

EVALUATION ON DISCOMFORT LEVEL AMONG STUDENTS USING DESKS IN CLASSROOMS

Mahmood Ali^{a,e*}, Mohd Sapuan Salit^{a,b}, Karmegam Karuppiah^c,
Abu Saleh Ahmed^d

^aLaboratory of Biocomposite Technology, Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

^bDepartment of Mechanical and Manufacturing Engineering, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

^cDepartment of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

^dDepartment of Mechanical and Manufacturing Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.

^eDepartment of Mechanical Engineering, Polytechnic Kuching Sarawak, KM.22, Jalan Matang, 93050 Kuching Sarawak.

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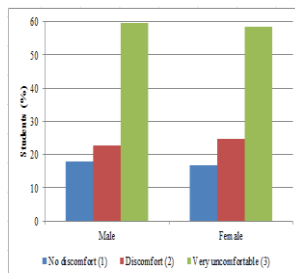
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*Corresponding author:
mode_intan@yahoo.com

Graphical abstract



Abstract

This study was conducted to evaluate the discomfort level among students using desks in classrooms of Polytechnic Kuching. The students (n=500) completed the questionnaire survey form using Borg's CR-10 Scale showing body chart discomfort. The students were asked to identify their body areas experiencing discomfort and to rate this discomfort on a score rating groups (0 to 5). Score 0-1.99 = No discomfort (1), score 2.00-3.99 = Discomfort (2) and score 4.00-5.00 = Very uncomfortable (3). The evaluation of the seating shows discomfort level of students and any outstanding problems arising. Students were asked to rank in the order of 10 statements about comfort and choose three responses which gave the most consistent equal interval scale. The results in that the main response of discomfort indicated the students mostly agree that they are feeling from cramped, stiff, numb, sore and tender to unbearable pain, barely comfortable and feel uncomfortable. The project was identified to evaluate the comfort level of classrooms desks for polytechnic students. Overall, there was a significant discomfort level for the students whilst using the desks and a possible solution put forward is to design a new type of classroom desk made of natural fibre reinforced composite.

Keywords: Evaluate comfort level, Classroom desks, Polytechnic students.

Abstrak

Kajian ini dijalankan untuk menilai tahap ketidakselesaan di kalangan pelajar menggunakan meja di dalam kelas Pengajian Politeknik Kuching. Pelajar-pelajar (n = 500) melengkapkan bentuk soal selidik menggunakan Borg CR-10 Skala menunjukkan badan rasa tidak selesa carta. Pelajar-pelajar telah diminta untuk mengenal pasti bidang badan ketidakselesaan mengalami mereka dan untuk mengadap ketidakselesaan ini pada kumpulan kedudukan skor (0-5). Skor 0-1,99 = Tiada rasa tidak selesa (1), skor 2,00-3,99 = Ketidakselesaan (2) dan skor 4,00-5,00 = Sangat tidak selesa (3). Penilaian duduk menunjukkan tahap ketidakselesaan pelajar dan sebarang masalah yang timbul. Pelajar diminta untuk pangkat dalam perintah 10 kenyataan tentang keselesaan dan pilih tiga

jawapan yang memberikan skala selang sama yang paling konsisten. Keputusan dalam bahawa sambutan utama rasa tidak selesa yang ditunjukkan pelajar sebahagian besar bersetuju bahawa mereka berasa dari sempit, kaku, kebas, sakit dan tender kepada kesakitan yang tidak bertanggung, hampir tidak selesa dan berasa tidak selesa. Projek ini telah dikenal pasti untuk menilai meja tahap keselesaan ofclassrooms untuk pelajar politeknik. Secara keseluruhan, terdapat satu tahap ketidakselesaan penting bagi pelajar menggunakan meja dan satu cara penyelesaian yang dikemukakan adalah untuk mereka bentuk jenis baru meja kelas diperbuat daripada serat semula jadi komposit bertetulang.

Kata kunci: Menilai tahap keselesaan, Meja kelas, Pelajar Politeknik

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1.0 INTRODUCTION

Chairs and desks have become an important element of the teaching and learning process. Chairs and desks are widely used in the classroom for the students of Polytechnic Kuching Sarawak [1]. Students remain seated at their desks for a considerable amount of time. Correct standing and sitting posture is an important factor for the prevention of musculoskeletal symptoms and an incorrect sitting or standing posture will put an extreme physiological strain on the muscles [2]. Taking this into consideration, as well as the potential incorrect use of polytechnic furniture, it is likely that some anatomical-functional changes and problems in the teaching learning process may occur. This situation could be a potential catalyst for the study and development of a new design of polytechnic furniture suitable to the needs of the students and utilizing the appropriate dimensions according to the student's anthropometrics characteristics [3].

Ergonomics is the study that aims to design an efficient work environment for workers and students alike, so that they can carry out their work or studies easily, effectively and safely [4]. The use of appropriately developed designed furniture may lead to reduced fatigue and discomfort in the sitting posture [5]. The anthropometric dimensions needed to determine polytechnic furniture dimensions that can promote a correct sitting posture include popliteal height, knee height, buttock popliteal length and elbow height [6].

The term comfort and discomfort in an ergonomic scope is generally used in scientific literature to highlight problems related to the seating condition [7]. However, this term has been also used to evaluate the comfort and discomfort among the students'. Relatively the existence of comfort and discomfort on students' body parts can be related to the design and development of new adjustable chairs and desks with the aforementioned functions which are essential for maintaining good posture which promotes better learning [8].

Classroom furniture is meant to provide comfortable support to students during classroom activities which includes when writing on the table. There can be a variety of comfortable furniture where

different furniture in different zones and places can be used together or separately to cater to the needs of types of users/students [9]. When designing classroom furniture, student's ease of mobility should be considered since localized muscle fatigue could set in due to prolonged immobility. Actual chair and desk dimensions are determined by measurements of the human body or anthropometric measurements since anthropometric statistics may be used for mass produced furniture and designs are usually made based on these statistics [10]. Previous studies conducted have recommended that an anthropometric survey is needed to determine the design dimensions of educational furniture for polytechnic students [11].

Wood is a valuable natural renewable resource that has helped countries lead sustainable development over countries. Wood-composite-manufacturing industries are in constant search for new sources of fibers as raw materials to be used in their production; therefore, potential natural or synthetic fiber should be taken into account as the raw materials needed for uninterrupted production [11].

However natural fiber does have advantages over synthetic fibers which are low cost, good specific mechanical strength, low density, good thermal and insulating properties and it causes no harm to the environment [12, 13].

This study is of particular interest as it concerns polytechnic students rather than younger children as reported in most previous studies in Malaysia and elsewhere. However, there hasn't been any research that has been undertaken to evaluate the comfort and discomfort levels among students during their learning process. Therefore, this study was undertaken in order to highlight the comfort and discomfort levels of the students whilst being seated. The objective of this study was to determine the overall discomfort score of students sitting in front of the desk, to identify the discomfort symptoms on which parts of their body whilst sitting in classroom and to identify the statistically significant differences on discomfort score among the male and female students.

2.0 METHODOLOGY

2.1 Study Model

This is a survey study conducted through quantitative analysis aimed at determining the discomfort level of students sitting in front of their desks and the comparison of body symptoms among the male and female students.

2.2 Population And Sample Of The Study

The students in Polytechnic Kuching, Sarawak, Malaysia were selected to be the population of this study. The students were selected randomly from the polytechnic students' database system. A total of 4,395 students were registered with this polytechnic in June 2014 session. A total 213 males and 287 female students were randomly selected as sample size for this study. This total of students is deemed as an appropriate sample size for this study based on previous studies¹⁴. For the purpose of this study, the students that have history of musculoskeletal disorder problems were excluded from this study.

The selected students were called in for a briefing session at the beginning of this study. The students were informed on the aim and objective of this study. They were also informed that this is a voluntary basis study and they have the option to pull out from this study if they need or wish to. The survey forms were distributed to the students at the beginning. The students were request to return the forms after 10

minutes (end). 10 minute duration was given so that the students could provide an effective answer to the required questions in the survey form.

In the end, the return ratio of the surveys was 100%. A total of 500 complete survey forms from the students were collected.

2.3 The Data Collection Instrument

A survey method was used to collect data within the scope of the study. There were two parts in the survey questionnaire. The first part was to determine the personal information of the students who participated in the study. In the second part, previous research works [15,16,17,18] were adapted with the aim of determining the symptoms of discomforts level of the students. It consists of a discomfort checklist questionnaire in the form of a body chart (Figure 1). The score rating of each discomfort symptom was carried out according to the checklist.

In order to determine its validity, the questionnaire was submitted to the experts in the field and necessary revision was done based on their feedback. The revised questionnaire was tested on a small research group. The value of coefficient of Cronbach alpha was examined in order to test the reliability of the survey. The analysis revealed that the alpha value of 20 items as 0.934. When the coefficient of alpha is between 0.80 and 1.00, which means that it is highly reliable. The latest revised questionnaire was then used to collect data from the selected student's population.

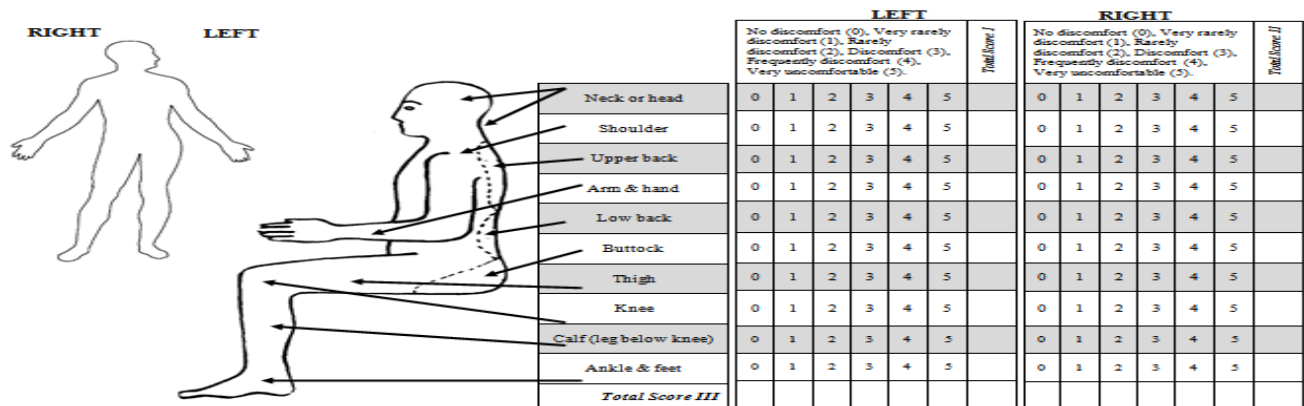


Figure 1 The body chart discomfort checklist (adapted from previous studies) [15,16,17,19]

3.0 RESULTS AND DISCUSSION

Before analyzing the data, the returned questionnaires were checked individually. The questionnaires that were not answered properly and those that reported of having history of musculoskeletal disorder diseases were excluded from this study. A total of 500 (100%) completed and valid questionnaires were returned by the respondents.

In order to determine the overall symptom of discomforts, the average arithmetic total score (on both left and right sides of the body) given by the students were calculated (total score III in Figure 1). The average arithmetic score distributions (total scores I and II in Figure 1) of the discomfort level experienced by students on parts of their body were also calculated. The findings were then evaluated on the following simplified score rating groups; score 0 to 1.99

= No discomfort (1), score 2.00 to 3.99 = Discomfort (2) and score 4.00 to 5.00 = Very uncomfortable (3).

In the analysis of the data, apart from the arithmetic scores, independent *t* test for paired comparisons were also applied. The significance level was accepted as 0.05 in the analyses

3.1 Characteristics Of Respondent's Students Sitting In Front Of Desks (N=500)

Table 1 presents the characteristics of the respondents sitting. A total of 213 male students and 287 female students participated in this study. Their ages ranged from 18 to 24 years. The value for uncomfortable score

rating groups was; score 4.00 to 5.00 = very uncomfortable. For the male students, the mean for shoulder was 4.43, upper back was 4.42, lower back was 4.47 and buttock was 4.73 respectively for the males. Meanwhile for the female students the mean for shoulder was 4.43, upper back was 4.27, lower back was 4.37 and buttock was 4.63. The means for neck or head were 2.75 and 2.77 for the male and female students respectively. The results of discomfort level are presented in Table 1. The results also highlight that the male and female students have reported discomfort levels in most of their body.

Table 1 Characteristics of the respondent students sitting on chairs (n=500)

Characteristics		Neck or head	Shoulder	Upper back	Arm & hand	Low back	Buttock	Thigh	Knee	Calf (leg below knee)	Ankle & feet
Male	Mean	2.75	4.43	4.42	2.45	4.47	4.73	2.44	2.37	2.47	2.47
	N	213	213	213	213	213	213	213	213	213	213
	Std. Deviation	1.495	.496	.495	1.485	.483	.483	1.567	1.664	1.667	1.653
Female	Mean	2.77	4.43	4.27	2.38	4.37	4.63	2.56	2.47	2.57	2.45
	N	287	287	287	287	287	287	287	287	287	287
	Std. Deviation	1.524	.495	.446	1.436	.483	.483	1.543	1.591	1.659	1.707
Total	Mean	2.86	4.43	4.34	2.45	4.37	4.63	2.50	2.47	2.50	2.43
	N	500	500	500	500	500	500	500	500	500	500
	Std. Deviation	1.510	.495	.473	1.456	.483	.483	1.553	1.621	1.661	1.682

3.2 Discomfort symptoms level by the students

Table 2 and Figure 2 highlight the overall score rating of discomfort level by the male and female students. The results indicate that more than 50% of the male and female students of having very uncomfortable level during the sitting process. It should also be noted that there is a high percentage of 59.53% of male students and 58.46% female student who have reported of having very uncomfortable levels of discomfort on their bodies. Meanwhile, 17.79% of male students and 16.72% of female students have been identified of having no discomfort in their body.

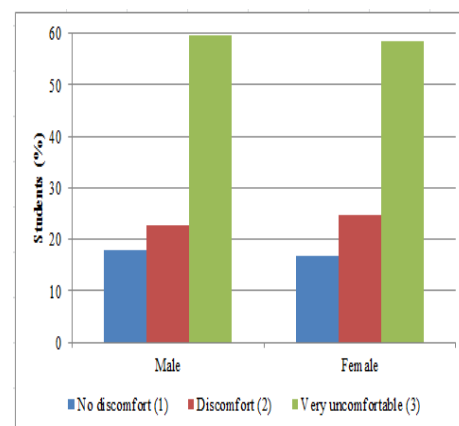


Figure 2 Score rating of student's discomfort

3.3 Discomfort Rating Symptoms Level By The Students

The results of discomfort level by a total of 500 students (213 males and 287 females) are presented in Table 3 and Figure 3. It represents the rating of discomfort level on each parts of their body. The results indicate that male and female students have a similar type of discomfort level whilst sitting. The results also highlighted that the male and female students have reported discomfort levels in all parts of their body.

The male and female students have reported of having discomfort level (score rating of 2) in the shoulder, upper back, lower back and buttock (male: 0.00%; female: 0.00%) where the no value of score rating (2) = level discomfort for the body part. The non-discomfort level are identified by the score rating of 1. The male and female students have identified thigh (male: 30.98%; female: 25.43%), knee (male: 32.86%; female: 31.707%) and calf leg below knee (male: 35.68%; female: 37.63%) as having the more discomfort in parts of their body.

It is also important to highlight that higher percentage of female students (37.63%) have reported to level discomfort in the calf leg below knee compared to male (35.68%). Meanwhile, 1.95% of male have been reported of having less discomfort level in their calf leg below knee compared to female (37.63%) students.

The score rating of 3 represents the most 'very uncomfortable' symptoms for the students. The male and female students have indicated that level the most uncomfortable symptoms in their shoulder, upper back, low back and buttock. A total of 100% of female and 100% of male students have been reported of having these uncomfortable levels in their shoulder.

Meanwhile, 100% of male and 100% female have uncomfortable levels in their upper back. The male and female students have identified lower back (male: 100% and female: 100%) as having 'very uncomfortable'. The male and female students have reported to have very uncomfortable level in the buttocks as well (male: 100%; female: 100%).

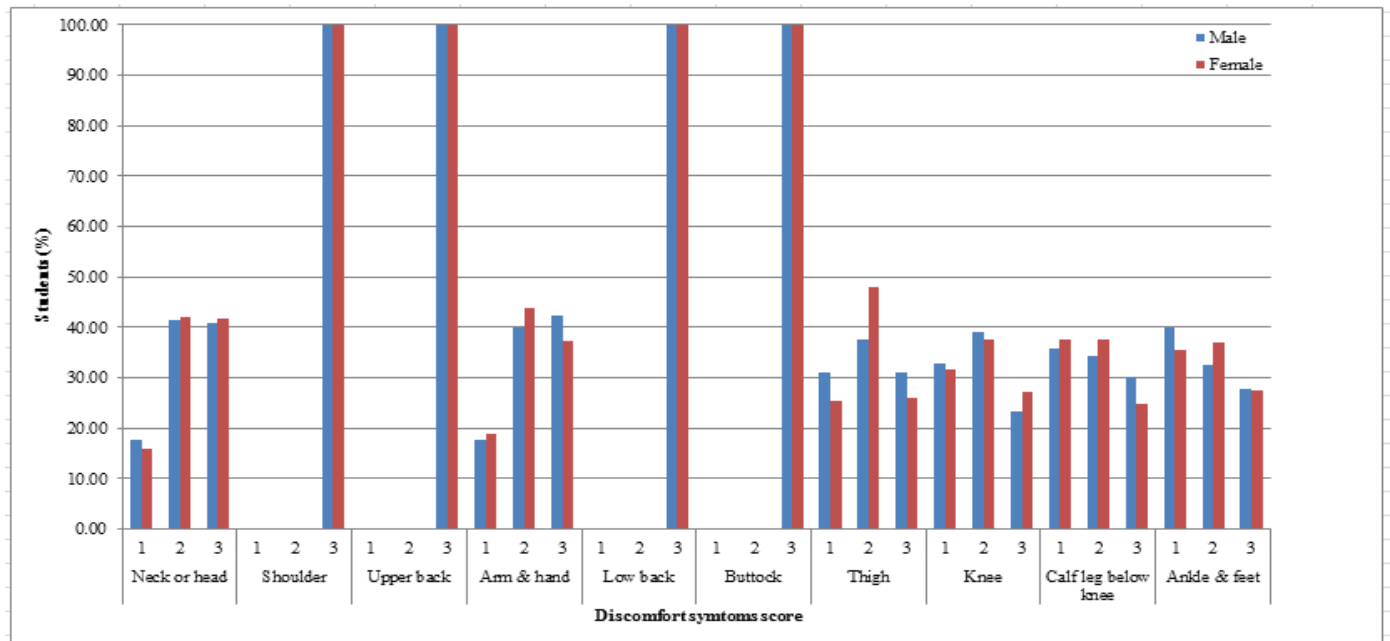


Figure 3 Students discomfort symptom score rating

Table 3 Rating on discomforts symptoms by students (n=500)

Table 3: Rating on discomforts symptoms by students (n=500)					
Body Part	Score rating	Male		Female	
		N	%	N	%
Neck or head	1	38.00	17.84	46.00	16.02
	2	88.00	41.31	121.00	42.16
	3	87.00	40.84	120.00	41.81
	Total	213	100	287	100
Shoulder	1	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00
	3	213.00	1.00	287.00	1.00
	Total	213	100	287	100
Upper back	1	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00
	3	213.00	1.00	287.00	1.00
	Total	213	100	287	100
Arm and hand	1	38.00	17.84	54.00	18.81
	2	85.00	39.90	126.00	43.90
	3	90.00	42.25	107.00	37.28
	Total	213	100	287	100
Low back	1	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00
	3	213.00	1.00	287.00	1.00
	Total	213	100	287	100
Buttock	1	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00
	3	213.00	1.00	287.00	1.00
	Total	213	100	287	100
Thigh	1	66.00	30.98	73.00	25.43
	2	80.00	37.55	138.00	48.08
	3	66.00	30.98	75.00	26.13
	Total	213	100	287	100
Knee	1	70.00	32.86	91.00	31.70
	2	83.00	38.96	108.00	37.63
	3	50.00	23.47	78.00	27.17
	Total	213	100	287	100
Calf leg below knee	1	76.00	35.68	108.00	37.63
	2	73.00	34.27	108.00	37.63
	3	64.00	30.04	71.00	24.73
	Total	213	100	287	100
Ankle and feet	1	85.00	39.90	102.00	35.54
	2	69.00	32.39	106.00	36.93
	3	59.00	27.69	79.00	27.52
	Total	213	100	287	100

Rating scale: 1 = No discomfort; 2 = Discomfort; 3 = Very uncomfortable

3.4 Comparison Of Discomfort Symptoms Among The Male And Female Students

The independent t-test was conducted in order to determine whether there is a statistically significant difference between male and female students with regards to their reported discomfort level (Table 4). The results indicate that there are a total of four significance differences in the score rating of discomfort levels between male and female students.

Significant differences were found in the shoulder, upper back, lower back and buttock. The mean discomfort scores of shoulder for male and female students differed significantly ($t=0.083$, $df=498$, $p<0.05$) with the male score being significantly higher than the female mean

Similarly, the upper back discomfort score for male are significantly higher than the female mean score with significant differences ($t=3.933$, $df=498$, $p<0.05$) between them.

The mean discomfort score for female on the lower back and buttock are significantly higher than the male mean score. The significant differences on the lower back ($t=0.039$, $df=498$, $p<0.01$) and buttock ($t=0.333$, $df=498$, $p<0.01$) was recorded for the male and female students.

The findings in Table 4 also shows that there are no significant differences in other male and female student's body parts such as neck or head, arm and hand, thigh, knee, calf (leg below knee), ankle and feet.

Table 4 Comparison of body symptoms among the male and female students (n = 500)

Body Part	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	T	df	Sig. (2-tailed)	Difference
Neck or head	0.022	0.883	-0.435	498	0.664	-0.052
Shoulder	0.027	0.869	0.083	498	0.934*	0.004
Upper back	32.400	0.000	3.933	498	0.000*	0.171
Arm & hand	0.346	0.557	0.406	498	0.685	0.051
Low back	0.006	0.939	0.039	498	0.969*	0.002
Buttock	0.449	0.503	0.333	498	0.740*	0.015
Thigh	1.505	0.221	0.389	498	0.697	0.068
Knee	0.472	0.493	0.205	498	0.838	0.027
Calf (leg below knee)	0.291	0.590	1.008	498	0.314	0.139
Ankle & feet	0.004	0.950	0.056	498	0.956	0.008

*significant at $p < 0.05$

4.0 CONCLUSION

The survey is to evaluate student's discomfort level whilst sitting in Malaysia where the data was collected, analyzed and summarized in order to achieve the three objectives of this study. The results indicated that the majority of male and female students experienced a degree of discomfort in parts of their body during their sitting process. The results also indicated that the students' main discomfort levels were on the upper parts of their body (shoulder, upper back, lower back and buttock) except the neck or head. Majority of the students (male and female) expressed no discomfort in their lower body part (arm and hand, thigh, knee, calf leg below, ankle and feet). The statistical test have indicated that there is a total of four significant differences ($p < 0.05$) (shoulder, upper back, lower back and buttocks) among the male and female students. These significant differences indicate that individual factors such as anthropometry and gender do have an effect on the student sitting comfortability. Therefore, these study findings can be useful for designers in the furniture 'desk' industry in order to enhance the ergonomic relationship between the human (students) and furniture. As a conclusion, the students in these classrooms have discomfort levels whilst sitting in front of their desk. Overall, the majority of the students feel uncomfortable. Since modern societies value a better quality of life, it is recommended that the user-friendly design concept be used rather than the economic theory be applied to educational furniture designs. It is recommended that the design of a natural fibre reinforced composite classroom desks for polytechnic students for better comfortability and to also to reduce cost manufacture.

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