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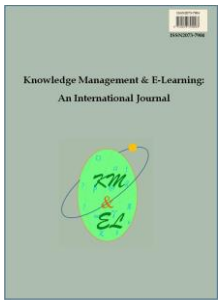

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Blackboard® LMS for blended learning: Students' views versus staff views on challenges and improvement

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Abstract: The Blended learning system (BELS) has become a popular tool of learning. BELS's effectiveness is substantially influenced by a number of elements, including teacher and student feedback and system design. This study on evaluating the Blackboard platform (removed for peer review) aims to determine the similarity between students' and faculty members' perspectives, identify the least satisfied elements of learning that need improvement, and collect suggestions for future enhancements. Using the SurveyMonkey service, questionnaires were sent directly to the emails of students and faculty members at the four colleges of the university. There were 1170 responses from students and 93 responses from staff members. SAS JMP was used to perform Linear Discriminant Analysis (LDA) to show the relationships between academic staff perceptions and their recommendations from one side and the students'

perceptions and satisfactions distributed by colleges from another side, while SPSS was used to visualize the data. Students and faculty were highly satisfied with blended learning and high expectations for its effectiveness The perceptions of faculty members were similar to those of students; however, they were more satisfied with certain features than students were. The LDA results of staff survey demonstrated that the responses of faculty members vary by college, unlike the LDA for students' survey that did no show between-college variations. This implies that, students across colleges have similar needs and common attitudes toward BEL. Students were least satisfied with peer interactions; online IT assistance; the development of skills using current students' activities; and the update frequency and quality of online content. We advocate incorporating student perspectives into plans and considering faculty members' suggestions particularly for increasing peer-to-peer learning; in-line translation and use of infographics.

Keywords: Discriminant analysis; Perception; Blackboard platform; Blended learning; Satisfaction

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1. Introduction

In recent years, the blended learning system (BELS) has gained popularity due to advantages such as schedule flexibility, cheap operational costs, and easy accessibility. Understanding the underlying concepts of online learning as well as being aware of the practical issues is critical for the continuation and growth of e-learning (Biech, 2015). Learners and instructors who are assumed to interact within the same context of comprehension and a high level of enthusiasm and a favorable attitude toward e-learning must also be familiar with new learning environments (Kasimoğlu & Çelik, 2021; Polakova & Klimova, 2021; Tanis, 2020).

The success of e-learning emerges from the proper integration and consideration of social, environmental, and personal characteristics. Technical competence, attitude toward students, teaching style, encouragement of students, etc., are a few of the potential qualities of online instructors that might affect the delivery of knowledge. The technical aspects consist of the IT infrastructure, accessibility, system interface, internet speed, technical support, and online content, among others (Bhuasiri et al., 2012; Wu et al., 2010).

Analysis of student's perceptions has long been recognized as essential in blended learning because they play major roles in determining students' intention of use and system acceptance (del Barrio-Garcia et al., 2015; Deng et al., 2022; Taliaferro & Harger, 2022; Tselios et al., 2011). Different perceptions of concern are considered including perceived self-efficacy, perceived easy-of-use, perceived usefulness, perceived online interactions and perceived online content…etc. The perceived online interactions and online content are the focuses of teaching presence which in turns associated with perceived learning, a student's self-report of knowledge gain (Martin et al., 2022). Surprisingly, students' perception on self-efficacy has shown no association with students' preferences although both of these two aspects are affected by student's experience and previous exposure (Bayrak, 2022). This is, if the students have computer skills or previously taken online courses, then their perceived self-efficacy will be high.

Blackboard is one of the most widely used blended learning platforms that promotes the attainment of learning objectives (Kumar et al., 2021; Lin et al., 2014). It allows smooth communication, instruction and assessment in a convenient learning environment where both students and instructors have different degrees of control of content (Al-khresheh, 2021; Ismail et al., 2022). It has diverse functionalities, interactive and user-friendly interfaces. With the Blackboard platform, educators are able to easily expand their courses beyond video conferencing and save time through the automation of administrative activities. Students comprehend the acquisition of a smooth learning environment that eliminates uncertainty beyond the use of the virtual classroom. In addition, institutions of higher education understand the significance of broadening students' learning horizons and seeking ongoing performance improvement through novel methods of student motivation and efficient knowledge access points. (Anas, 2020; Alexander & Golja, 2007). The new features of Blackboard collaborate Ultra has great impact on students self-efficacy, mobility and enhancement of self-managed learning which are all considered crucial factors that encourage educational institutions to adopt Blackboard platform (Mujalli et al., 2022).

Blackboard is used at the Saudi Electronic University (SEU) to manage multiple learning aspects, including the delivery of online lectures, online departmental meetings, the completion of administrative tasks, and the management of student activities such as quizzes, discussion forums, and assignments, among other learning tasks. Extra benefits of

Blackboard include ability to incorporate built-in apps for different functionalities such as secure e-exam, plagiarism check and file transfers. Faculty members, administrative assistants, and students are granted varying levels of approved accessibility. University administrators have access to both students' and instructors' working environments for the purposes of monitoring and quality control, whilst the IT department manages the domain-wide settings of the university. Instructors have access to all online activities, including lectures and assignments, as well as group work preparation and oversight.

The gap in the research and study problem involves the investigation of potential difficult issues that students are less satisfied with, which require subsequent improvement and highlighting implications of massive usage of electronic tools in learning at Saudi Electronic University. The gap in the research that we would like to address is to investigate whether staff recommendations are closely linked with their perceptions. That is, to demonstrate the connections between the various perspectives/perceptions held by faculty members and to test whether these perceptions are the main attributes that determine their recommendations for system improvement. We are addressing also, whether there is a great variability in perceptions among the teaching staff according to their colleges. Since blended learning is applied at all colleges, a great percentage of students enrolled to Saudi electronic university considered employed personnel above 30 years who join the class after work shift. This implies that the age factor may affect the students' self-efficacy and satisfaction while employment (being busy most of the day) possibly influence the time flexibility and studying hours, particularly when we take into account that the university partially apply student-centered approach by incorporating students' suggestions into university plans. The novelty in the research is reflected in supporting our discussion with Linear Discriminant Analysis (LDA), a pattern recognition method that we applied to depict the connections between the faculty staff's perceptions and their recommendations. The findings of this research are then useful for improvement aspects of Blackboard platform, particularly elements with higher impact on student satisfaction and system components with lowest students' satisfaction.

This study aimed to compare the degree of agreement and gap between the opinions of faculty members and students regarding aspects of blended learning, as well as to assess some of the possible difficult issues that both faculty members and students showed low satisfaction about which require subsequent improvement. In this study, we used Linear Discriminant Analysis (LDA), a supervised pattern recognition technique for classifying (or predicting) and explaining the data pattern along with data visualization, to explain group differences and illustrate the associations between the various responses of the study participants. In addition, the technique reveals whether participants from a particular college have perceptions or suggestions that differ from those of other colleges.

Few studies have directly compared faculty members' satisfaction and perceptions with those of students. Most of the conducted research emphasized the role of teaching staff as facilitators of learning through effective synchronous and to a lesser extent asynchronous communication and facilitating access to relevant course materials. A positive correlation between students' perceptions and faculty members' perceptions toward BEL was fond and that, both students and staff were optimistic about future of BEL (Almahasees et al., 2021). We assume differences in satisfaction and perceptions between faculty members and students due to wide spread exposure of teaching staff to blended learning after COVID 19 pandemic. A second reason for the differences between staff and students regarding perceptions toward BEL is the professional continuous training on LMS that offered to faculty members, while students getting limited orientation about using LMS.

Subsequently, we hypothesized that the staff hold great recommendations for improvement of BEL, along with our assumption that, their experience affect their satisfaction compared to students who need more time of exposure to the new BEL systems. In Saudi Arabia, almost all universities have tried the BEL after COVID 19 pandemic (Al-Mamary, 2022). Apart from system related difficulties, there some issues influencing faculty's perceptions toward BEL including financial constraints, internet accessibility and involvement of non-expert academicians in BEL improvement (Fauzi, 2022).

2. Materials and methods

2.1. Sampling technique

This research is intended for SEU undergraduate students and faculty members (teaching staff). Using SurveyMonkey, data were gathered through an online questionnaire. Students and faculty members constitute natural groupings (i.e., colleges and departments). The online survey was made available for an extended period of six weeks, and a crosscheck was performed to ensure that a proportionally representative subsample (of students and staff) participated from each cluster before survey closure. The university consists of 13 branches in 13 cities and four colleges namely, college of Computing and Informatics, college of Administration and financial science, college of health sciences and college of Science and Theoretical Studies. It has to be mentioned that in each branch, female students and male students' study in separate campuses, with the female to male ratio vary across colleges. We checked that, students from different branches, colleges and age groups are represented, with at least 60 students of each branch have taken part in this study and that, a minimum of 50 students from each college have participated in the survey. To enhance students' participation to get representative subsamples, we have reminded students via university Email system and encouraged teaching staff from colleges of moderate participation to remind their students. Generally, more than 30% of students are considered either government employees or staff working in private sector and mostly in the age group between 25 years to 44 years. For the teaching staff, we cross checked their participation and found that at least 20 members from each college have participated, with total staff participation of 93 out of 840 in the university at the time of survey. The design of the questionnaire particularly the one directed to students, is supported by similar studies that applied some of validated similar questions, with slight changes to fit our study because different studies have investigated different LMS platforms not necessarily Blackboard (Abbad, 2021; Raza et al., 2021; Yuen & Ma, 2008). Items of the questionnaire directed to teaching staff are modified from work done by Yuen and Ma (2008). For validity and reliability of items, we have performed internal consistency test indicated by values of Cronbach's alpha for the items of the students' survey and faculty members' survey, accounting for 0.879 and 844 which were all above the benchmark value of 0.7 as mentioned in recent relevant studies (Almahasees et al., 2021; Sonji et al., 2023). Moreover, to assure the validity of the questionnaire and understandability of students, we have done also a pilot survey by directing the questionnaire to a small group of less than 70 students to find out whether questions are clearly understood, and we revised them accordingly. It is noteworthy the entire questionnaire items are answered using 5-points Likert scale and that; all questions are designed in English with Arabic translation being incorporated into the online questionnaire.

The sample size for students and staff was calculated independently using the following formula:

$$n = \frac{N}{1+Ne^2} \qquad \text{equation} \quad 1$$

Where n is the sample size, N is the total population, and e, with a value of 0.05, is the permissible margin of error. According to the above equation, a sample size of 394*2 (design effect) = 788 students is required, whereas actually 1170 students (out of 27855 at the time the questionnaire was issued) and 93 faculty members participated in the online survey.

Some of Study hypotheses

- Student satisfaction is lower than that of faculty members.
- Faculty members' recommendations are intimately tied to their satisfaction and perceptions.
- Students are most dissatisfied with course assessment techniques and online delivery.

Some of study specific questions

1) What are the LMS aspects that both students and faculty members are least satisfied with
2) Are the percentages of disagreement or neutrality of responding to some questions considered negligible or worthwhile?
3) Are there great differences in the faculty members' recommendations due to differences in academic major (across faculties)?
4) What is the influence of *within-college differences* compared to *between-college differences* regarding perceptions toward Blackboard LMS?
5) What are the percentages of agreement among faculty members regarding some recommendations for improvement?

As shown in Table 1, the e-questionnaire administered to students consisted of a number of questions pertaining to nine categories, all of which belong to student satisfaction and experience with Blackboard Platform. On the other hand, the questionnaire directed at faculty members contained some questions similar to those directed at students (Table 1), as well as an additional ten questions regarding faculty members' recommendations for system improvement, two of which were open-ended so that staff could offer additional comments. The questionnaire directed to faculty members (Table 2), contained two extra questions about SwiftAssess, a complementary LMS software used at the University along with Blackboard for carrying Midterm and final exam.

2.2. Statistical analysis

The LDA was performed utilizing JMP V.14 (John's Macintosh Project) statistical analysis software (SAS- Statistical Analysis System Institute, Cary, United States). For data visualization, the statistical program for social science (SPSS, version 22) was utilized. Cross-validation or the "leave one out approach" is used to validate LDA by dividing the entire sample into two subsamples, one for evaluating the test and the other for completing

the analysis, with additional information on LDA accessible in the literature. (Meyers et al., 2013; Miller & Miller, 2005; Mohammed et al., 2016). The values of wilks' Lamda statistic were reviewed to assess the significance of the discriminatory power of the test, with low values of wilks' Lamda closer to zero implying high discriminatory power (Mohammed et al., 2016).

Table 1
The major questions of the questionnaire directed at students

Question domains	Code	Questions: To what extent you agree/satisfied with the following aspects
Satisfaction	PU.1	Q.9 Overall, Blackboard is useful in my study
	PU.2	Q.8 Blackboard enables accomplishing tasks quickly
	PU.3	Q.7 Blackboard improves my academic performance
Easy-of-use	POU.1	Q.12 Overall, I found Blackboard easy to use
	POU.2	Q.10 it is easy for me to become skilful in using Blackboard
	POU.3	Q.11 My interaction with Blackboard is clear and understandable
Subjective norms	SN.1	Q. 13 People who are important to me would strongly support my using Blackboard
	SN.2	Q. 14 People whose opinions I value would prefer me to use Blackboard in my study
System functionality	SF.1	Q.15 Blackboard provides flexibility in time and place
	SF.2	Q.16 Blackboard allows us to get control over our learning activity
Students' self-efficacy	CSE.1	Q.17 I can finish the job in Blackboard using user manual only
	CSE.2	Q.18 I can complete the job in Blackboard, with the help of someone
	CSE.3	Q.19 I can finish the job in Blackboard using build-in technical assistance
Effectiveness & efficiency	PEE.1	Q.20 The manner of delivering online lectures meet my expectations
	PEE.2	Q.21 The quality of information that available is satisfactory
Online materials	PM.1	Q.23 I receive online assistant from IT team
	PM.2	Q.24 The online materials are relevant and updated
Online interaction	PIT.1	Q.25 instructors give me a chance to participate in discussion
	PIT.2	Q.26 I receive online assistance from the course instructors
	PIT.3	Q.22 My classmates and I can discuss at any time through Email, discussion thread, etc.
Course evaluation methods	PCA.1	Q.28 Activities, assignments and discussions are useful for developing skills
	PCA.2	Q.27 Course evaluation methods are satisfactory

2.3. Ethical considerations

An official ethical clearance was obtained from the university research ethics and data collection committee, with approval letter being attached with the main manuscript. Additionally, an electronic informed consent was included in the first page of the electronic questionnaire where we indicated that, participation in this survey is optional and there was receive no direct benefits to participants. However, the participation will help us to accomplish this study in an appropriate manner and suggest future improvement for

blended learning. Most importantly, we have made it clear that, collected via this survey will be used only for the purpose of this study, while all personal data be kept confidential.

Table 2
Questionnaire directed to faculty members

Perception domain	Code	Questions (To what extent you agree/satisfied with the following aspects?)
Satisfaction	PU.1 Overall sati.	Overall, I find Blackboard useful in my teaching.
	PU.2	Blackboard enables me to accomplish tasks more quickly.
	PU.3 Perform. Expect.	Using Blackboard improves my performance.
Effectiveness& efficiency	PEE.1	Using Blackboard enhances my effectiveness on teaching
	PEE.2	Using Blackboard increases my productivity.
Easy-of -use	POU1. Overall easiness	Overall, I find Blackboard easy to use.
	POU.2	It is easy for me to become skilful in using Blackboard.
	POU.3	Learning to operate Blackboard is easy for me.
	POU.4	I find swift assess easy to use system?
	POU.5	I find swift assess a reliable assessment platform?
Interaction	PIT.1	My interaction with Blackboard is clear and understandable.
Subjective norms	SN.1	People important to me strongly support my Blackboard using in my teaching.
	SN.2	People with valuable opinions prefer me to use Blackboard in my teaching.
System functionality	SF.1	Blackboard provides flexibility in the time and place for the learning.
	SF.2	Blackboard allows us to get control over our learning activities
Faculty members' recommendations	REC.1	How likely you recommend incorporating in-line translation into the system?
	REC.2	How likely you would recommend incorporating Learning from peers?
	REC.3	How likely you would recommend Chat bots (instant answering) alongside the current IT help?
	REC.4	How likely you would recommend technology awareness events (exhibitions and public seminars)?
	REC.5	How likely you would recommend inserting Infographics into the system to motivate students?
	REC.6	How likely you recommend activating video conference and live video streaming during online lecture?
	REC.7	How likely you recommend incorporating Web-based (non-live) courses?
	REC.8	How likely you recommend Semi virtual laboratories (training aided by webcam)?
	REC.9	What other possible applications or systems do you suggest for assessing students' performance?
	REC.10	Optionally, what suggestions do you have for carrying out the practical training of students?

3. Results

3.1. Students' views versus staff views distributed by faculties

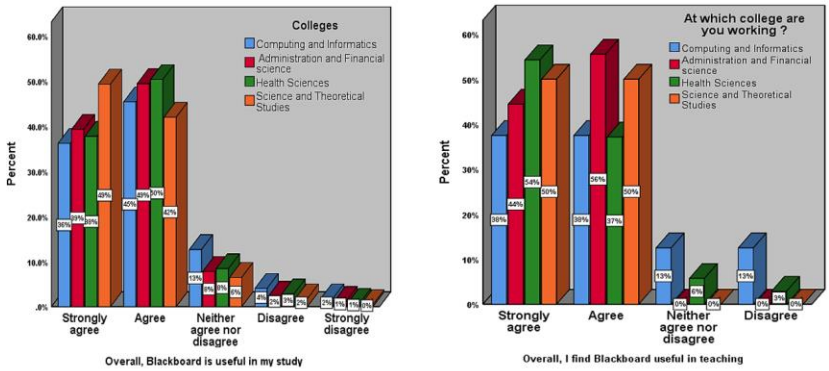
As shown in Fig. 1.a, students at the college of science and theoretical studies are the most satisfied with the utility of the blended e-learning system (BELS), including 91 percent of the students from this college who participated in this study. This is followed by college of health sciences students (88 percent), college of administration and financial science students (88 percent), and college of computing and informatics students (81 percent). It us worth noting that student satisfaction is a single measure that reflects diverse perspectives. On the other hand, teaching staff from the college of computing and informatics exhibited a moderate level of dissatisfaction (13%), compared to only 6% of students from the same college; nevertheless, the percentage of participants who were neither satisfied nor unsatisfied (neutrally responded) stayed roughly the same at around 13%. With regard to expectations of academic performance using blended learning, Fig. 2.a shows that, most of students at the college of science and theoretical studies, have high expectations about their academic performance through e-learning systems, accounting for 86%. This was followed by students at the colleges of administration and financial science; college of health sciences; and college of computing and informatics, accounting for approximately 83%, 81% and, 74% of students from each college that participated in this study, respectively. As in the case of e-learning satisfaction, students at colleges of science and theoretical studies have the highest expectations, whilst students who study computing and informatics have the lowest. In contrast, almost all faculty members (except 3% from college of health sciences) believe that using blackboard, as a platform for blended learning will improve their performance.

Over 80 percent of the students who participated in this study agreed with the statement that it is simple to become skilful at utilizing the Blackboard (Fig. 3). Additionally, the majority of faculty members replied that it is simple for them to master blackboard usage. Similarly, in response to a question on "Blackboard permits completing tasks fast," there was high agreement among students and faculty that Blackboard allow them to complete tasks quickly (see Fig. 4), with more agreement among faculty than students. Some students in computing and informatics (11 percent), administration and financial sciences (10 percent), health sciences (13 percent), and scientific and theoretical studies (7 percent) are neither agree nor disagree. Overall, more than 90% of students of each college believe that blackboard is a flexible platform (Fig. 5). Similarly, more than 90% of the faculty members also agree with this claim. As stated elsewhere in this statement, course flexibility encourages more potential candidates to join the blended learning programs.

Comparing responses to a question on the effect of important others (subjective norms), most of students and staff believe that people in their social and academic environment support the idea of using blackboard platform (see Fig. 6). During the COVID 19 pandemic, people are more concerned about blended e-learning, and they recognize that e-learning will not replace face-to-face learning, but it does offer some advantages, such as cost savings, flexibility, and the avoidance of traffic jams while commuting between university and home (Almahasees et al., 2021; Ayasrah et al., 2022). Last yet importantly, both students and faculty members, agree largely that their interaction with Blackboard (Fig. 7) become clear and understandable, with great percentage of agreement exceeding 95% for most colleges. Overall, regarding the comparison between students' and faculty

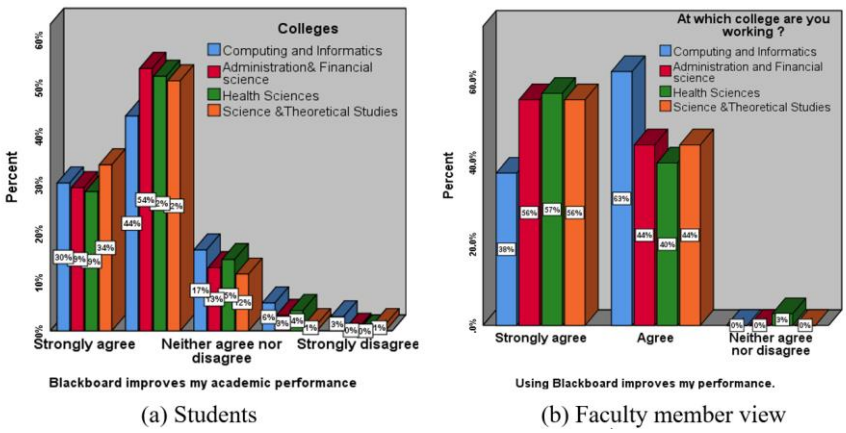
members' perceptions, it seems that the faculty members are most satisfied with LMS aspects compared to students and that, between-college differences are slightly high among the teaching staff compared to students as illustrated in Fig. 1 to7. The highest percentages of satisfaction are reported for Blackboard usefulness, Blackboard flexibility, and speed of accomplishing task via Blackboard, compared to least satisfaction about performance, support of important others (influence of social environment) and being skilful in using Blackboard. These late findings giving an answer to question #1 of this study.

In addition to the comparison between students and faculty members' perceptions, there are some unique questions directed to students only as detailed in Table 1. Students found least satisfied with the online IT assistance where 38% chosen neutral answer while 30% are not satisfied. Similarly, 26% and 25% of students responded neutrally (nether satisfied nor dissatisfied) and dissatisfied about the course evaluation methods (assignment, Quizzes, .etc.), respectively. Students were moderately dissatisfied with the quality of online content where 20% and 19%, were either responded neutrally or not satisfied, respectively. Around 29% of students were also dissatisfied with the online interaction with their peers. To conclude, these percentages of dissatisfaction or neutral replies give an answer to question #2 about aspects with least students' satisfaction and a partial answer to question #1 as well.



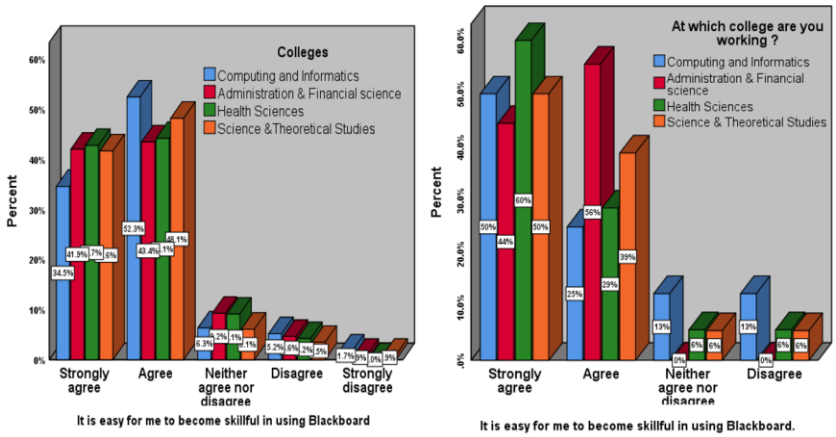
(a) Students (b) Faculty member view

Fig. 1. Overall satisfaction about usefulness of blended learning, according to colleges



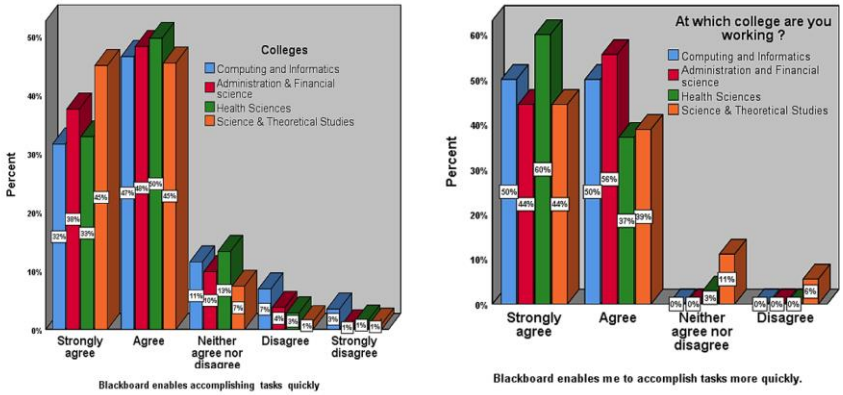
(a) Students (b) Faculty member view

Fig. 2. Performance expectation distributed by colleges



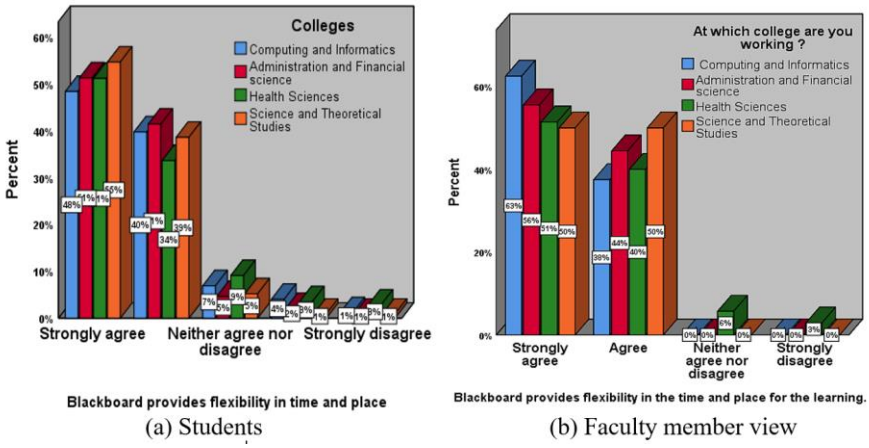
(a) Students (b) Faculty member view

Fig. 3. Perceived being skilful in using Backboard



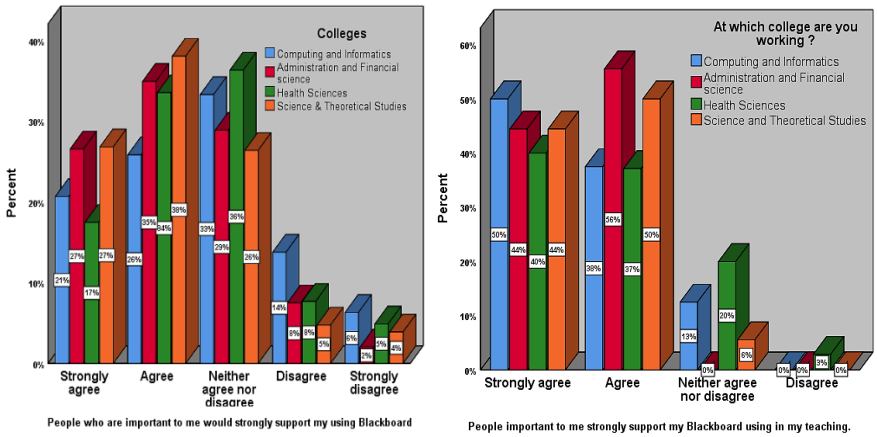
(a) Students (b) Faculty member view

Fig. 4. Blackboard enables accomplishing tasks quickly



(a) Students (b) Faculty member view

Fig. 5. Perceived flexibility of Backboard in time and place



(a) Students (b) Faculty member view

Fig. 6. Opinion of important others on Blackboard

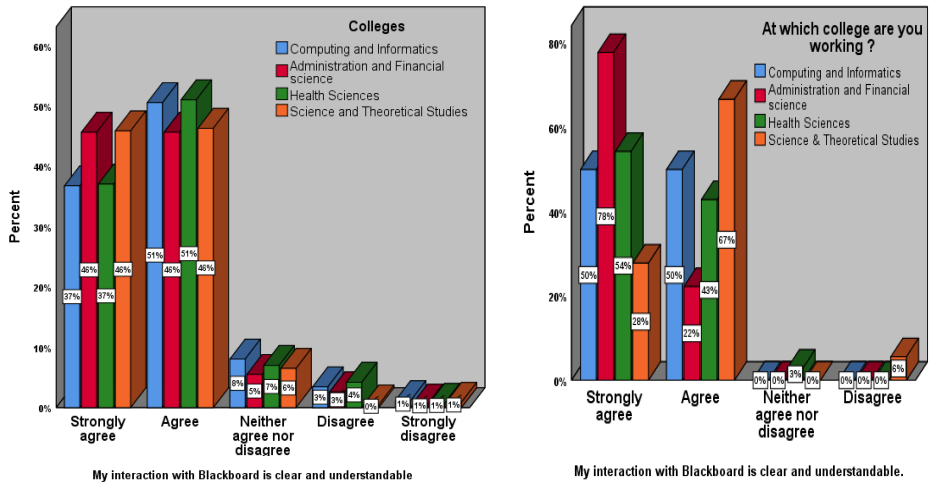


Fig. 7. Interaction with Blackboard is clear and understandable

3.1. Findings of LDA: associations between staff perceptions and their recommendation

The findings of LDA are first validated by reviewing the parameter Wilks' lambda, which showed a value equal to 0.09 (P value less than 0.001). The canonical function 1 and function 2, respectively, explain approximately 47.8 percent and 35 percent of the total variance that can be attributed to the research variables. The results of the canonical discriminant functions that were generated as part of the LDA are illustrated in Fig. 8. These results provide a visual representation of the interconnections among faculty members' diverse perceptions and their recommendations across colleges. The ellipses that are closer to the centre of the figure represent the 95 percent confidence interval (CI), which is based on the assumption that these ellipses contain the actual group centroids or averages. The ellipses that are further out represent the 50 percent normal contour (assumption that these ellipses contain at least 50 percent of the observations of each assigned group). It was

obvious from Fig. 8 that there was no overlap between the 95 percent CIs of individual groups, whereas there was some overlap between the 50 percent contours. This indicates that faculty members at a given college have slightly different perspectives on blended learning than faculty members at the other colleges. The BiPlot rays in Fig. 8, originate from the centre of the groups and indicate the discrimination of groups according to study variables (perceptions and recommendations of faculty members). Variables centering the BiPlot rays imply similarity of responses/perceptions of participants of the different groups (i.e. colleges) while variables tend to be closer to a specific group suggest that, participants from such a group are the most contributors. The directions of BiPlot rays reflect similarity in perceptions (degree of agreement with the questions being asked), which must be evaluated in conjunction with Figs 1-7, which indicate whether the similarity is positive (agree) or negative (disagree).

In contrast, Fig. 9 visualizes the findings of students' survey demonstrating the distribution of students' perceptions and satisfaction across colleges. As in the case of staff survey, findings of LDA for students' survey are validated by reviewing the parameter Wilks' lambda, which showed a value equal to 0.084 (P value less than 0.001). The canonical function 1 and function 2, respectively, explained around 52% percent and 31% percent of the total variance that can be attributed to the research variables. These percentages of variance reflected by canonical functions 1 & 2 are very similar to the aforementioned values for the staff survey. In Fig. 9, the interior ellipses represent 95% CI containing the groups' centroids while the exterior ellipses assumed to contain at least 50% of the observations for each group.

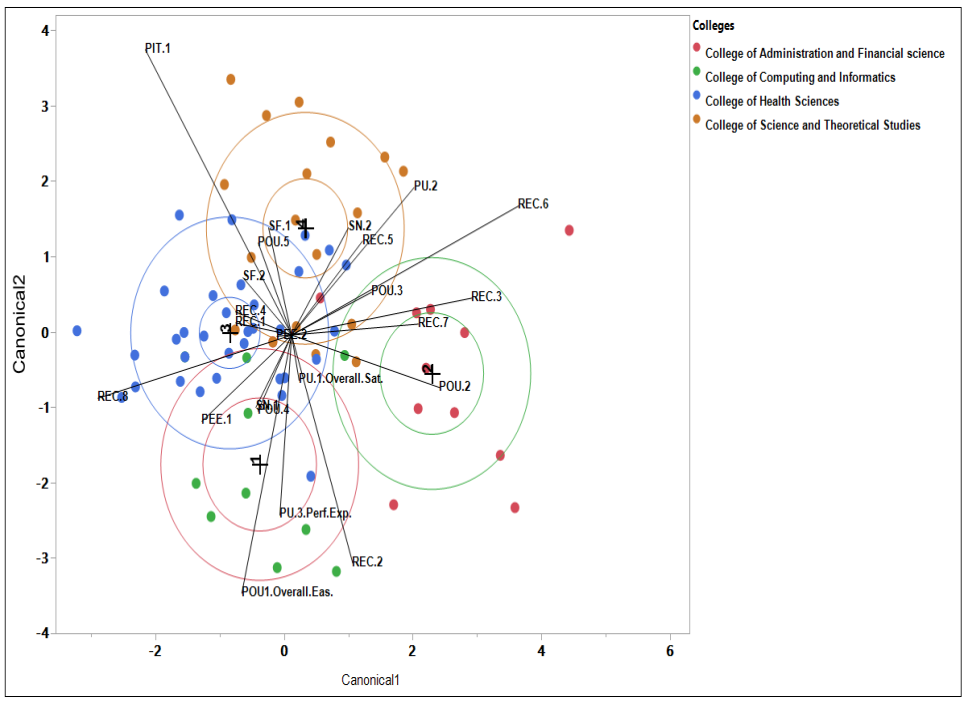


Fig. 8. LDA results for Faculty members' survey visualizing distances between study variables distributed by colleges

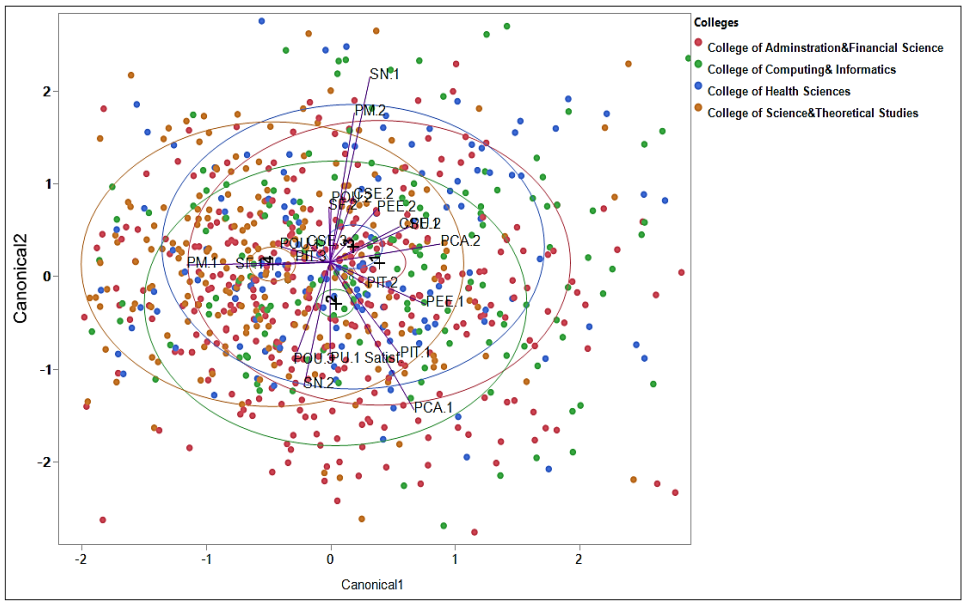


Fig. 9. LDA results for students' survey demonstrating the distribution of students' perceptions and satisfaction across colleges.

3.3. Faculty members' recommendations for improvement

The recommendations of faculty members to improve the current system are summarized in Fig. 10. Despite the claim that machine translation is impractical, faculty members support the addition of in-line (machine) translation (REC.1) to the current blended learning system. The high percentage (90%) of staff who recommend learning with peers (REC.2) (Fig. 10), reflect their understanding of the idea that, learning with peers improve academic achievements and support the approach of student-centred education where students gain more confidence in themselves, as mentioned in the literature (Lim et al., 2020). A large percentage (85%) of faculty members favour incorporating chatbots into the existing online IT assistance system. Chatbot with a language processing unit capable of finding a matching response to a student's question may easily respond to many course-related questions. Infographics, coded as REC.5 are considered to be a form of microlearning, highly recommended by the vast majority (91 percent) of the staff members who participated in this survey. Students are encouraged to study with infographics, which visually illustrate summarized ideas to improve students' conceptual understanding. Regarding the suggestion to increase one's familiarity with technological advancements (coded as REC.4). The vast majority of teachers (94 percent), who took part in this study project, gave their enthusiastic endorsement to the idea of organizing technology awareness events for improving students' comprehension of the blended learning system and its functions. There was a general agreement (90%) among the participants that learning from peers is a good approach that has to be incorporated into the current system, and the question remains, how will this incorporation be done? Adoption of virtual laboratories and experiments (REC.8) in blended learning is greatly suggested by staff members. Approximately 22 percent of the university faculty do not propose activating live video during lectures when discussing online video-aided lecturing (REC.6), although online

video is considered to be one of the characteristics that enhances peer engagement (Raes et al., 2020).

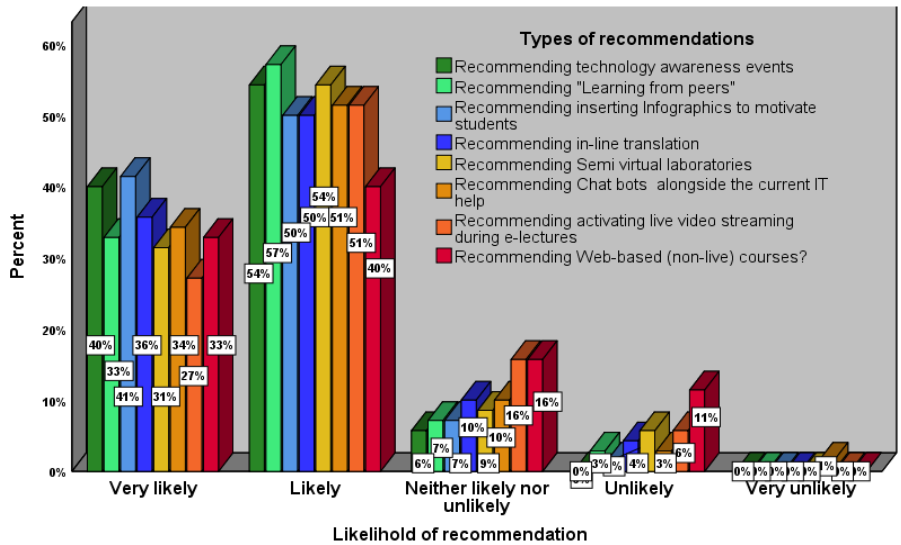


Fig. 10. Recommendations from faculty members

4. Discussion

The higher overall satisfaction as reported in this study denotes a favourable attitude toward factors such as content, system functionality, engagement, and learning climate, and inferentially reflects performance expectation (del Barrio-Garcia et al., 2015; Wu et al., 2010). The levels of satisfaction regarding the usefulness of Blackboard were found to follow the same pattern among faculty members as those found among students, with the exception of a slight difference. Academic success or the accomplishment of learning outcomes is the primary factor that validates the usefulness of blended learning systems in comparison to fully virtualized learning environments. Student's satisfaction is tightly linked to their academic achievement. It should be noted that reviewing students' prior academic achievement (i.e., their achievement through traditional in-class learning) is necessary for evaluating their academic performance in blended learning (Asarta & Schmidt, 2017; Kumar et al., 2021). The findings related to response to a question on "Blackboard permits completing tasks fast", emphasize the need for increased student-focused technology awareness initiatives. The research identifies system flexibility and its enhancement as a crucial aspect in the success of BELS (Bhuasiri et al., 2012), and help students to balance between work-related affairs, family needs and study requirements. It is noteworthy that, blended LMS offers flexibility to students to learn faster at their own pace and improve chances of feedback, particularly when we realize that students are different in their mental capabilities and their personal preferences (Taliaferro & Harger, 2022; Im, 2021). Course flexibility in time and place not only enhances the students' satisfaction, but also improves online interactions between course instructors and students. This is especially significant when we consider the fact that a number of students are already employed in the government or commercial sector. This result is consistent with the conclusion of a previous study on the driving forces of a successful e-learning system,

which underlined the significance of flexible course delivery (Sun et al., 2008). Overall, the flexibility offered by blended LMS that create positive attitudes toward learning an issue that received attention in recent years (Fauzi, 2022; Mohammed et al., 2022; Tahir et al., 2022; Zhu et al., 2021). Perceived interaction is one of the motivational domains that also includes students' opinions on the value/importance of the academic tasks (Anthonysamy et al., 2020). This Learner–content interaction is one of the key three forms of interactions that should be of concern. The other two categories are learner–instructor interaction and learner–learner interaction. Learners engage in this interaction with the material when they acquire knowledge of the content using one or more types of media, such as web-based courses, tutorials, or CD-ROMs (So & Brush, 2008). According to Simanovic et al. (2021), creating a sense of community requires students' physical presence and online communication facilitated by instructors. Furthermore, lack of online interaction implies that either academic presence or social presence is not sufficient which ultimately affects students' satisfaction (Chang & Hall, 2022; Sjølie et al., 2022). According to findings of our study, students' belief that they are not getting enough support and encouragement for the wider social environment that not limited to their classmate but includes also family members and friends, etc. This implies a need for supportive social groups through community awareness, annual academic fairs or students' activities to be sponsored by the university administration (Simanovic et al., 2021; Wang & Lin, 2021).

From findings of LDA, it was evident that faculty members of all colleges have similar (positive) perceptions of Blackboard's overall usefulness. This is supported by the position of the variable PU.1 (Overall satisfaction with Blackboard) in Fig. 8 that centered the four groups (i.e., the colleges) and was located near to the center of the BiPlot rays. Similarly, the variable PEE.2 (Perception that utilizing Blackboard will boost faculty productivity) is positioned near the middle of the graph, indicating that the majority of participants from various colleges perceive that Blackboard is good for enhancing teaching productivity. By reviewing the discriminant function coefficients (discriminant weights) as part of LDA, we found that the variables such as PU.2, POU.1, POU.2, REC.2, REC.3, REC.7, REC.8, PIT.1, showed moderately high values of function coefficients. As a result, they are regarded as the greatest predictors/discriminators of the variation between colleges regarding responses to these questions and show that, across colleges, participants had different perceptions compared to within-group variation (inside a college). Hence, this result about the great predictors of variation between colleges, give an answer to question #3 and question #4 of this study. In contrast, low discriminant function coefficients and the position in the BiPlot rays, of some recommendations such as REC.1 (recommending in-line translation), REC.4 (recommending technology awareness events such as exhibitions and public seminars) and REC.5 (recommending infographics), suggest that faculty members across colleges agree with these three recommendations, with no great between-college differences. This gives a partial answer to question #3 and question #5 regarding variation of recommendations between colleges. As evidenced by the position of the BiPlot ray, members of the college of health sciences and the college of theoretical studies responded similarly to PIT.1. Logically, members of the college of computing & informatics believe that Blackboard is an easy-to-use platform, as indicated by the position of POU.1 on the chart. This may be due to the fact that, members of the college of computing & informatics have acquired strong computer skills as part of their specialization, making it easier for them to use Blackboard. The REC.6 (activating live video streaming during lecturing) is mostly recommended by members from the College of administration and the College of theoretical sciences. The use of video in blended learning is widespread, yet its usefulness across disciplines not well review (Belt &

Lowenthal, 2021). Video as a multimedia tool is not confined to lectures; recorded discussion, recorded experimentation, and animated lectures are excellent uses of video (Lo & Tang, 2018; Roy, 2018). The REC8., which is about adopting semi virtual laboratories is mostly recommended by faculty members of health sciences, and that is attributed to a fact that college of health sciences is the first college of applied sciences at Saudi Electronic University that need laboratories. Apparently, most of the other variables showed overlap across the colleges implying similarity in perceptions. According to their responses, faculty members need more training and orientation on how to use the swiftassess platform for completing major exams, as approximately 21 percent of them do not view Swiftassess as an easy-to-use platform or do not have any comments on the matter, and 19 percent have doubts about Swiftassess's dependability. This claim about using swiftassess is believed to be common among faculty members regardless of their colleges, as indicated by the positions of the two questions on Swiftassess coded as POU.4 and POU.5 that aggregated near the center of BiPlots of the LDA.

Findings of LDA for students' survey (Fig. 9), have given strong evidence that distribution pattern of the students' perceptions and satisfaction across colleges completely differ from those of faculty members. There has been apparent an overlap in the 50% confidence intervals of the four colleges (groups) suggesting that there are no great between-college differences in the students' perceptions and satisfaction, supported by the position of the BiPlot ray in Fig. 9 that centered the distribution of study observations. According to the BiPlot ray almost all the students' perceptions and satisfaction related aspects are located within the 50% CI of the four colleges, with the exception of four aspects namely SN.1 & SN.2 (about influence of subjective norms); PM.2 (about relevance& update of online materials) and PCA.1 (about whether the course assessment methods be useful in developing skills). This suggests that, students perceptions toward these four aspects varied between colleges. Overall, these LDA results of students' survey confirm and complement findings illustrated in Figs 1-7 about perceptions toward Blackboard, reflecting that students' views are common concerns in the university.

The college members' recommendation for including in-line machine translation into the learning system may reflect their awareness of the variation in students' English skills and familiarity with some technical jargon. In-line translation between Arabic and English is challenging due to the fact that machine translation into Arabic is yet immature and its accuracy is still low (Omar & Gomaa, 2020). However, through blended learning, translation across European languages (English, Polish, Greek, etc.), Russian, and Chinese has been studied, with positive outcomes where machine translation has been incorporated as an innovative tool (Castilho et al., 2017). Interestingly, machine translation has a relation with self-regulation, a dynamic and interactive process that ultimately affect the academic performance of students. In addition, as students are motivated by things they enjoy and feel to be significant, the introduction of machine translation into the current learning system will be one of the motivators to draw students to online activities.

Learning from peers is one of issues that received attention recently. Peers are not only involved in assisting and commenting on the works of their classmates, but also in evaluating their performance and development (Qiao et al., 2020; Bazelais et al., 2022). Relevant research suggests some form of online assistance in which students obtain answers to their submitted queries and discuss performance-enhancing ideas (Chyr et al., 2017). If collaborative assignment writing is incorporated into blended e-learning, classmates will be able to provide immediate comments on one another's work, so enhancing their skills in writing scientific arguments (Lopez-Pellisa et al., 2021). Peer

learning could be effective in teaching some subjects such as language (Fang et al., 2022) and in teaching health professionals' students where senior students serve as peer tutors or mentors for junior students (Burgess et al., 2020).

The incorporation of chatbots into the existing online IT assistance as recommended by the majority of faculty members helps relieving instructors of the pressure of answering the same question several times from various students. This is also simplifying some routine activities so that instructors have more time for effective direct contact with students (Ch'ng et al., 2019; Istrate, 2018). Another intriguing feature of chat bot is that it compiles all of the unusual questions asked by students. This allows the chat bot to be enhanced in the future by having additional questions included in its database. In the meantime, it gathers information that can be place toward the overall improvement of the learning system (Galiamova et al., 2018). This engagement with chat bots delivers a tremendous number of possibilities for students' independent learning and directs them toward acquiring knowledge. However, the system might require other components such as cloud computing and an appropriate framework, among other things, in order to function properly (Wei, 2016).

Infographics have been proven effective in both the theoretical and empirical sciences (Almazova et al., 2018) and applied sciences such as public health (Manzanares et al., 2019). A study that was conducted in Saudi Arabia to investigate students' experiences with the Blackboard platform found that students prefer illustrated materials (infographics) to reading texts or listening to audio that is available in the blended learning system (Anas, 2020). Lastly, although a great percentage of faculty members suggested improving technology awareness through annual awareness events, the decision regarding the degree to which instruction is dependent on virtual events will ultimately be made by the faculties as well as the management of the university. Academic accomplishments can be improved by the strategic utilization of online training programs such as online laboratories (Manzanares et al., 2019) and considered useful in developing practical skills in applied science (Hamed & Aljanazrah, 2020), particularly when supported with interactive content such as 3D models (Lanzotti et al., 2019).

5. Conclusion

Both students and faculty members were highly satisfied with some aspects such as usefulness, flexibility, speed of accomplishing tasks and interaction with Blackboard LMS. Overall, regarding the comparison between students' and faculty members' perceptions, it seems that the faculty members are most satisfied with LMS aspects compared to students and that, between-college differences are slightly high among the teaching staff compared to students. From findings of LDA, it was evident that staff perceptions and recommendations showed great between-college variations compared to students' perceptions and satisfaction, which overlapped and seemed common between colleges. Overall, this project revealed that students and staff of the College of Science and theoretical studies were the most satisfied ones about the usefulness, performance expectations, and different aspects of BELS compared to students and staff at other colleges. Students' satisfaction with online IT help; development of skills using current students' activities; updating and quality of online information; and peer interactions were not significantly high. Students' satisfaction has a great impact on the university's reputation and has other benefits, such as a reduction in course dropout rates and other advantages. Hence, we recommend that greater efforts have to be devoted in this direction.

We suggest setting plans for enhancing blended learning systems to incorporate the students' perspectives on online interaction, online IT assistance, and performance objectives. We support the faculty members' recommendations for improving BEL by incorporating an in-line translation service, the enhancement of learning from peers, the use of professionally designed infographics that contain both academic information and general information about necessary skills for students, and the use of video lecturing which are all aspects we recommend for the future improvement of blended learning. Last yet importantly, we urge the need for supportive social groups for students through community awareness, annual academic fairs or students' activities to be sponsored by the university.

6. Study limitations and future direction

There are various constraints to consider when interpreting the study's findings before assuming generalizability of the outcomes. For instance, a large proportion of students who are employees, hence, their study preferences may be distinct from those of unemployed students. The fact that registration in an online course or face-to-face course is not entirely the student's choice, making it difficult to examine the issue of "intention" with high precision. In addition, extra separate platforms are occasionally linked with Blackboard for administering midterm or final exams, which may represent additional obstacles and impede the students' responses to a question regarding perceptions of easy-of-use. Future studies should focus on certain e-learning components to give an in-depth insight of the technical characteristics of the learning system rather than just the overall viewpoints. In particular, studies are needed to determine the value of various online communication strategies between students and teachers, i.e. online discussion forums, blogging tools, and online corresponding. Other studies to investigate and confirm the feasibility of the system aspects that recommended by the teaching staff. The genuine disparity between classroom instruction and online courses in terms of skill development may be covered in other studies, while online assessment of students activities are all possible challenges that need further study.

Author Statement

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