ISSN No:-2456-2165

Understanding Students Views and Preferences towards Blended Learning in a Civil Engineering Course

Jorge Olmedo Montoya Vallecilla[1] and Galena Pisoni[2]
[1]Universidad de Ibagué, Ibagué, Colombia
[2]University of Trento, Trento, Italy

Abstract:- This paper presents a case study of students' views and preferences towards a Blended Learning (BL) course in Mechanics of Materials. The BL approach was introduced with the aim to enhance student's active participation in and outside classroom, as well as to allow the students to acquire knowledge and skills by exploring their individual learning styles. In this approach, the professor videotaped classes and asked the students to watch them prior to the face-to-face sessions. In the face-to-face sessions, the students discussed the concepts introduced in the videos within their work teams and typically used physical models (i.e. physical copies of objects or phenomena) to enhance and facilitate understanding. In this paper, the authors presents the results of a survey responded by 98 out of 104 participants. The questionnaire was designed to measure the students' views and preferences towards BL. This study concludes that the majority of students have a good perception towards BL. They consider the class time is used in a more effective and efficient way, compared to traditional engineering lecture approaches. On the other hand, they think that by using the BL methodology, they have to work extra time inside and outside the classroom and see this as a negative aspect.

Keywords:- *Blended Learning, Mechanics of Materials, Physical Models, Perceptions, Attitudes.*

I. INTRODUCTION

Frontal lectures have been used for hundreds of years to convey information to students and have been the norm in engineering courses. The traditional engineering lecturing approach consists of giving lecture, typically by the professor of the course, followed by tutorial and/or laboratory sessions in which students apply the acquainted knowledge (Nepal and G.A. Jenkins, 2011). In a typical engineering class, the lecturer explains the subject matter (theoretical concepts, equations deductions, etc.) and / or solves complex mathematical problems, while students take notes and pay attention to the lecturer. Students are expected to later demonstrate that they have gained the information or knowledge presented by taking final written or oral exams.

The effectiveness of this approach can be discussed. Except for the phase where students take notes, in the rest of the lecture they are physically inactive and in the same time they are expected to be mentally alert. Previous studies have shown that most students of any age cannot maintain such behavior for a long period of time (Cangelosi, 2002), which is in contrast with the goal of knowledge acquisition. Even more, according to some authors (Butt, 2014), listening does not seem to be students' favorite learning activity. In a study among 60 respondents who had been exposed to different learning environment, students selected listening to someone talk as the least effective activity that assists learning, followed by reading and finally, performing an activity as the most effective (Butt, 2014).

The problem with traditional frontal lectures is that some learners find themselves locked into a transmission model of learning, in which it is assumed that the purpose of lectures is to transmit facts that simply need to be recorded and learned (Van Dijk and Jochem, 2002). Traditional lecture approach in engineering courses focuses more on knowledge transmission than on knowledge construction. According to some authors (Van Dijk et al 1999, Vinke 1995), lecturers tend to concentrate on covering and explaining the subject matter and only occasionally allow students to ask questions. Traditional lecture approach does not offer enough space for interactions between the students and the lecturer and the students.

It is clear from the above that in a traditional lecture centered approach, students are not the center of the teaching-learning environment and they are not participating actively in the process. Some authors (Michel et al, 2009) affirm that the traditional method of teaching sees students as passive learners because it does not engage them actively. Some others even conclude that engineering is still using outdated approaches for teaching technical concepts and problem solving (Sheppard et al, 2008).

In recent decades, active learning pedagogies have emerged in engineering courses (Kersten S. 2018, Garcia-Peñalvo and Colombo Palacio, 2015). These modern methods are based on cognitive science research, which places students at the center of the teaching-learning scenario and in them students build knowledge as a result of their mental activity (Cross 1999). In this typical modern method, learners focus on real world facts and experiences, concepts, tools, and technologies, all of this in a social environment, where they work in teams to construct required knowledge and ability to solve realistic problems. The Blended Learning approach (BL) has emerged recently and it is a term increasingly used to describe how online learning combines with traditional lecture approach and independent study to create a new, hybrid teaching-learning

ISSN No:-2456-2165

methodology. It represents, a huge change in the way students approach their learning experience.

- *Background*

BL is defined as method that combines online learning with face-to-face teaching and has been increasingly used in higher education over the last years (Thorne K, 2003, Moebs and Weibelzahl, 2006, Hisham et al, 2006). Scholars (Garrison DR. & Vaughan, 2008) define the BL methodology as the integration and a careful selection of face-to-face training approaches and online technologies. (Lalima and Dangwal, 2017) define BL as "an innovative concept that embraces the advantages of both traditional teaching in the classroom and Information and Communication Technology (ICT) supported learning" including features from both, offline and online learning. It built on the premises of collaborative learning, constructive learning and computer assisted learning (Lalima and Dangwal, 2017).

Blended learning has been applied in engineering programs in recent years. This new education approach had a lot of resistance among instructors and institutions in its beginnings and for that reason it hasn't been so widely adopted in engineering education programs yet. Different models on how BL can be introduced in education curricula have been presented in the literature (Pisoni at al, 2018, Pisoni, 2019). There are several successful blended learning intervention publications that enable and encourage application in engineering. (M. Qiu, and L. Chen, A, 2010) developed a methodology in which they combined face to face teaching and e-learning for advanced software engineering course where the students work in groups to solve a practical problem. Their survey found that students' academic performance improved, compared to traditional lecture approach. In a similar study (Peter et al, 2017) combined online assignments and face-to-face problem solving teaching method: the study concluded that students' achievement improved significantly compared to classes in which they employed traditional lectures centered approach. Students who have undergone BL training obtain higher grades compared to those in completely virtual environments or entirely face-to-face training (Means et al, 2009).

In a flipped class intervention, (Hotle and Garrow, 2015) found out that students perceived that they had learnt the course material in a better and faster way than they would do in a traditionally teacher centered approach. Difference have also been perceived by some researchers in assessment, for instance (Smith, 2013) concluded that students feel better prepared for assessment when being exposed to a blended learning environment. (Harris and Park, 2016) partially flipped a portion of a third-year energy conversion course and collected instructors and students' perceptions of the blended intervention. They concluded that both, instructor and students had positive perceptions of the classes taught using the flipped classroom pedagogy. Other authors (Martinez et al, 2011) conclude that student satisfaction also tends to be higher in BL learning environments than in traditional lecturing approach.

Student's willingness or reluctance to knowledge acquisition is also another important factor in education, whatever the pedagogical approach may be. The attitude students show toward the different teaching-learning methodologies is affected both by personal motivations of origin and academic customs, as well as by the social and training environment (Maio and Haddock 2018). The success or failure of the methodology is linked to levels of perceived student satisfaction. Therefore, student's attitude needs to be evaluated continuously to guarantee the quality of both individual and group learning experiences. Satisfied students are more motivated and are more committed and are, therefore, better apprentices than their dissatisfied counterparts (Shantakumari and Sajith, 2014). Attitude therefore, is an important and critical factor that determines success in BL training. This is also especially due to the fact that the interest of the students depends on the interest generated by both the proposed methodology and the topic, among other factors. A strong character of the teacher to guide learning and positive attitudes of the students towards learning can contribute to the effective use of learning strategies (Maio and Haddock 2009).

The use of the BL methodology allows students to appropriate their time and rhythm, by controlling a good part of the teaching-learning process. This is an advantage, since in these scenarios the students are in charge of their learning process. Some students prefer an individual or less structured learning environment. In other words, they need appropriate learning material to learn at their own pace. At the same time, educators face the challenge of integrating emerging and traditional technologies, as well as balancing the learning styles of students (Wan Ahmad et al, 2010).

The present study seeks to understand the view the students have towards the BL methodology and tries to demonstrate that, the BL reinforced with representations of physical models is a good alternative to strengthen the engineering concepts and make them last over time. It is important to highlight that BL requires the active participation of the students, making them protagonists of the teaching-learning processes, which is not necessarily true in a traditional lecturing approach (Mills & Treagust, 2003).

II. MATERIALS AND METHOD

A. *Seting and Participants*

Here we present the results of survey study we did with students' participants following the Mechanics of Materials course in a 5-year civil engineering program at a private university in Colombia. It included in total 98 student participants. In this course, the students, besides being exposed to BL as a methodology, were also given physical models (smaller scale copies of objects or phenomena used for didactic purposes) as additional materials to help the group discussions in the face-to-face sessions. Students enrolled in this course were in their fifth semester of a ten-semester program. The same course was offered over the two semesters in 2017: there were 54 students in semester 1 (30 male and 24 female) and 50 students in semester 2 (35 male and 15 female). Students' mean ages were 19.63 years for semester 1 and 19.83 years for semester 2. There was no difference in course content or the number of previous courses taken by students between semester 1 and 2. This course met twice weekly for a total of 64-hours per semester. First semester runs from February to May and second semester from August to November. The BL methodology described below was implemented in each course offering. Both sections (1 and 2) had the same content: normal and shear stress and strain, axial load, torsion stress and strain, transversal loads, beams flection and deflection and stress transformation.

B. Blended learning implementation

It is important to clarify that the common methodology of instruction in the faculty of engineering at Universidad de Ibagué is that of traditional lecturing approach. The civil engineering department has started to introduce active learning approaches only recently by by first introducing physical models as additional materials in Mechanics and Statics courses and only in this course starts to use also BL. (Montoya, 2018) developed a methodology during 4 years where students discussed the phenomena to be studied, prior to the introduction of equations, with the help of deformable materials. The studied compared students in class participation between a teacher centered approach and an active physical model discussion methodology and concluded that in the active approach, students' participation increased (from 20 % to 60%). The study also concluded that students passing score increased significantly.

In this study, the students had to cover part of the course learning objectives by viewing online video contents and participating in online discussions. As a complement posterior to the virtual activity, the face-to-face sessions involved collaborative work - group discussions and the use of deformable physical models. The purpose was to allow students to experiment with the physical models to test and strengthen their understanding of concepts studied outside of class. Course was divided into two parts: one virtual and the other one face-to-face. For the execution of the methodology, work groups of 4 students were formed at the beginning of each semester; the students autonomously selected their members.

Virtual sessions

For the virtual session, the teacher created explanatory videos of the subject, to be watched by the students before class. Each video had a maximum duration of 10 minutes, so that students do not keep their attention on the contents presented (Guo, 2014). Videos were created using the A-tube-catcher free software and edited with YouTube Creator Studio. Students were required to watch the videos and take notes. Students were also encouraged to watch the video content as many times as required, and take notes of the concepts that were not clear. They could also communicate by any electronic means (mail, chat, Moodle) with the teacher and the teacher's assistants. The role of the teacher´s assistant was exclusively concerned with the outside classroom activities; the assistant never participated in the face-to-face sessions. The assistant answered individual and group questions related to clarification of video explanation and the extra class assignments that the students needed to complete in the virtual environment, using Moodle, Google classroom, Google docs and the university e-mail. He was available twice a week for two hours each. Students could leave their questions in advance or chat with the assistant when he was on line. The instructor was on line once a week in a different hour than the assistant. There was a total of six virtual tutoring hours (two from the instructor and 4 from the assistant). When questions were not asked during an online chat, students waited as much as 24 hours for a response, with the exception of weekend question, with a maximum waiting of 48 hours.

The number of videos assigned per week depended on the subject, with a minimum of one video and a maximum of three videos per week. In addition to the videos, the teacher also assigned readings, virtual labs, or the observation of some phenomenon online, related to the subject of study. Students could exchange information or discuss concepts with their team mates or with other group members. The activities to be done outside of class, either watching of videos, consultations, and readings were to be completed by the students before the complementary face-to-face session as the content coverage was needed for the face-to-face discussion and physical models experimentation. There was an electronic reminder twice a week for students to review the assignments.

Face-to-face sessions

During the face-to-face session, the chairs were arranged in a circle so that students could work with their teams. They could make use of the basic resources of the room: the board, scoreboard, blackboard, or they could also make use of their cell phones and use their laptops. The initial work instructions were given by the teacher. The aim was that students discuss the topics studied, exchange knowledge, and address points of confusion. In a typical face to face session, for the first 8-10 minutes of the two-hour session, the students discussed the concepts learned in the videos, the additions readings, and assignments they were given. Then the physical models were given by the teacher, with an instruction of 5 minutes on what was asked from them to do with the models. Each group worked with physical models for 15 minutes. For this, they had to try to represent the phenomena and concepts presented in the virtual class and the consultations, using the physical models. Figure 1 shows pictures of typical face-to-face sessions.

The role of the teacher was that of a facilitator, going around the teams and encouraging them to work collaboratively. During the following 20-25 minutes, each team was sharing the results from the group work with the rest of the class. The rest of the session is dedicated to applying the knowledge gained in a practical problem. Given that there were two face-to-face sessions per week, the first session was organized as described above, and the second session, the students only worked on an exercise in which they applied the gained knowledge on a practical case. The procedure was the same for section 1 and 2. There was no tracking if the students' watched the video. Nevertheless, they were asked to take notes when watching the videos and there was notes were sent to the teachers before the beginning of every class, in order to be guarantee that the students watched the contents prior to the face-to-face session (Brame, 2013; Shumski, 2014).

Fig 1:- Typical face-to-face sessions with physical models representation

There were a total of 16 face to face sessions for each semester: the BL intervention was used in 8 sessions. Physical models were used in six of them and discussion without physical models occurred in 2 sessions.

At the end of some of the face-to-face sessions (in 60% of the sessions), a non-summative evaluation was carried out using Moodle or Socrative online tool. Socrative is a free software that works as a clicker. The instructor can either ask a question or prepare a quick test and students participate using their mobile phone. The results were shared within the work teams and with the group in full.

Data collection and analysis

The survey contained a total of 33 Likert-style items and was aimed to capture students' views and preferences of BL environment described. It contained 8 different sections, each focusing on different aspect of the BL process. The survey was opened during the last week of the semester and it was open for a week. Students responded to it using Google docs. Their names or identification were not registered, and they provided their responses anonymously. All aspects concerning the nature of the survey and specialized terms were clarified within the survey.

III. RESULTS

98 of a total of 104 students responded to the survey. In the first part of the survey, students were asked about their participation in the BL methodology and the role of some of the actors, as well as the evaluation process. The Likert-items words were converted to 1 to 5 number scale, were 1 corresponds to completely disagree and 5 to strongly agree. The results are presented in tables as per different sections of the survey. The last column of these tables represents the mean and standard deviation (std) of every question. Positive answers were calculated adding up agree (A) and strongly agree (S.A) responses, while negative answers included strongly disagree (S.D) and disagree (D) responses. Percentages of students not taking a clear position, neither agree nor disagree (N/D) correspond to the fifth column of all tables (converted to a 3.0 number scale).

In response to the question if the material was well organized, 78.5% of the participants agree, and in response to the question if the course provided the necessary tools to achieve the learning results, 85.8% of the participants responded positively (Table 1.)

Regarding the communication among the actors involved in the process, 82.3% of respondents think that communication with the teacher and the teacher's assistant was easy, while 9.3% do not take a position on it; 93.9% stated that the teacher used online media to communicate with students in some way and 66.3% indicate having communicated with their peers using online resources. It should also be noted that the statement it was easy to communicate with the teacher and the teacher's assistant obtained an average of 4.15 (of a total of 5.0) and a standard deviation of 0.97 and the statement I communicated with other students online or through electronic means obtained an average of 3.74 but a standard deviation of 1.36.

Regarding the final evaluation of the course, 64.9% indicate that improvement activities were effective and that self-assessment helped learn the subject matter better.

For individual participation in the BL methodology, 89.8% of the participants said that they did the tasks and activities assigned by the teacher, 17.4% say they needed advice or clarification from the teacher after the group discussions. Around 50% considered that it was difficult to get used to studying the material online, prior to the class and around 60% also consider that the BL methodology requires more dedication than the traditional methodology of lecturing approach.

About the time and effort invested (questions 11-13), half of the respondent said that it was difficult to get used to investing time to study the on line material and 59.8% believe that BL requires more dedication and greater discipline, compared to the traditional methodology of lecture classes.

About the improvement of the learning process (questions 14-17), 86.7% of respondents consider the development of online material as a key for their understanding of concepts, 72.2% think they obtained better results with BL, compared to traditional lecture approach and 78.6% think they gained initiative. 77.5% of respondents think BL is better suited to the learning needs of students, compared to the traditional methodology of lecture classes. This information can be seen in Table 6.

In respect to group discussions and the use of physical models (questions 18-22), the majority of respondents (86.6%) consider that the group discussions are more fluent and productive after having studied the material online and that, in addition, they helped in a significant way to clarify the concepts when there were in doubts. Finally, respondents consider that physical models facilitate both the rapid understanding of concepts and the dynamics of group discussions (92.7%).

A preference of BL over traditional lecturing methods was shown by 73.5% of the participants, with 11.2% that is not decided in this respect and 15.4% preferring the traditional lecturing approach. 51.1% of respondents consider the BL methodology adequate even for shy or introverted students, in contrast with a 26.5% believing that it represents a difficulty for them.

The statement The BL methodology combined with the use of physical models in group discussions is an effective tool in Civil Engineering courses obtained an average of 4.49 and a standard deviation of 0.89.

	About the BL methodology	S.D	D	N/D	A	S.A	Mean/std
1	The online material was well organized.	3.1	2.1	16.3	31.6	46.9	4.18/0.99
2	The course provided all the material required to achieve the expected learning results.	3.1	2.1	9.1	32.6	53.1	4.32/0.95
3	In the course the BL methodology was well combined with group discussions.	2.1	2.1	11.3	30.9	53.6	4.33/0.91

Table 1:- Percentages of answers to questions 1-3

	About the communication among actors	S.D	D	N/D	A	S.A	Mean/std
4	It was easy to communicate with the teacher or the teacher's assistants during the course.	2.1	6.3	9.3	38.8	43.5	4.15/0.97
5	The teacher used online media to communicate with students in some way.	4.1	1	1	25.5	68.4	4.52/0.91
6	During the course, I communicated with other students online or through electronic media.	10.2	11.3	12.2	26.5	39.8	3.74/1.36

Table 2:- Percentages of answers to questions 4-6

	About the evaluation	S.D	D	N/D	A	S.A	Mean/std
7	During the course, the self-assessment or improvement activities were effective and helped me to learn better.	8.2	6.1	20.6	43.3	21.6	3.66/1.15

Table 3: Percentages of answers to question 7

	About the individual participation in the methodology	S.D	D	N/D	A	S.A	Mean/std
8	In the topics where the BL methodology was applied, I carried out the online activities and tasks assigned by the teacher, prior to each group discussion.	3.1	1	6.1	41.8	48	4.30/0.89
9	After the study of online material and group discussions, I needed clarification or additional advice from the teacher.	34.7	35.2	12.7	11.2	6.2	2.15/1.17
10	I have participated before in group discussions with prior study of online material	40.2	30.6	13.3	7.8	8.1	2.12/1.26

Table 4:- Percentages of answers to questions 8-10

	About the time and effort invested	S.D	D	N/D	A	S.A	Mean/std
11	It was difficult to get used to invest time in studying the material online, before each class	11.3	18.0	20.2	25.8	24.7	3.34/1.33
12	The time that I invest in acquiring the concepts in the BL methodology is bigger than in the traditional methodology of lecture classes	11.3	18.3	18.4	31.6	20.4	3.32/1.30
13	The BL methodology requires more dedication and greater discipline on the part of the students, compared to the traditional methodology of lecture classes.	8.2	8.2	23.8	32	27.8	3.63/1.20

Table 5:- Percentages of answers to questions 11-13

	About the improvement of the learning process	S.D	D	N/D	A	S.A	Mean/std
14	The development of online material allowed me to improve my learning process.	1	4.1	8.2	43.8	42.9	4.26/0.85
15	I obtained better learning results with the BL methodology.	3.1	6.1	18.6	36.1	36.1	3.96/1.03
16	The BL methodology helped to have bigger initiative and participation.	2.1	2.1	17.2	37.8	40.8	4.13/0.92
17	The BL methodology is better suited to the learning needs of students, compared to the traditional methodology of lecture classes.	2.1	4.1	16.3	35.7	41.8	4.17/0.92

Table 6:- Percentages of answers to questions 14-17

	About group discussions and physical models	S.D	D	N/D	A	S.A	Mean/std
18	The development of material and online work facilitated group discussions and exchange of ideas with other classmates.	2.1	3.1	10.1	30.6	54.1	4.32/0.93
19	The group discussions after the development of online tasks were important to clarify concepts that were not clear with the online study.	2.1	1	7.2	27.8	61.9	4.46/0.84
20	Group discussions are more productive if they are carried out after the development of online learning activities.	2.1	4.1	7.2	32.5	54.1	4.33/0.93
21	Group face-to-face discussions after studying the material online are more productive if they include physical models.	2.1	1	4.1	18.6	74.1	4.62/0.79
22	Different learning experiences, such as face-to-face group discussions combined with materials for online study (BL), increase motivation for learning.	2.1	2.1	11.3	43.3	41.2	4.19/0.87

Table 7:- Percentages of answers to questions 18-22

	About the assessment and preference of the BL methodology	S.D	D	N/D	A	S.A	Mean/std
23	If I could decide between BL and the traditional methodology of lecture classes, I would decide for BL.	8.2	7.2	11.2	33.7	39.8	3.90/1.24
24	I think the BL methodology is recommended for shy or introverted students.	10.2	16.3	22.4	14.3	36.8	3.51/1.39
25	The learning assessment system, summative and non-summative, was consistent	5.1	5.1	29.6	40.8	19.4	3.61/1.02
26	I think that the BL methodology DOES represent an advantage.	7.2	16.5	11.3	19.6	45.4	3.80/1.35
27	The BL methodology combined with the use of physical models in group discussions are an effective tool in Civil Engineering courses.	3.1	1	5.1	25.5	65.3	4.49/0.89

Table 8:- Percentages of answers to questions 23-27.

IV. DISCUSSION

The survey indicates that course material was well organized and the communication between the different involved actors (teachers and students) happens online. The use of physical models was an important complement to the BL methodology and seems essential in the study carried out. This was recognized and accepted by students (88.9%). The fact that 82.3% of the students see a clear and efficient communication with the teacher's assistants and the teacher was another confirmation for the efficiency of the approach. Only 15.9% of respondents have previously participated in group discussion that included online assignments. This factor is critical in order to consider the methodology as a new approach for students.

It is also striking that nearly two of every 10 students (17.4%) say they needed advice from the teacher, after the group discussions and the use of physical models. The group discussions were made within the teams formed by the students and the teacher circulated around the teams and had the role of a facilitator; however, despite the fact that the there was no teacher's assistant during the face-to-face sessions and that it was difficult for the teacher to assist 12-13 teams, there was not much request from teams about lack of understating the concepts or needing further explanation after the physical model discussion.

It is also important to highlight that more than 92.7% of the students believe that the BL methodology is more efficient, when the class complement is carried out through group discussions using physical models to represent phenomena.

Finally, although a good number of students prefer the BL methodology compared to the traditional methodology of lecture approach, only 51.1% believe that it is adequate even for shy and introverted students. This is not surprising since, both in online tasks and in group discussions, initiative and active participation is required, which could represent a challenge for some students, especially during the first weeks of adaptation.

V. CONCLUSIONS

The communication between teacher and students and teachers' assistants and students is essential for the development of an active learning methodology as BL is. The study shows that this has been one of the most important factors and was achieved. This not only helps students from the same team to communicate with each other, but also between members of different teams, which is valuable in the process of self-evaluation and even in the taking of initiative and participation of students in the discussions groups. The study also indicates that students require the presence of the teacher in group discussions after online work, but also indicates that the methodology can be applied with good results in large groups, only if it is well planned, if there is a two way communication among actors and if students do their part of developing the online activities prior to the face-to-face discussion.

Definitely, the BL methodology is a challenge for the teachers due to the amount of time spent in the preparation and execution of the learning activities, but also, the study shows that it is a challenge for the students too, since they must switch from the passive role of going to the classroom to listen to the teacher and from time to time to work on solving a problem, to an active role in which they are expected to participate in the discussions, not to mention that it is necessary to spend time before the class to review the study material. It is not common practice in the traditional methodology of lecture approach, such an active role and such a responsibility in students. This indicates that the BL methodology requires a strategy that attracts students and also generates interest in the learning process. This can be achieved by working on how students are approached and the variety of alternatives chosen to introduce the topics.

The active learning methodologies, in this case the BL, motivates students to participate and to show more initiative, and like this also contributing to the development of the students into professionals with greater capacity for teamwork. The representation of phenomena in engineering improves and speeds up the achievement of learning objectives. Group discussions in engineering courses are more efficient if representations are used to explain phenomena.

The BL methodology must be combined with strategies that allow the teacher to reach a greater number of students, to work with large groups and, above all, to motivate learning and focus on students who are not active or introverted, without neglecting those of their own initiative. In other words, it is a plus for the teacher, to explore the learning styles of students and work in the constant seek of the participation and comfort of all.

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