A Collaborative Learning Environment Using Blogs in a Learning Management System

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Abstract. Over the last decade, we have seen an increasing trend in the development, and adoption of self-paced learning systems in both formal and informal sectors. Our Learning Management system is one such web-based interactive learning system that facilitates the acquisition of structured query language skills. In this pilot study, we extended our LMS teams environment to support more collaborative interactions, and knowledge sharing between learners with a blog feature. Thus allowing learners share their insights and learning experiences and further receive feedback from other learners within the course. To evaluate the effectiveness of our approach, we employed a survey research method and its corresponding evaluations on a selected student population. The evaluation shows that blogs are more effective at conveying one's learning experience compared to the use of chat rooms as learners could progressively restructure, and develop their understanding of every task. Also, the blogging environment allows them understand other students' points of view, thus making them convenient for knowledge acquisition and distribution.

Keywords: Collaborative learning · Educational blogs · Knowledge sharing

1 Introduction

A recent survey on the E-learning market by Global Marketing Insights reveals that the E-Learning Market size crossed USD 250 billion in 2020 and is expected to grow exponentially [1]. There has been a sustained growth in digital education over the years. These platforms not only provide a self-paced learning environment, but also allow learners to restructure their learning and understandings from their peers thus providing a collaborative learning environment with cognitive engagement and social interactions among the learners. Knowledge management and sharing are vital in these learning platforms and it is essential to

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invest time and resources to create an efficient knowledge base that is accessible to all the learners at any time.

Several challenges arise When individuals wish to share knowledge. The sender's perception, and method of transmission may be perceived differently by the receiver, thus resulting in contradictions. Another issue is temporal-spatial issues, where people need appropriate time and location to gather and share knowledge. Before modern communication methods, people needed to gather data and knowledge physically to share it with others, resulting in a time penalty. However, blogs greatly reduce the temporal-spatial aspect of knowledge management and sharing by eliminating the traditional physical proximity requirement for the sender, and receiver [2].

Our Learning Management system, SQLValidator [3] is a web-based interactive tool for learning and practicing structured query language, which is the most commonly used language in database-related courses. The LMS teams feature is dedicated to team collaboration. From the perspective of a student, it aids to fulfill the assigned exercise tasks. In the course of these tasks, students are provided the option of reviewing past query submissions in a bid to foster reflection as they continue working on future tasks. However, solving tasks correctly and completely in itself is not enough for effective learning. Our Literature research showed various methods to present "knowledge sharing" to students as an aid to their learning process and several research articles showed that usage of blogging in education has improved knowledge sharing between individuals.

In all, taking the influence of social networking on students into account, and transferring it to LMS teams via a blog feature, we aim to stimulate more collaboration among student and instructors. This study aims to shed light on the following research questions:

- How blogging within a learning environment helps in efficient knowledge management, sharing, and skill acquisition?
- Which features in blog pages would be effective, encouraging for a learner in finding hints/tips for tasks and expressing themselves?

The paper proceeds as follows. The next section deals with introducing the related background to our work. Section 3 deals with the implementation of blogs in the teams page of Our Learning Management system. Section 4 with an evaluation of the effectiveness of using blogs to support more collaborative interactions, and Sect. 5 concludes with our contributions, and directions for future scope.

2 Literature Research

As stated earlier, our aim is to enhance the current teams environment in the LMS to support more collaborative learning. Collaborative learning is a structured learning technique to allow learners to respond to each other's ideas, designs, or even teach each other [4]. Many researchers embrace collaborative

learning theory to offer enhanced learning environments in education systems [4–7]. Smart Collaborative pedagogy directs students and educators in using interactive technology and models [8] to form a collaborative learning environment resulting in improved professional skills through coordination and cooperation in a team consisting of people of the same or different expertise. [6] In traditional classroom learning learners can either produce a proposal/presentation or a report on their learning and it mostly stays between the tutor and the learner [9] or if it is collaborative learning in classrooms then within the team and the tutor. An increase in digital learning has forced researchers to find new ways to reproduce aspects of traditional classroom learning and suit it better to the digital learning environment [10,11]. [6] has assessed key criteria for intelligent collaboration and to provide a better learning environment based on learners' reports and his evaluations.The key criteria are *Transparency, Collective intelligence, Democratized learning, Smartly sharing, Knowledge engagement, and Openness* [6].

A summary of theories behind collaborative learning was described by [4]. [12] mentions "Connectivism" as knowledge distribution traversing among connections i.e.) acquiring knowledge through connections. An important finding during the search on collaborative learning strategies was from [13]. It provides an overview of a collection of research articles relating to the New Generation of Collaborative Learning Systems and the needs of next-generation learning systems. Investigation in [13] reveals the supporting factors of next-generation collaborative learning systems - *Enabling Technologies, Psychological factors, Learning dimension, Knowledge management, Social networking infrastructure.* All these factors were investigated with several dimensions within themselves. Interestingly 3 factors namely Learning dimension, Knowledge management, Social networking infrastructure along with their dimensions suited to our need of enhancing the learning environment in the LMS. Keywords like *E-Feedback micro-blogging management, online communities, Knowledge mobilization, Connectivity Experience* were of our necessities. Also, the classification of collaborative approaches in [4], provided different criteria for collaborative learning techniques in E-learning environments. We picked up factors from each point of view that would suit our need in improving the learning environment in the LMS. From the Purpose View - Debate and discussion, Social networking provides interactions, networking, and collaboration. From the view of Method - Communicating/chatting, sharing links will lead to collaborative interactions. From the tool's view of [4], we picked up - Wikis, Social networking, Content communities, E-learning services, Discussion forums. This led us to think about providing a service within the learning management system to share knowledge with learners and also serve as a knowledge base. Wiki and Blogging models were the first to hit us as they are the most familiar knowledge base and knowledge sharing platforms.

Our search on literature shifted to finding research works on using blogging services in various learning environments and their outcomes. We found several research articles [14–18] using blogs as valuable platforms for constructivist learn-

ing and is also suited to support a wide range of educational concepts.To this end, literature research has been carried out to analyze the degree of effectiveness of blogging techniques in collaborative learning environments, along with positive and negative impacts. Apart from that, different features have been remarked within blogging serving different purposes, which are also another direction in our research to augment the learning environment. The vast majority of researches [15,19,20] have been encountered with findings on educational affordances and valuable application methods of blogs within the educational concept.

To begin with, [17] focuses on the effectiveness of blogging application in educational environments based on cognitive and social constructivist thinking, by taking into account the ability of blogs to be customized for supporting various educational activities.

Application of blog technology has been stated as a solution to obstacle factors in individual knowledge sharing, such as human factor, knowledge characteristics, and the spatial and temporal factors by [2], stating the superiority of blog technology as being low-cost, interactive, and open, but most importantly, the main advantage here is in the main target of blogging, which is to share and to facilitate the sharing activities.

While blogging activities are solution-oriented technological advances helping students in collaborative learning and knowledge sharing, the findings are quite divergent in terms of advantageous factors. Preliminary findings by [17] concluded the detrimental effects of blogging as well; for instance, the possibility of students becoming overwhelmed by various topics and concepts causing them to read and contribute rapidly and neglectfully, which in turn may lead to unrelated and not meaningful contributions, by which the effectiveness claim of blogging technology is becoming contradicted.

In the research by [15], the benefits of commenting feature in blogging is stated as the development of interactions between students as well as encouraging and praising each other by guiding on how to solve the problems but searched ways to enhance the self-directed learning skills for students to also coach each other, and by doing so enhancing the value of blogging in a contemporary learning environment.

While analyzing more than 300 cases in form of journal entries and comments by students, [18] concluded that descriptive reflections outnumbered the critical reflections, concluding that most students dedicate time and effort to produce a work in higher quality, knowing that their writing will be presented to an audience. Through the analysis of comments directly from the target audience, [18] highlighted the benefits of blogs as a learning tool in the learning process of students from different aspects.

However, only blogging itself or only Computer-Mediated tools are not enough and appealing from a student perspective in effective learning. This statement is strongly supported by [16], mentioning that instead of replacing the computer-mediated communication (CMC) applications with blogs, prefers integration of blogs in educational contexts to improve the communication environment among students and teachers, believing that would bring more con-

tributions. A summary of important literature is shown in Tables 1 & 2 which covers the summary of the paper, its assessment method, and the type of learning environment.

3 Background

The aim of this study is to improve the collaborative learning aspect in the learning management system by introducing blogs. Therefore, it is essential that we initially cover in detail what these terms are before proceeding with our practical tasks.

3.1 The Learning Management System

Our learning management system features a built-in system to check the syntax and semantics of SQL queries and give feedback to the students accordingly. When a student submits a SQL query with a syntax error, the student is notified that there is a problem with their syntax. In the case of a semantic error, the student is notified of what is required from them and what their code outputs. For example, the result relation may be required to have 2 columns but the students' code may be resulting in a table with 3 columns. This is reflected as such by the learning management system. With this feature, students can check the correctness of their assignments before submitting them. These assignments may be individual or group based assignments. In the case of a group assignment, a page is created for each group, featuring a chat board where students can post their entries as a means of collaboration. When one student submits the assignment, it is submitted for the whole group. Not all students need to anticipate in the submission process. The same goes for editing the code, when a student edits the code, it is visible for the whole group. Here in addition to the team and the chat system, an instructional feedback feature allows the tutor communicate with each team, posting to the chat system together with the students, in addition to this, there is a separate announcement board where the tutor posts task descriptions and students submit their solutions to the respective tasks. To improve the collaborative learning aspect of this tool, we will develop and integrate a blog into the system.

3.2 The Notion of Blogs

A blog can be described as a website in which a blogger or several bloggers can write entries and these entries are ordered chronologically. In the old days one who wanted to blog needed to spend time writing tedious HTML code to own a personal blog. Nowadays people with minimal computer knowledge can effectively use blogs. In education, a blog has several features which make it stand ahead of traditional computer-mediated communication (CMC) technologies [28]. With traditional CMC technology, we can provide students effective and efficient distance learning which enhances collaboration, cooperation, knowledge

Table 1. Summary of important literatures of the study

Ref	Description	Assessment methods	Environment
[9]	Implemented group collaboration, writing progress reports and developing product versions and the online file sharing tool DriveHQ	Students' feedback on collaborative learning and progress report - checking the existence of individual accountability and positive interdependence in the learning environment	Online learning
[21]	Digital group conferences on the group interaction of the students	Analysis of transcripts of conferences and questions to group conferences -Tally, Interviews (NUDIST (Nonnumerical Unstructured Data Indexing, Searching and Theorizing) software to categorize as themes)	Online learning
[7]	Application of different amounts of coercion to the users of Negotiation Tool and testing the effects of three versions of NTool using Kruskal-Wallis tests	Questionnaire (6point Likert Scale), Statistical Analysis (Kruskal-Wallis tests, Spearman test, Mann-Whitney U test), Interviews (recorded, open coding with a focus on formalism and coercion)	Online learning
[18]	Engagement of students in the usage of Social Networking Sites in learning and Blogs as Online Assignment	Qualitative Analysis from students blogs post, comments and interviews	Classroom learning
[22]	A Quantitative research design that uses non-linear regression Partial Least Squares Structural Equation Modelling (PLS-SEM)	Online survey (5 point Likert scale)	Classroom learning
[23]	Measure the effect of the difference between blogs in design (hypertext, super graphics) and form on how students gain knowledge	Pre and Post Knowledge Tests and Quantitative analysis, SPSS	Online learning
[15]	Assessment module in the form of a portfolio comprising of a design diary, peer reviews, interactive pet (requiring 3D object building programming skills)	Thematic analysis from blog corpus. Qualitative content analysis - descriptive statistics (Kurtosis, Skewness), SPSS form inter-rater reliability statistics	Online learning
[24]	A research based on a survey: How the students reacted/perceived the integration of a blog was investigated	A survey (facilitating a 5 point Likert Scale) with data analysis via a t-test, reliability analysis, factor analysis, a series of ANOVAs, and multiple Regression analysis using SPSS 18.0	Classroom learning

Table 2. Summary of important literatures of the study

Ref	Description	Assessment methods	Environment
[25]	The co-relational research design and Examination of the relationship between various pre-service teachers' perceptions and their perceived learning in two courses that incorporated blogging	Three online questionnaires (Collaborative Learning scale, Sense of Community-scale, Perceived Learning scale)	Collaborative learning environment
[26]	Investigation of the influence of the social network's characteristics on students' performance and access to knowledge in learning via blogs	Multiple Online questionnaires - 5 points Likert Scale. Qualitative - Face to Face interviews coded by MAXQDA 18, Open Coding, Category Assignment	Online learning
[27]	Blogging was incorporated into the internship activities of interns. Behavior, perceptions, and processes of blogging among interns was examined from two disciplines and a mixed-method design was used to obtain quantitative and qualitative data through structured interviews and blogging entries	Questionnaires, Telephone interviews [Blogging Behavior (5point Likert scale) - InterQuartile Range, Blogging perception (4 point Scale) - Descriptive statistics (Kolmogorov-Smirnov test, Mann-Whitney test)]. Qualitative Analysis - Nvivo 8 software (Major Themes - cognitive, metacognitive, social and effective)	Online learning
[19]	A framework for educational blogging in the context of teacher education	Exploratory study, Pre-assessment questionnaire (4 point scale), Post-assessment questionnaire (5 point Likert scale), Formal personal interview, Analysis of blogs, and comments using indicators for self-expression and Social support	Online learning

sharing, and exchange of ideas. Students themselves also acknowledge the conclusions of the studies which point out these advantages. Such CMC systems also have limitations. They are not good at motivating students and making them feel engaged in this learning environment. Blogs are a good tool to overcome this challenge [29]. The Simple Syndication (RSS) feature of blogs is pointed out as an improvement to traditional CMC environments. RSS enhances collaboration and knowledge sharing by updating everyone involved with the blog with the relevant information, ensuring engagement which traditional CMC systems often lack. Blogging is also well noted for its ease with which it makes shared

data easily available. In traditional CMC environments, there are often many steps/procedures to start using the tool to collaborate and share. Blogs are a lot more flexible in this regard, where even anonymous people may just leave an entry as they wish, meaning a blog is a far more dynamic, efficient, easy to use tool compares to traditional CMCs. A blog also incorporates different types of external media via so-called hyperlinks. This means blogs can incorporate videos, text, and other types of media flexibly and efficiently. The comment/reply feature of blogs can motivate individuals to participate more when they receive comments to their entries from their peers [30,31].

3.3 The Notion of Collaborative Learning

Collaborative learning can be described as a learning setting where students share knowledge, gain knowledge shared by others, express and exchange views and ideas with other students to enhance their overall learning experience [32]. In our study, we will be focusing on online collaborative learning. Collaborative learning systems can be categorized into three types: mirroring systems, metacognitive tools, and coaching systems. These systems are further categorized based on their technical aspects such as the type of data they deal with and the high-level representations etc. Another study investigated the issues in the transformation of collaborative learning systems in the present day and the dimensions of these issues as well as some scenarios related to these dimensions. [4,13] An important term in our research and development is computer-supported collaborative learning (CSCL) [33]. The way technology has progressed has made it even more important for individuals to share knowledge and collaborate on their expertise. This term emphasizes the use of technology to enhance the aforementioned concepts of collaborative learning. Two important features of CSCL are noted to be individual accountability and positive interdependence. The first term indicates that every individual comes with their respective set of skills, fields, and knowledge. A promising collaborative learning environment facilitates the effective deployment and benefiting of this diverse set of knowledge to produce the common goal most effectively [34]. But every individual comes as important here and must contribute accordingly to reach the common goal. This concept of gathering a diverse set of individuals closely around a common goal, pointing out their responsibility motivates everyone to put in their work.

3.4 The SQLValidator

In the SQLValidator architecture, Fig. 1, users access, and interact with the platform via a web interface. The tasks, and submissions components contain all information necessary for its processing. A PHP server mediates between user requests, the databases and the relational database management system [3]. In SQLValidator, there are four main databases:

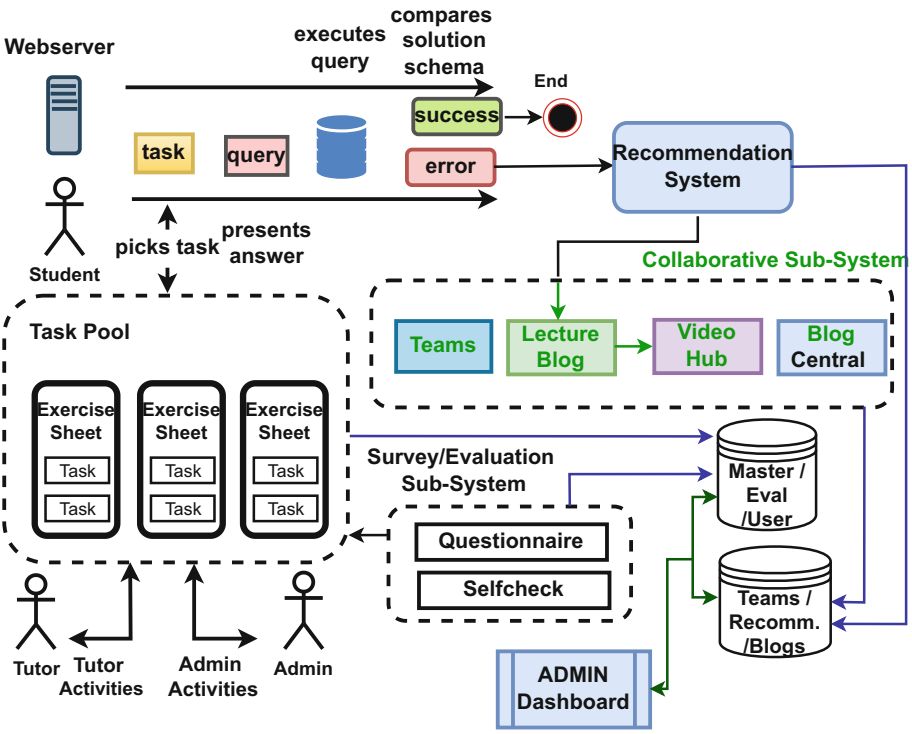

Fig. 1. Granular architecture of the SQLValidator

- `sqlvali_data` contains all relevant data to maintain the organization of the SQLValidator itself, such as user management and task definitions.
- `sqlvali_master` contains all standard tables and data used to perform an evaluation of the user query on the database.
- `user_#` contains physical user-specific slave databases related to the sqlvali_master where the users can perform their own queries.
- `sqlvali_eval` contains all relevant evaluation data to provide a proper basis for analytics.
- `sqlvali_teams` contains all data needed to maintain the team system used for team projects.
- `sqlvali_Recomm` contains the slide recommendation data maintain the team system used for team projects.

Now given that a student with access already picked a task and submitted an answer for the task, as shown in Fig. 1, SQLValidator validates the query for syntactic errors and then compares the resulting schema with a pre-defined solution schema for the particular task. If there is a mismatch between the two schemas, further evaluation is carried out and the cause of the error is returned to the student. The student can then correct and resubmit the query again until the query statement is successfully validated. A record of all last attempts for each

individual task is saved on the user's page for that task. For analytic purposes, all submission attempts are saved in the sqlvali_eval database.

4 Blog Implementation

The literature review conducted by [35], highlights blog design, navigation, media use, usability, content, and accessibility as key factors taking into consideration wile designing and developing an educational blog. Navigation was achieved through the menu and links in the header of all pages. We have restricted the media usage to only image files to make it simple. Usability and accessibility are the key criteria in helping users achieve goals efficiently in the context of using the system. Figure 2 shows the use-case diagram that depicts the various use cases, users, and interactions among them.

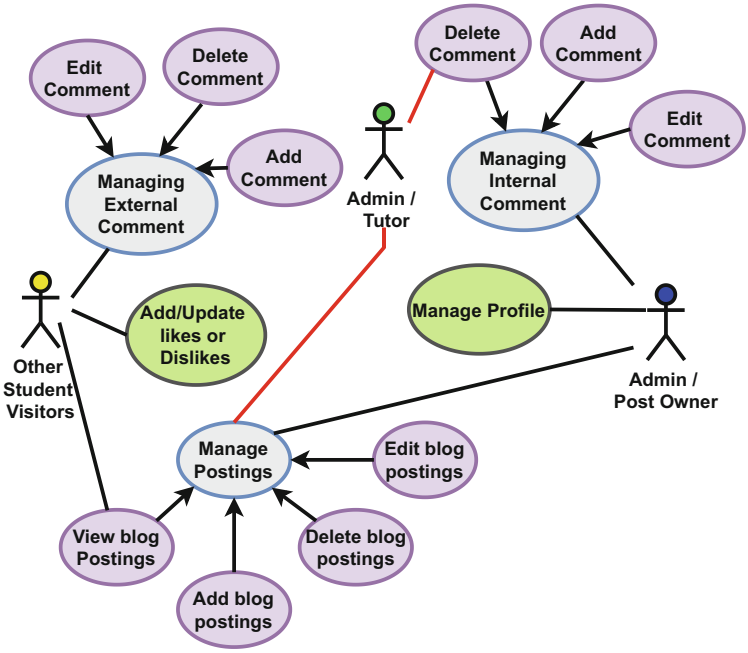

Fig. 2. Use-case diagram

The use case diagram depicts three actors. The owner of a blog post, the other students, and the tutor. The post owner can manage internal comments, which include editing, deleting, and adding comments. The tutor can delete these comments. The other students who are authorized to comment on one's blog post can manage external comments, namely add, edit and delete them. Both the post owner and the other students can manage their profiles. The post

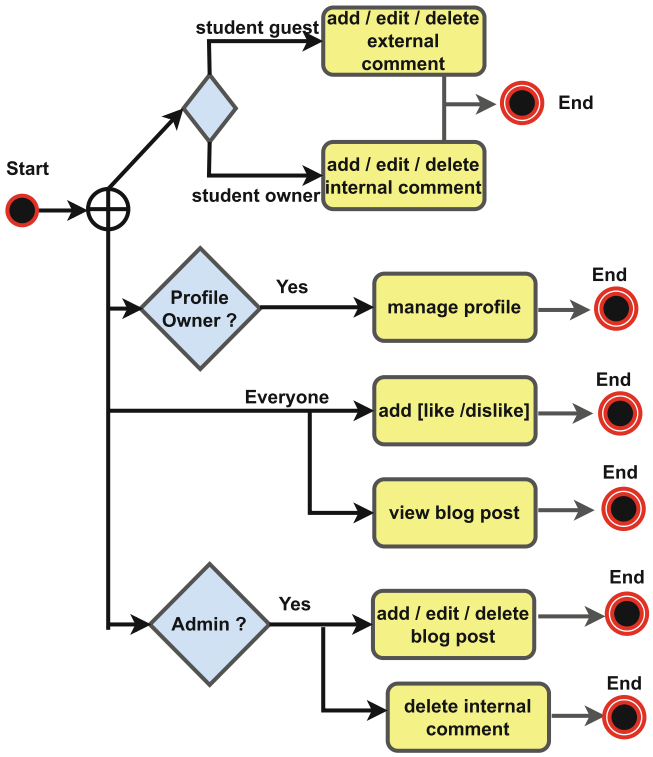

Fig. 3. Activity diagram

owner can manage their posts, namely add, edit and delete them. The other students can only view these.

The activity diagram, Fig. 3, is designed based on the use case diagram, about its constraints. It defines an initial state, from which the user can choose an activity to be performed as a decision node. For example, if the user wanted to manage an external comment, the user must be a student other than a post owner. When an activity is completed, we reach another decision node, asking the user whether they are finished. If not, we return to the initial decision node. To understand every action a user can take and its respective outcomes, we have prepared the activity diagram that depicts user actions and outcomes in Fig. 3. The comment section is available under each blog post to allow discussions related to the respective post. Users can type their comments in the provided box and subsequently post them. If a user wanted to correct a mistake or add more information etc., they have the option of editing their comment. They can also delete their comments. it is also possible to interact with another user's comments. The reply functionality extends this notion further, allowing discussions related to a single comment. Therefore a comment section is a key part of online collaborative learning since it increases collaboration among learners and

authors. The author of a post can edit or delete the post is viewed. The author can now edit the contents where a preview of the old attachment is shown so they can decide to update the attachment or not. On confirming we update the table in the database and display the updated post on the index page.

5 Evaluation

A survey research design was used to investigate and get feedback on our system's usability. The basis of our survey was inspired by [24]. We developed a questionnaire relating to answering our research purpose with 5 point Likert scale (Strongly disagree,..Strongly agree) and a few multiple-choice questions. We divided it into three sections namely perception of collaboration, sense of learning and expressing, blogging behavior. We believe each section helps us to quantitatively measure each of our research questions. The questionnaire used can be found from the Table 3, Table 4 & Table 5.

5.1 Evaluation Results

For this pilot evaluation, we selected 21 active users from the 94 students that enrolled in the database concepts course. There were an equal number of males and females and a special participant. Most of the users were between the age of 27–31 and most of them did not have previous experience in using blogs/microblogs. Descriptive Statistics like mean, the standard deviation for the quantitative questions were calculated and added to Table 3, Table 4 & Table 5. No. corresponds to the population and is 21. The vast majority of quantitative replies were 4 and 5 on the scale. Therefore, the standard deviations are fairly small for a vast majority of the questions. There were no questions that were answered mostly negative but there are several questions with mixed replies. A notable

Table 3. Questionnaire

ID	Perception of collaboration	No	Mean	SD
1	I thought the blog was easy to use?	21	4.48	0.79
2	Can you feel a sense of community while learning in this blogging environment?	21	4.14	0.77
3	Blog discussions help me to share my knowledge and experience with my peers easily?	21	4.48	0.66
4	I think that the blog feature will be frequently used by new users	21	4.48	0.66
5	I think that I would need the support of a technical person to be able to use this tutorial	21	2.71	1.24
6	Do you think blogging environment provides an opportunity to improve social skills?	21	4.14	0.71

Table 4. Questionnaire

ID	Sense of learning and expressing	No	Mean	SD
1	Do you feel confident expressing yourself using the blog?	21	4.48	0.79
2	Are you open to debatable learning?	21	4.14	0.77
3	I understand the topic better after reading the blog posts	21	4.48	0.66
4	Blog discussions help me understand other points of view?	21	4.48	0.66
5	Getting to know people of common interests from the profile page is useful?	21	2.71	1.24
6	I find this blogging environment very informative and captivating to read and learn	21	4.14	0.71

Table 5. Questionnaire

ID	Blogging behavior	No	Mean	SD
1	I thought the blog was easy to use?	21	4.48	0.79
2	Can you feel a sense of community while learning in this blogging environment?	21	4.14	0.77
3	Blog discussions help me to share my knowledge and experience with my peers easily?	21	4.48	0.66
4	I think that the blog feature will be frequently used by new users	21	4.48	0.66
5	I think that I would need the support of a technical person to be able to use this tutorial	21	2.71	1.24
6	Do you think blogging environment provides an opportunity to improve social skills?	21	4.14	0.71

question is "I think that I would need the support of a technical person to be able to use this tutorial".

The average score of the question was a modest 2.71. In addition, several questions had a comparatively higher number of participants giving a score of 3 or 4 compared to 5. The questions were prepared in a way so that not only perceptions about the blog, but also their previous experience with blogs, blogging behavior, opinions about blogs, learning preferences can be understood. There were also other multiple-choice and textual input questions (Table 6 and 7) that the participants had the flexibility to describe briefly. These questions are qualitatively assessed to understand the users. From Fig. 4 & Fig. 5 we can assess the usability measured as relative to users of our blogging system. The success rate was high where all the users found our blogging system was easy to use. Users satisfaction can be understood from the outcomes where users voted for the system functions being well integrated.

As stated earlier, we have divided the questionnaire into three sections so it would help us to quantitatively measure each of our research questions. The

Table 6. Qualitative analysis

Perception of collaboration	No	(%)
Gender		
Male	10	47.6
Female	10	47.6
Special	1	4.8
Age		
below 20	0	0
21–23	0	0
23–27	4	19
27–31	12	57.1
above 31	5	23.8
Preference to learn in groups		
Yes	10	47.6
No	10	47.6
Sometimes	1	4.8

Table 7. Qualitative analysis

Perception of collaboration	No	(%)
Classroom or digital learning		
Classroom learning	7	33.3
Digital learning	2	9.5
Partly both	9	42.9
Depends on subject	8	38.1
Used blogs/micro-blogs earlier?		
Yes	13	61.9
No	8	38.1
When would you comment?		
Aware of the topic and you see misunderstandings	7	66.7
Aware of the topic and like to appreciate it	6	28.6
Unaware of the topic and you ask questions on it	7	33.3
Unaware of the topic and like to appreciate it	2	9.5

section on the perception of collaboration helps us to understand, if the learners are willing to learn in groups, does this environment helps them to share their knowledge and experience with others easily, do they feel a sense of community during learning, does it help in improving social skills. For example, From Table 6, we see that there is an equal number of users who prefer to learn in groups and not. Figure 6 shows that most users feel a sense of community while

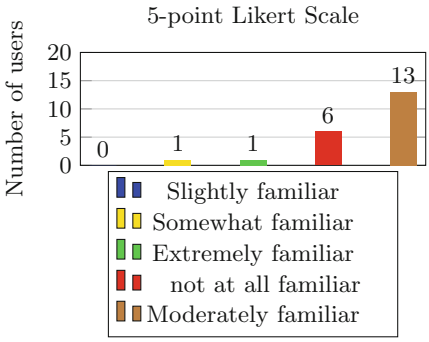

Fig. 4. I thought the blog was easy to use

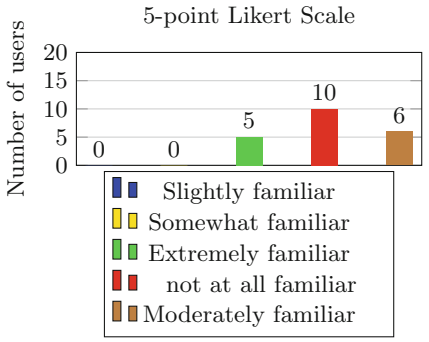

Fig. 5. Various functions in this blog system were well integrated

learning with the blogging system. Also from Table 3, we can see a majority of positive feedback where they feel blog discussions help in knowledge sharing and provides opportunities to improve social skills. All these results correspond to answering our first research question on the idea of cultivating a more collaborative learning environment in the teams page of the learning management system.

The next question on how blogging helps in knowledge management, sharing, skill acquisition can be answered using the section on the sense of expressing and learning from the survey. From Table 4 we infer that majority of the users are open to having debatable learning and the systems help them to understand the topic better after reading a post. Users have also agreed that blog discussions help them to understand the discussion from others' points of view. Figure 7 shows the response among the users in feeling confident to express themselves using blogs.

Similarly using the last section on Blogging behavior will help us to answer the last research question on blog features that are useful and encouraging for the learner while using the environment. Referring to Table 5 again, we can see that most users felt the "post hit" feature useful to find more engaging and interesting posts. The share and search options were also rated necessary by most users. Interesting finds in this section from Table 7 are that most users like to spend more than 6 min in a blog post and are most likely to comment when they are "Aware of the topic and you see some misunderstandings" or Unaware of the topic and you ask questions on it. Sadly we see only 10 % of users like to appreciate others in sharing a post on a topic they weren't aware of. We could also see that the limitation to image format files in attachments was of concern to users to allow open format for attachments. Figure 8 depicts that the keywords/tags feature used was helpful and would be of great use if we could group posts based on keywords which makes it easy to look for specific posts. Similarly, Fig. 9 shows that most users felt that the commenting system is necessary to engage in discussing the topic further.

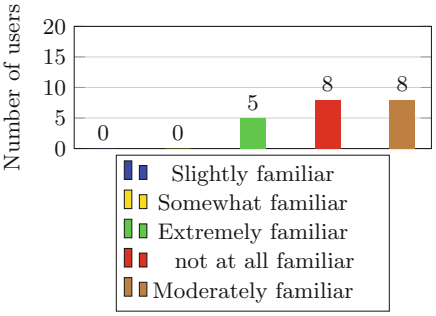

Fig. 6. Can you feel a sense of community/collaboration within the blogging system?

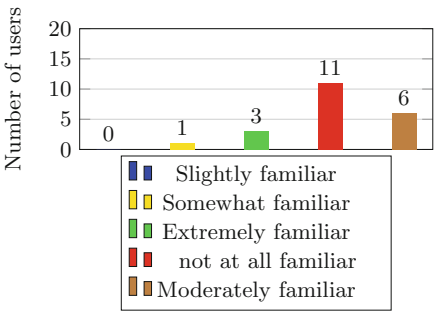

Fig. 7. Feel confident in expressing yourself using the blog?

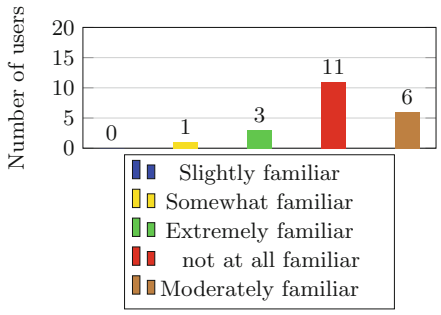

Fig. 8. Do you suggest grouping/searching posts with keywords?

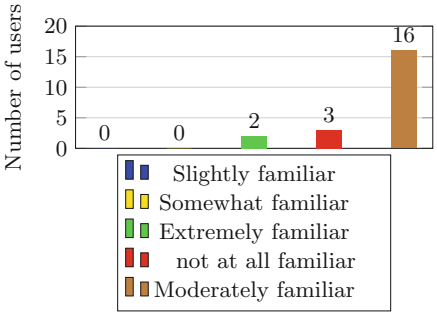

Fig. 9. The comment section is very helpful and engaging to discuss the topic further

Another topic of interest is the correlation between the responses to the survey questions. To this end, pairs of questions that should logically be correlated were statistically tested. To find the correlation between two 5-point Likert questions, linear regression can be performed on the plot of the scores of the influencing question against the influenced question. While comparing a categorical question vs a 5 point question, the average score for each category can be computed and vice versa. To capture the correlation of two categories, the average scores for each category, for each participant can be calculated, plotted on a 2D plot and the slope can be estimated by linear regression. A positive slope means the variable on the x-axis, positively influences the variable on axis y.

For example: "Do you prefer classroom learning or digital learning?" Vs "How would you rate your overall experience with the blogging system", are analyzed for the correlation between the participants' learning preferences vs their experiences of this blogging system. The choices are classroom learning, digital learning, partly both, and depending on the subject of learning with the respective average scores of 4, 4.5, 4.11, and 4.125. From a logical point of view,

a person who prefers classroom learning should be expected to give a lower score than a person who prefers digital learning, with the other two choices being in between. The results also say so, but since the margins are low and sample sizes are small, we need more participants to identify such correlations accurately. The three categories of interest are Perception of Collaboration, sense of expressing, and learning Blogging Behavior. For each of the 21 participants, their average given score for each of the categories was computed. Three comparisons were performed. Perception of Collaboration vs sense of expressing and learning, Perception of Collaboration vs Blogging Behavior, sense of expressing and learning vs Blogging Behavior. So there are three 2D plots, each of which has 21 data points (N). The respective slopes for these three comparisons are as follows: 1.012, 0.889, 0.6925. All of which are positive slopes, suggesting a positive correlation between all three categories. This is expected since we could generalize that a person who had a good experience with the blog would most probably give good grades for all categories. Moreover, the statistical results we got also displayed statistically significant correlation among categories. For each respondent, one question has been selected from each category, and Pearson coefficients has been calculated along with P-Values. The strongest significant correlation has been seen between Perception of Collaboration and Sense of Expressing and Learning ($R = 0.62$, $p = 0.0029$), as well as between Blogging Behavior and Sense of Expressing and Learning ($R = 0.57$, $p = 0.006982$). A slightly moderate but still significant correlation was detected between categories Perception of Collaboration and Blogging behavior ($R = 0.52$, $P = 0.015679$).

6 Conclusion

From the responses received, it can be concluded that 85% of the users had a good overall experience with the system. The response to the question "I think that I would need the support of a technical person to be able to use this tutorial" was an interesting outlier because, despite the vastly positive feedback about the blogging system, people seem to have difficulty understanding functionalities in the system. This leaves space for improvement, to make it more user-friendly. Questions measuring the technical/collaborative aspects of the blog were mostly rated 3 and 4 on the scale, suggesting room for improvement. Proposed future improvements obtained from the survey results are grouping and searching posts based on keywords. The current search feature allows users to filter posts based on the title, content of blog posts. This feature could be enhanced further by grouping the posts based on keywords which would help users to find multiple posts that pertain to a keyword and also reduce the risk of finding irrelevant or missing relevant posts. Another possible upgrade is an open format for attachments. Currently, the blog posts only allow image files to be attached. But a blogger may need to include different file formats such as videos, which would enhance learning. Also, more users agreed to maintain an administrator to manage posts and activities around it. To conclude, our study to improve collaboration in teams page of the learning management system using blogs seems to

be in the right direction as 90% of users agreed upon it. This semester, plan to further improve the system and conduct further tests before full integration to the learning management system's teams.

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