observation	Initial Action by the Speaker	Timestamp	Action by the Listener
G1	O2	Look (P3 to P1)	16:10	Nod & “Yeah” (P1)
		Look (P3 to P4)	16:09	Look (P4)
		Look (P3 to P2)	18:50	“Yeah” (P2)
		Look (P2 to P3)	18:52	Look (P3)
		Look (P1 to P3)	18:54	“Yeah” (P3)
		Look (P3 to P1)	18:56	“Yeah” (P1)
		Look (P1 to P3)	22:51	Nod (P3), Look (P2)
		Look (P1 to P2)	22:52	Nod & Look (P2)
		Look (P1 to P3)	22:58	Nod & “Yeah” (P3)
G2	O2	Look (P2 to P4)	23:02	Look (P4)
		Look (P3 to P1)	1:53	“Yeah” & Look (P1&P2 to P3)
		Look (P3 to P1)	15:53	“Yeah” & Nod (P1 to P3)
		Look (P3 to P1)	17:31	“Yeah” & Nod (P1), Look (P2 to P3)
		Look (P3 to P1&P2)	21:32	“Yeah”, Nod, Look (P1&P2 to P3)
		Look (P1 to P3)	3:51	“Yeah”, Nod, Look (P3 to P1)
		Look (P3 to P1)	4:13	“Yeah” & Nod (P1 to P3)
G2	O3	Look (P2 to P3)	4:54	Look & “Yeah” (P3 to P2), “Yeah” & Look (P1 to P2)
		Gesture & Look (P3 to P1)	4:38	Look, Nod, & “Yeah” (P1&P2 to P3)
		Look (P3 to P1)	4:59	Look (P1&P2), “Yeah” (P1)
		Gesture (P1 to P2&P3)	6:50	“Yeah” (P2&P3), Look (P3 to P1)
		Look (P3 to P1)	12:18	Look, “Yeah”, & Nod (P1 to P3)
		Gesture & Look (P3 to P2)	14:16	“Yeah” (P1&P2), Nod (P1&P2), Look (P2 to P3)
		Facing & Gesture (P2 to P1)	21:45	Look (P1&P3) & Nod (P1 to P2)
Look (P3 to P1)	21:52	Look(P1&P2), Nod (P1 to P3)		

RQ4. Table 5 shows speakers' various actions (including gestures) whereas Table 6 presents speakers' actions (gesture only) and resulting back-channels from the listeners. As can be seen from the tables, listeners used all kind of back-channels such as gaze, nod, verbal response and sometimes gesture. According to the Table 5 when the speakers look to their listeners during a collaborative interaction,

listeners mostly response verbally as well as looking back to the speaker whereas according to the Table 6, if the speaker gestures only, listeners respond mostly by looking and sometimes accompanied by a verbal response or a nod. It appears from table 5 and 6, that look accompanied by a gesture resulted in richer response from the listeners compared to gestures alone.

Table 6. Gestures by Speakers and resulting back-channels

Group	Observation	Initial Action by the Speaker	Timestamp	Action by the Listener
G1	O2	Gesture (P3)	15:42	Nod (P1&P2), "Yeah" (P1), Look (P1 to P3)
		Gesture (P1)	18:53	Look (P2&P3 to P1)
		Gesture (P2)	23:04	Look (P4 to P2)
		Lean back & Gesture (P1)	28:55	Look (P2 to P1), "Yeah" (P3 to P1)
G2	O2	Gesture (P3)	1:45	Look (P1&P2 to P3)
		Gesture (P1)	1:51	Look (P3), Look (P1 to P2)
		Gesture (P2)	4:51	Look & "Yeah" (P1&P3 to P2)
		Gesture (P3)	15:35	Look (P1&P2), "Yeah" (P1&P2), Gesture (P1 to P3)
		Gesture (P3)	17:32	Look (P1&P2 to P3), "Yeah" & Nod (P1 to P3)
		Gesture (P3)	21:17	Look & "Yeah"(P2), Look (P1)
G2	O3	Gesture (P1)	4:17	Look (P2&P3)
		Gesture (P3)	4:38	Look (P1&P2), Nod (P1)
		Gesture (P3)	6:55	Nod (P2), "Yeah" & Gesture (P1)
		Gesture (P1)	12:01	Look (P2&P3)
		Gesture (P1)	14:16	Look (P2&P3), Nod (P3)
		Gesture (P2)	21:47	Look (P1&P3), Nod (P1)

RQ5. Table 7 shows the listeners' and the speakers' actions for the next turn of speaking and the corresponding actions from the listeners. Listeners, who wanted to speak, generally look and gesture to the speaker for taking the turn. As can be

seen from the Table 7, speakers sometimes relinquish their turn to one of the listeners by looking at them and listeners also use eye gaze most of the time to take the turn of speaking.

Table 7. Sample use of back-channels with turn taking

Group	Observation	Timestamp	Action by the Listener	Action by the Speaker	Response from Listener	Timestamp
G1	O2	00:24	Look at screen (working)		Speak (P1)	00:27
		16:10	Nod, "Yeah", Look (P1 to P3)		Speak (P1)	16:12
		18:37	"Yeah" (P2)		Speak (P2)	18:50
		18:50	Look (P3 to P2)		Speak (P3)	18:51
		18:52	Gesture (P1)		Speak (P1)	18:53
		18:57	Look away (P3 from P2)		Speak (P3)	18:58
		22:58	Look (P2 to P4 & P1)		Speak (P2)	22:59
G2	O2	01:44	Look and Gesture (P3 to P1&P2)		Speak (P3)	01:45
		15:33	Look & Gesture (P3 to P1)		Speak (P3)	15:35
		15:36	Look & Gesture (P1 to P3)		Speak (P1)	15:37
		17:34		Look (P3 to P2)	Speak (P2)	17:35
		17:41		Look (P2 to P1)	Speak (P1)	17:44
		17:44		Look (P1 to P2)	Speak (P2)	17:50
G2	O3	21:21	Look (P3 to P1)		Speak (P3)	21:27
		04:34	Gesture (P1), Look (P3 to P1)		Speak (P3)	04:35
		12:07		Look (P1 to P2)	Speak (P2)	12:10
		12:10	Look, Nod, "Yeah" (P1 to P3)		Speak (P1)	12:23
		13:43	Look & Gesture (P3 to P1), Look (P2 to P3)		Speak (P2)	13:46
		13:46		Look (P2 to P3)	Speak (P3)	13:51
		23:48	Look (P2 to P3), Look (P1&P3 to P2)		Speak (P1)	23:52
23:54		Look (P3 to P2)	Speak (P2)	23:55		

4. Discussion

Participant contributions and interaction patterns can be helpful for identifying the emergent leaders in a group discussion [20]. Li et al. [21] proposed a method for identifying a leader. Also, Dowell, et al. [20] discussed passive vs. active and leading vs. following behavioral engagement style, type of contribution such as *Figure 1. Sitting arrangement of participants* new information or echoing established information, and social orientation to present six types of group discussion participants. In Ho, et al. [22], a novel approach was suggested for identifying opinion leaders from group discussions with degree of participation, emotion for each participant, and influential capacity. Strijbos, et al. [5] examined roles in groups with a focus on a computer-mediated context, however the groups worked asynchronously. Similarly, in this study the participant contributions namely speaking duration and number of speaking times in a group discussion was investigated for understanding the roles in a group. The results of this study showed that speaking duration of a participant is the most important factor to determine a leader. However, the role of 'number of times a person spoke to discover a leader cannot be discounted. Therefore, it can be said that, those who take leadership roles tend to talk more during group discussions.

According to the literature, visibility was shown to be a large factor in receiving communication in a group discussion setting and that centrality was a large factor in initiation [23]. High centrality and high visibility were shown to be a predictor of group discussion domination as well [23]. A study on establishing emergent leaders through eye gaze and speaking found that the amount of speaking is a better indicator than visual attention (or gaze) of emergent leadership and that gaze can be used as an indicator of dominance perception between participants [24]. Maclaren et al. [25] found that speaking time retains its direct effect on leader emergence when accounting for intelligence, personality, gender, and the endogeneity of speaking time. The present study found that leaders, in terms of speaking duration, did not always receive the most attention (such as gaze and nods) from other participants. Sometimes participant who spoke highest number of times but not the longest duration received the most visual attention.

Research has also shown that there is more interaction with group members who sit opposite or diagonally to each other rather than adjacent to one another for groups who sit in circular or rectangular seating arrangements [26]. However, the relation between seating arrangement and amount of attention

is not apparent from the data during this study. Participants paid more attention to either leaders or subleaders irrespective of their seating position even if they were adjacent.

A speaker's need for grounding may be marked by certain cues (gaze, intonation, etc.) that invite a response from the listeners [27] since listeners are more than just passive recipients of speaker's talk [28]. Speakers pro-actively seek listener feedback when they need information on whether a listener perceived, understood or accepted their message and listeners pro-actively provide feedback when they think that it is important for the speaker to know their mental state [29]. Grounding can be achieved verbally or non-verbally [30]. Eye gaze is a the most basic form of providing evidence of grounding from non-speakers, whereas nodding is similar to verbal evidence of grounding [30]. Results of this study showed that speakers tracked their listeners' backchannels to validate mutual understanding. Speakers mostly used eye gaze to ensure the understanding of their listeners. As a response to the speaker, listeners dominantly used nodding and gave verbal acknowledgements during the group discussion.

Listeners' responses are not coincidence but very much connected to speakers' actions. They signal that the contribution is being attended to, understood, agreed upon or some other attitudinal or affective reaction to it [31] [32] [33]. Amalanci [34] discusses how gestures strength words "in the act of impressing". As gestures are used while speaking, they cannot be interpreted separately from the discussion and context. Gestures also inform others about the speakers' identity and emotions and can be important for increasing understanding during communication. With larger groups, the effect of gestures can be seen as higher even when verbal dominance is low, but there was not much of a difference when verbal dominance was high and if gesture usage was high or low. However, it is important to study gestures in relation to speaking, as they are often used as clarification or in lieu of words. Also, there are several studies supporting the importance of eye gaze in social settings as an vital instrument for a successful communication [35]. Listener's gaze has a crucial role in the production of backchannels and listener orients to the speaker while producing backchannels, both verbal tokens (e.g. mh hm, yeah, okay, right, that's great) and visual practices, such as facial expressions, head nods and gestures [28]. The results of this study showed that listeners in a group discussion generally used different kind of back-channels such as gaze, nod, and verbal response. When the speakers look to their listeners during a collaborative interaction,

listeners mostly responded by nodding and responding verbally as well as sometimes looking back to the speaker. Also, it can be said that gesture can often lead to back channels being used by listeners. When the speaker gestures only, listeners respond mostly by eye gaze sometimes accompanied by a verbal response or a nod. However, when the look was accompanied by a gesture from the speaker, it resulted in a richer response from the listeners compared to gestures alone.

For taking the turn in a group discussion participant follows different patterns. There are five abilities required for efficient turn-taking: 1) It involves knowing how to signal that one wants to speak. 2) It means recognizing the right moment to get a turn. 3) It is important to know how to use appropriate turn structure in order to use one's turn properly and not lose it before finishing what one has to say. 4) One has to be able to recognize other people's signals of their desire to speak. 5) One needs to know how to let someone else have a turn [36]. The first, third and fifth are more active abilities, involving linguistic (e.g. phrases, words, and noises) and, paralinguistic (e.g. eye contact, facial expression, and gestures) techniques [37]. In this study, listeners looked or gestured to the speaker for taking the turn in a group discussion. Compared to the gesture, eye gaze was mostly used for turn taking. On the other hand, speakers often relinquished their turn to the listener by using eye gaze.

5. Conclusion

This study was conducted to understand the behavior of participants from an engineering degree programme during group discussions in a blended environment. The group discussion setting included a combination of face-to-face group discussion and CSCW together. It has been seen that, even though all participants were using technology such as laptops, projectors, and mobile phones, it did not seem to affect participation or the flow of the group discussion. Eye gaze was often divided between other participants and the technology used, however other back channels were also used for grounding and turn taking. The results of this study seem to imply that there is no difference, in terms of communication and other related issues, between a group discussion with shared visual information in a blended environment and group discussion in a conventional setting (without shared visual information) as mentioned in other research. The only deviation found was that the effect of seating arrangement was not apparent. Participants who spoke most either in terms of duration or frequency received the most attention from other participants

irrespective of their sitting place. That means even if the speaker was adjacent to the listener, which is seen as an unfavorable position for receiving the attention from the listener, still listener paid the most attention to the speaker.

This pilot study was conducted with limited groups therefore there is a need to expand this study by including more groups with higher number of participants in the future in order to ensure the accuracy and confirm the findings.

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