Lab 2 – Study Buddy Product Specification

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CS 411

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1 Introduction

Student Success Center at Eastern Illinois University (2018) defines a study group as a small group of students with similar goals who meet regularly to review course material and prepare for exams. Forming and/or joining study groups can be an essential approach for enhancing knowledge. One benefit of joining a study group is being able to share talent and knowledge within the group. Students with different perspectives can offer insight on new topics and improve the group’s collective understanding of course materials. Study groups tend to be more fun because there are individuals to discuss content and create exciting activities to help the group retain information. Studying with a friend also makes students less likely to procrastinate and increases students’ commitment to the coursework, which improves learning outcomes.

The peer support in study groups helps students retain lecture material. Keith Sawyer, a professor at Washington University, conducted a study where he followed college students in study groups and in the classroom. He noticed that when the students took notes during lecture classes, they were so busy writing that it was hard for them to really absorb the material. However, in study groups, they constantly looked down at their notes and back up to their peers. Through those interactions, Professor Sawyer determined that “study groups are so effective because they provide a way for students to make the lecture notes their own” (2016). Lynden Barry, a master’s student at Southern Cross University, explains the importance of study groups for online students. Barry has her own study buddy and she found that the additional peer support and encouragement “can be the difference between passing and failing” (2016).
Joining a study group can benefit students in several ways, however, it is often difficult for some students, particularly for shy students and online students, to form study groups. Figure 1 shows the struggles some students face during the process of finding a study group. Students have limited ways to communicate, such as posting on a discussion board or emailing a classmate. This can lead to a negative response and the student will be left to study alone. Shy students sometimes do not feel comfortable asking other students for help, so they miss out on being matched with a study buddy. Online students are physically unable to meet up with study groups, so they also miss out on the great benefits of joining study groups.

![Figure 1: Current Process Flow](image)

Along with the difficulties of physically forming study groups, some students find it challenging to find like-minded peers with similar study habits, lifestyles, and motivations. Different study habits can lead to students clashing in a group, and not getting work done. Some students choose to prioritize studying during study groups to only focus on the coursework,
while others enjoy socializing and chatting while they study. Some individuals prefer studying at night, so it would be difficult to adapt with students who prefer to study during the day.

Incompatible learning styles can make it difficult to find ideal study partners. Auditory learners best comprehend information by listening to information rather than reading it or seeing it visually. Reading/Writing learners learn best by reading texts and rephrasing it in traditional lecture and note-taking environments. Visual learners best understand information by visualizing relationships and ideas through maps, charts, diagrams and essays. Kinesthetic learners work best by participating in activities or solving problems in a hands-on manner. Learning styles within groups can make a difference in students’ ability to focus and maintain motivated while studying.

Different motivations for joining a study group can influence the students’ test outcomes as well. Some students may be motivated to join a study group to get a head start and meet deadlines on assignments, while other students feel the need to join a study group for the sole purpose of reviewing for upcoming assessments. Students choose which study groups to join depending on the motivations of other students in the group.

Another challenge is connecting with people due to different responsibilities and scheduling conflicts. Students often have various family, work, and school responsibilities that may interfere with one another and hinder participation in a study group. It can also be difficult to create a schedule that works for everyone in the study group.
1.1 Purpose

Study Buddy will be a web application designed to help anyone pursuing knowledge find the ideal match for a study group. Study Buddy will provide users with an organized way to match with like-minded individuals. The end-user will utilize the application to match with others based on set preferences and filters. Figure 2 displays the proposed process flow for Study Buddy. Online and shy students will be able to easily set up a study group based on specific preferences such as class, subject, and topic. The user will be able to find study buddies that have similar learning styles, availability, and motivations.

![Flow Chart](image)

*Figure 2: Proposed Process Flow*

Study Buddy will utilize a web user interface to capture the end users’ input. The application will use the Intelligent Buddy Matching algorithm to match users with their ideal match. Users will also be able to utilize external applications to facilitate communication and collaboration.

The User Interface will be equipped with several features to help users navigate the website. The Home Screen will consist of a returning user’s option to sign in or a new user’s sign up
option. Returning users can click on the returning user option and be prompted to enter their email and password. New users will have to sign up by entering their name, email, school, phone number and create a password. After entering the site, end users will arrive at the Main Menu, which consists of the Study Buddy questionnaire that allows them to select availability, study preferences, courses, study topic(s), group size preference, and time/location (online/in person). Users will create profiles with their preferences, and the data will be gathered. Once each student is done using the Study Buddy application, they will be prompted to an Exit Screen that will allow them to close the application. The data collected from the end users will then be used in the algorithm to find a Study Buddy match.

One key feature of the Study Buddy application will be the Intelligent Buddy Matching algorithm. To match users with one another, Study Buddy will use a proprietary intelligent buddy matching system which gathers information from the users’ answers to a questionnaire. First, the Study Buddy system will create a possible match list. Then, a similarity score will be computed based on users’ preferences. Lastly, the users will use the matched buddies list to form study groups.

Study Buddy will also use external services to facilitate better online study group communication and collaboration. Some APIs that will be integrated into Study Buddy include: Google Drive, Google Hangouts, Codeshare, Jupyter Notebook, Slack, and Git. Google Hangouts will be used to help online students communicate with live students during study groups. Slack chat will be embedded directly into Study Buddy for private messaging and video calls. A feature will be added to also allow users to create and share repositories using Git. Google Drive will be used for file storage and sharing. Codeshare will be used for real time
collaboration on software assignments, and Jupyter Notebook will be used for sharing mathematical equations and visualizing data.

Study Buddy will be designed for anyone pursuing knowledge, with particular focus on students. Universities will be the target consumer group because there is a nice mixture of online and shy students. As shown in Section 1, online and shy students often find the most difficulty joining study groups, so an application that can help these students is very necessary. Students with varying majors, personalities, and schedules attend universities and this will be a great place to market Study Buddy. Universities also have several different students who may take similar classes, so the Study Buddy application will come in handy when students want to join study groups. Students will be able to form groups with people in their classes or online and experience an effective study group by utilizing the application.

1.2 Scope

Study Buddy will be designed primarily for university students. The goal of Study Buddy will be to effectively match students with their ideal study group by considering their availability, study preferences, courses, study topic(s), group size preference, and time/location (online/in person). The Study Buddy prototype will consist of similar functionality of the real-world product. The prototype will implement the majority of the algorithms required for the final product. The Intelligent Buddy matching algorithm will be altered on the prototype to match users on a reduced set of study preferences. The distribution of the web application will be limited to an internal testing team. The geographical area will be restricted to Old Dominion University for testing purposes.
Old Dominion University (ODU) will be the first University in which Study Buddy will be implemented. ODU has a large population of online students and can use the application to promote better studying habits. ODU currently has a Find a Study Group web application, as shown in Figure 3. The current version is a quick solution to the problem, but ODU needs a better site to help students find effective study groups.

![Figure 3: ODU Find a Study Group webpage](image)

The Study Buddy prototype will have a more responsive webpage that will gift shy and online students the ability to experience a productive study group. Users will be able to create an account and save their study preferences, availability, and courses. The Intelligent Buddy Matching algorithm, discussed in Section 1.1, will be used to match users based on study preferences. Google Hangouts will also be integrated into the web application to help online students communicate with live students during study groups.
1.3 Definitions, Acronyms, and Abbreviations

**Auditory Learner** - best comprehend information by listening to information rather than reading it or seeing it visually.

**Business Logic** - The programming that manages communication between an end user interface and a database.

**CRUD** - Stands for Create, Read, Update, and Delete. Basic database/application operations.

**Entity Class** - A simple Java Class with member variables and getter and setter methods defined.

**JPA** - Java Persistence Application Programming Interface is an API for handling all database operations such as storing or retrieve entities from the database.

**JSF** - Java server faces is a java framework that couples the view and servlet into one managed component.

**Kinesthetic Learner** - best comprehend information by participating in activities or solving problems in a hands-on manner.

**Learning outcomes** – statements that identify the knowledge, skills, or abilities learners should gain by the end of a particular assignment, class, course, or program.

**Modern Interface Design** - the process of making manageable interfaces for computing devices, with a focus on current styles.

**ORM** - Object-relational mapping. Technique for persisting objects into a database table. Tables are modeled after Entity classes.

**Procrastination** - delaying or postponing a task, which needs to be completed, often to the detriment of the procrastinator.

**Prototype** - the prototype of Study Buddy will be a reduced scale version of the final product and will demonstrate the functionality of the completed product in a simulated environment.

**Reading/Writing Learner** - best comprehend information by reading texts to further absorb information by condensing and rephrasing it in traditional lecture and note-taking environments.

**Study Group** - a small group of students with similar goals who meet regularly to review course material and prepare for exams.

**Visual Learner** - best comprehend information by visualizing relationships and ideas through maps, charts, diagrams and even essays.

**Web Application** - an application that uses a website as the interface.
1.4 References

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1.5 Overview

The product specification provides an overall look at the intended goals and capabilities of the Study Buddy product. The information provided in the remaining sections of this document will detail the software and external interface architecture of the Study Buddy prototype. Section 2 will include the key features of the prototype and describe the external interfaces used to control, manage, establish, and display the major features. Section 3 will contain the product specification requirements and will be provided in a separate document.

2 General Description

Study Buddy will be a web-based application where students can connect with others to form or join study groups. The User Interface will be equipped with several features to help users navigate the website, as discussed in Section 1.1. Users will create profiles with their preferences, and the data will be gathered to be used in the Intelligent Buddy Matching algorithm. Study Buddy aims to provide students with a comprehensive web application to effectively match with like-minded individuals.

2.1 Prototype Architecture Description

The prototype architecture will consist of a server and a database. The prototype database will be similar in structure to that of the final product. Figure 4 depicts the Major Functional Components of Study Buddy where end users will be using devices with internet access to access the Study Buddy Web Application. The database will store and process the users’ information and the server will host the Study Buddy application. The Study Buddy web application will be developed using Java Enterprise Edition (Java EE). To facilitate online study groups, the application will be integrated with the online collaboration tool Google Hangouts.
A computer with Internet access and a web browser will be used to access the Study Buddy website. Google Chrome Version 72, Safari Version 12, and Microsoft Edge Version 17 will be compatible web browsers for the application. The foundation that the Study Buddy prototype will rest on will be the Java Server Faces (JSF) Framework. The JSF framework will support expression language and will enable the communication of data to and from the front end and back end server. The front-end will be written in Java, HTML, and CSS. The JSF framework will also allow for a robust and innovative user interface prototype design.

The Java Persistence API (JPA) will be used to access, and manage data between Java objects, classes and relational database tables. The prototype application will utilize a Microsoft SQL Server 2017 to store user’s personal information, and industry best practices will be used to secure the data. JSF and JPA will run in a Java Enterprise Edition (Java EE) container such as Glassfish. Glassfish Application Server version 4.1.2 will be used to host the prototype web application.
2.2 Prototype Functional Description

The Study Buddy prototype will consist of similar functionality of the real-world product. The Study Buddy Prototype will implement the majority of the algorithms required for the final product. The Intelligent Buddy matching algorithm will be altered on the prototype to match users on a reduced set of study preferences. A complete list of features is available in Table 1.

<table>
<thead>
<tr>
<th>Features</th>
<th>STUDY BUDDY Final Product</th>
<th>STUDY BUDDY Prototype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login</td>
<td>Allows user entry of authentication credentials</td>
<td>Will be implemented</td>
</tr>
<tr>
<td>New User</td>
<td>Allows a user to create an account</td>
<td>Will be implemented</td>
</tr>
<tr>
<td>Study Preference Setting</td>
<td>Allows users to set study preferences for intelligent buddy matching algorithm</td>
<td>Will be implemented with limited study preference fields</td>
</tr>
<tr>
<td>Search for buddies</td>
<td>Allows user to search for study buddies</td>
<td>Will be implemented</td>
</tr>
<tr>
<td>Create a study group</td>
<td>Allows user to create a study group</td>
<td>Will be implemented</td>
</tr>
<tr>
<td>Set wait time</td>
<td>Allows user to set wait time in case of no matched buddies found</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td><strong>GUI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Web Application</td>
<td>The way in which the user will interact with the Study Buddy application using a web browser</td>
<td>Will be implemented</td>
</tr>
<tr>
<td>Mobile Application</td>
<td>The way in which the user will interact with the Study Buddy application using their smartphone device</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td>Private Message</td>
<td>Allows users to send and receive private messages within the Study Buddy App</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td>Block buddies</td>
<td>Allows users to block buddies with different goals</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td>Partner match by subject of interest</td>
<td>Matching Study Buddies by their own subject interest</td>
<td>Will be implemented</td>
</tr>
<tr>
<td>Intelligent Buddy Matching</td>
<td>Matching Study Buddies with the proprietary algorithm</td>
<td>Will be implemented</td>
</tr>
<tr>
<td>Google Hangout Integration</td>
<td>Allows users to integrate their Google Hangouts accounts for setting meeting times and web conferencing</td>
<td>Will be implemented</td>
</tr>
<tr>
<td>Google Drive Integration</td>
<td>Allow users to share documents</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td>Slack Integration</td>
<td>Allows users to integrate their Slack accounts, allowing channels to be made to aid in communication between Study Buddies</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td>Git Integration</td>
<td>for creating repositories to share with your study buddies</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td>Codeshare integration</td>
<td>Allows users to share their code real time with their Study Buddies</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td>Schedule syncing</td>
<td>Allows users to make matches with Study Buddies based on the availability they input</td>
<td>Will not be implemented</td>
</tr>
<tr>
<td>Rate your buddy</td>
<td>Allows users to provide feedback on their Study Buddies</td>
<td>Will not be implemented</td>
</tr>
</tbody>
</table>

Table 1: Prototype Features

The study preference field will be limited due to time constraints. The feature to allow users to set wait times for study groups will not be implemented on the prototype. Block buddies
list, private messaging, rate buddy feature, and scheduling synching, will not be added to the web application prototype. Some external tools will not be integrated such as Slack, Git, Google Drive, and Codeshare due to limited development time.

The User Interface will be equipped with several features to help users navigate the Study Buddy web application. When users attempt to login, their username and password will be authenticated through the Microsoft SQL Server Management Studio. New users will have to sign up by entering their name, email, school, phone number and create a password. Once a user has logged into their account, the server will direct the user to the Main Menu, which consists of the Study Buddy questionnaire that allows them to select availability, study preferences, courses, study topic(s), group size preference, and time/location (online/in person). Users will be able to edit account information and have the option to hide or display personal information.

Users will create profiles with their preferences, and the data will be gathered and used in the Intelligent Buddy Matching algorithm to find a Study Buddy match. As stated in Section 1.1, one key feature of the Study Buddy application will be the Intelligent Buddy Matching algorithm which first uses the Preprocessing algorithm to create an initial list of matches.

The preprocessing algorithm will create a list of possible matched buddies. Once the end users enter class/subject or topic into the system, a list of people who are searching for the same class or topic will also be created. Next, the system will remove users with different availabilities and remark buddies who are on the blocked list.

The Intelligent Buddy Matching algorithm will match users based on study preferences. Study preferences will be stored in vectors and the similarity score will be measured by computing the cosine of an angle between 2 vectors. When the preprocessing is done, the system will compute a similarity score, of each study preference vector, between the user’s vector and
the possibly matched buddy’s vector. The possible matches list will be sorted according to the sum of the similarities. Figure 5 shows an example of the Intelligent Buddy Matching algorithm.

\[ \cos \theta = \frac{\mathbf{W} \cdot \mathbf{J}}{\|\mathbf{W}\| \|\mathbf{J}\|} \]

\[ = \frac{2}{\sqrt{2} \times \sqrt{3}} \]

\[ = \frac{2}{\sqrt{6}} \approx 0.8165 \]

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>User: Jamal Williams</th>
<th>User: John Crotzer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Auditory</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Reading/Writing</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 5: Intelligent Buddy Matching Algorithm

The cosine of an angle is the result of the dot product of two vectors over the magnitude of vector A times the magnitude of vector B. Two vectors with the same orientation have a cosine similarity of 1, orthogonal vectors have a similarity of 0, and two vectors diametrically opposed have a similarity of -1. In Figure 5, the two vectors have more similarity if the result is closer to 1, so with a cosine of approximately 0.8165 the two users have a strong similarity. This similarity score will be used to sort the possible buddy match list in descending order.

2.3 External Interfaces

To demonstrate the functionality of the prototype, interfaces will be used by the user to interact with the program. The three interfaces that will be discussed in detail in the following sections are: Hardware Interface, Software Interface, and User Interface.

2.3.1 Hardware Interfaces

Users will need a computer with stable internet connection to effectively interact with the prototype. No other hardware is required for this product.
2.3.2 Software Interfaces

The Java Persistence API (JPA) will be used to access, and manage data between Java objects, classes and relational database tables. The prototype application will utilize a Microsoft SQL Server 2017 to store users’ personal information such as name, email, school, phone number and password. JSF and JPA will run in a Java Enterprise Edition (Java EE) container such as Glassfish. Glassfish Application Server version 4.1.2 will be used to host the prototype web application. JPA will supply the entity annotation that marks classes that need to be saved in a database and will create the tables inside the database from the fields of the entity classes. The entity manager and its supplied methods will make basic database operations: Create Read Update Delete (CRUD) simple and easy to achieve.

Study Buddy will also integrate with the Google Hangouts API. This API will enable communication between online students and live students during study groups. Users will need the necessary web browser and stable internet in order to adequately visualize and utilize the Google Hangouts features.

2.3.3 User Interfaces

Users will interact with Study Buddy through a web browser: Google Chrome Version 72, Safari Version 12, and Microsoft Edge Version 17. The screen will display 1920 by 1080 resolution. Internet connection will be needed to interact with the web browser and the additional external APIs.