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An Estimation of Student Well-Being Using Experience Sampling

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Abstract: This paper presents a study into the well-being of students using the Experience Sampling Method (ESM). The study aims to explore the relationships between locations, activities, and social interactions with emotional states over time, the dynamic interrelations among different emotional states, and the impact of daily activities on the transitions and stability of students' emotional states. The study leverages the Ateneo Experience Sampling App (AESapp) to collect real-time data on students' emotional states, activities, and contexts. Data was collected from 104 college students over two weeks, with participants responding to daily prompts about their emotions and situational contexts. To address the research questions, the study employed data science tools and methods. Findings indicate that leisure activities and social interactions with friends and significant others enhance positive emotions like happiness and engagement. In contrast, interactions with parents and classmates can increase negative emotions such as anger and sadness. The study also highlights the emotional stability provided by structured activities like schoolwork and leisure.

Keywords: Well-being, experience sampling, happy, engaged, fear, anxiety, sadness, aesapp

1. Introduction

In recent decades, the field of positive psychology has significantly contributed to the understanding of student well-being, encompassing positive experiences, thoughts, and emotions that foster student growth (Moulton, 2022). However, well-being is not solely defined by positive emotions; negative emotions are also a crucial component of the human experience, offering valuable insights into one's environment and inner state (Fredrickson, 2001). This study utilizes emotional data as a means to provide immediate feedback about the student's current state. By analyzing emotional data alongside contextual information, we aim to identify patterns and trends in students' emotional experiences, thereby gaining insights into their overall well-being.

Traditional methods for collecting and assessing well-being include surveys, questionnaires, focus groups, and interviews. While these techniques offer valuable insights, they also possess certain limitations (Larsen & Rasinski, 2002). These limitations include retrospective or recall bias, social desirability bias, lack of context, the infrequency of data collection, and self-report errors (Ellison et al., 2020; Habets et al., 2021; Eisele et al., 2020; Van Berkela et al., 2020). Conventional methods capture well-being at a specific point in time but fail to capture the nuances and contextual factors impacting student well-being. Consequently, these limitations can affect the accuracy and reliability of the data and analyses.

To address these limitations, this study introduces the Experience Sampling Method (ESM) in data collection. ESM is a structured self-report diary technique used to collect data on participants' experiences and behaviors in their natural environments in real-time, multiple times a day, at random intervals (Myin-Germeys & Kuppens, 2022). The advantages of ESM include increased ecological validity, reduced recall bias, detailed temporal data, context-sensitive insights, enhanced participant engagement, and the ability to capture rare or transient events (Csikszentmihalyi & Larson, 2014; Shiffman et al., 2008; Reis, 2012; Hektner

et al., 2007; Bolger et al., 2003). It is noteworthy that ESM is scarcely utilized in Philippine research (Rodrigo et al., to appear), and it has not been applied extensively in positive education, highlighting the need for more ESM studies in this research area (Jacques-Hamilton et al., 2022). This method was selected for its ability to capture real-time data on human behavior during daily activities (Rhee et al., 2020) and to introduce this data collection method to the Philippine educational context.

This study is part of a broader ESM study using the Ateneo Experience Sampling App (AESapp) to capture data from college students randomly once a day over two weeks. The AESapp's ESM protocol enables the recording of students' emotional states (happiness, engagement, anger, anxiety, and sadness) in near real-time. It also gathers contextual data such as online status, online activity, locations, activities, and social interactions, which are essential for ESM analyses. This approach provides researchers with a detailed understanding of how students' emotions respond to their immediate environments (Csikszentmihalyi & Larson, 2014). The study aims to address the following research questions:

1. What is the relationship between locations, activities, and social interactions with emotional states over time?
2. How do different emotional states relate to each other over time among students?
3. What is the impact of daily activities on the transitions and stability of students' emotional states?

The results of this study can assist school administrators in designing programs and creating a supportive environment that enhances positive emotional experiences for students, thereby contributing to their overall emotional well-being and mental health.

2. Review of Related Literature

2.1 Experience Sampling Method

The study introduces the Experience Sampling Method (ESM) as an alternative approach. ESM involves systematic self-reporting at random times during a normal week from a sample of individuals, allowing for the creation of a dataset of daily life experiences for study (Larson & Csikszentmihalyi, 1983). Since its development, ESM has been used in various research areas, including studies on adolescents (Csikszentmihalyi & Larson, 1984), individuals with schizophrenia (Delespaul & deVries, 1987), women with cancer (Hedricks & Neville-Jan, 1995), people with depression and anxiety (Schimmers et al., 2020), and youth (Hunter & Csikszentmihalyi, 2003; Jacques-Hamilton et al., 2022).

Frequent data collection in ESM studies can be burdensome and intrusive (Dejonckheere & Erbas, 2022). The repeated prompts for data gathering may interfere with participants' daily routines and be perceived as intrusive. This burden can lead to reduced compliance and increased dropout rates.

Designing the ESM protocol is crucial for the success of any ESM study. Key ESM parameters include study duration, assessment frequency, sampling scheme, questionnaire density, and study device (Vachon et al., 2019; Dejonckheere & Erbas, 2022; Kuppens et al., 2010; Shiffman et al., 2008; Van den Bergh & Walentynowicz, 2016; Eisele et al., 2020; Trull & Ebner-Priemer, 2013; Stone et al., 2003). The specification of these parameters primarily depends on the research questions, while considering the need to minimize intrusiveness and burden (Dejonckheere & Erbas, 2022).

2.2 Ateneo Experience Sampling App

This study is part of a broader research project titled "An Experience Sampling Study of Student Emotional Life," The study utilizes AESapp to collect data from college students at a large university in the Philippines. The AESapp aims to address the limitations of conventional methods and mitigate challenges associated with ESM studies. This research is one of the first ESM studies focusing on the well-being of Filipino students (Rodrigo et al., to appear). The design protocol followed by AESapp is outlined in Table 1.

Table 1. *Summary of ESM protocol of AESapp*

Parameters	Description
Sample	104 participants
Study Duration	14 days
Assessment Frequency	1x a day
Sampling Scheme	Randomly between 8:00 AM to 12:00 Midnight
Questionnaire Density	10 questions; 45 minutes to respond, else marked 'NO_RESPONSE'
Device	Smartphone (iOS and Android)

The AESapp administers ten questions at each prompt, as detailed in Table 2. Five questions assess emotional states, where participants rate their levels of happiness, engagement, anger, fear, and sadness using a Likert scale from 0 (Not at all) to 5 (Very much). The remaining five questions gather contextual information regarding online status, online activity, location, offline activity, and social interactions. Answers to questions 7 to 10 are selected from categorical lists.

Table 2. *Ten (10) questions from AESapp*

Questions	Response Options
1. How cheerful, happy, or good do you feel right now?	0 to 5
2. How involved, interested, or engaged do you feel right now?	0 to 5
3. How angry, irritated, or frustrated do you feel right now?	0 to 5
4. How anxious or fearful do you feel right now?	0 to 5
5. How sad, low, or down do you feel right now?	0 to 5
6. Before you started answering this survey, were you online?	Yes or No
7. What were you doing online?	Scrolling on social media, Watching videos, Games, School/Work, Content creation, Browsing for information/entertainment
8. Where are you right now?	At home, In school, Other
9. What are you doing right now?	Schoolwork, Leisure, Resting, Eating, Talking with others, Sports/Exercise, Other
10. Who are you interacting with right now?	No one, Classmates, Friends, Parents, Siblings, Teacher, Significant other/Partner/Boyfriend/Girlfriend, Other

All participant information and responses are securely stored in a cloud-based database that complies with the university's data privacy policies. Two separate databases are maintained: one for participant information, which includes a user ID (userUID), nickname, full name, device, and email, and another for participant responses, which consists of the responses to the ten questions, user ID, timestamp (date and time), and completion status (indicating whether the response was completed or delayed).

3. Analysis and Results

3.1 Participants and Procedures

The researchers conducted room-to-room recruitment based on the agreed schedule the concerned teachers gave. Aided by a slide deck and a short video, the students were oriented with the study's purpose, the ESM protocol, and how they will use the AESapp. At the end of the recruitment, the researcher presented the QR code that led the students to a Google Form. This form contains the consent and links to download the app. When downloaded, a simple signup process asked the students for their nickname, full name, student.ateneo.edu email account, and unique password for the app. After this, an email with a verification link was sent to their student.ateneo.edu account for final confirmation that signaled the start of data collection.

The AESapp was programmed to notify the students to answer their emotional levels and situational contexts (see Figure 1 for an example of how questions are displayed) after which students were asked to respond to the survey within 45 minutes, if possible. If the student was notified but unable to answer within the response delay, the feature 'finishReason' will be marked 'NO_RESPONSE'.

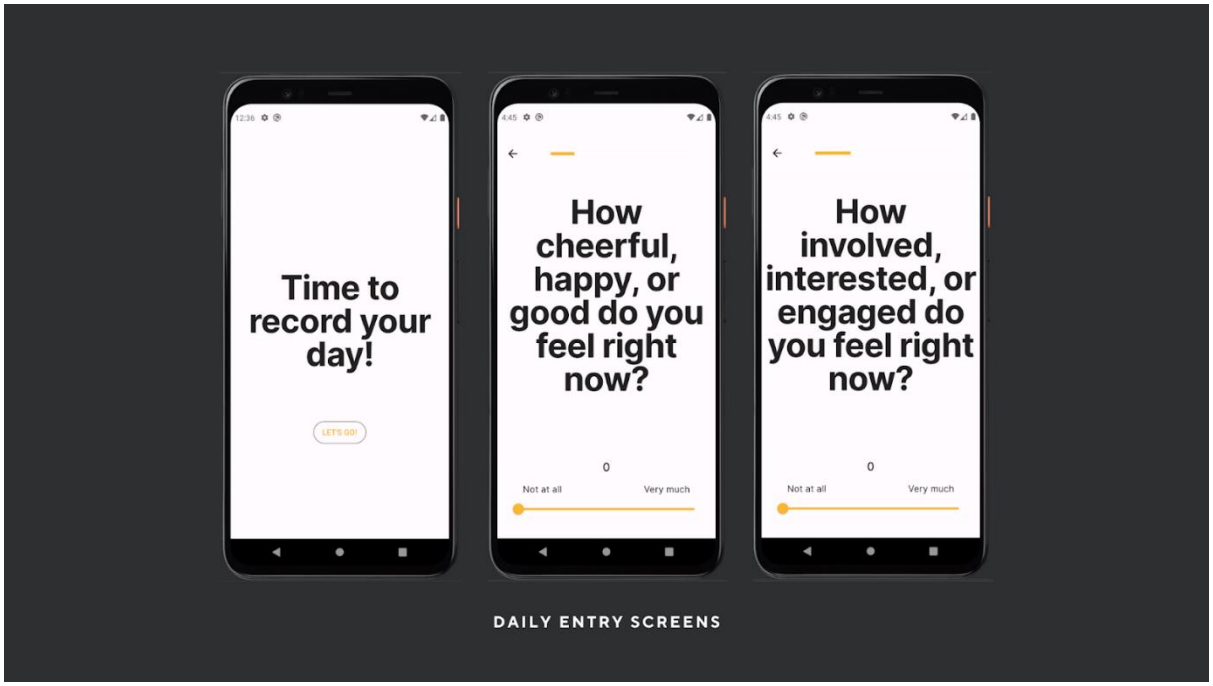

Figure 1. Sample of data entry screens

3.2 Data

The research team recruited a total of 53 classes with an average of 30 students per class. However, only 165 students downloaded and registered through the AESapp. After preprocessing and combining the datasets from the three waves of data collection, we have a total of 618 data points from 104 participants (female=65; male=39; mean=52; std=18.30). 164 entries were marked 'NO_REPONSE'. The participants averaged 5.33 entries with a standard deviation of 3.64 and a maximum of 14 entries.

3.3 Relationship of Emotions and Context

RQ1 asks: What is the relationship between locations, activities, and social interactions with emotional states over time? While substantial research exists on factors influencing student well-being, less is known about the impact of situational contexts such as location, activity,

and social interactions on momentary well-being (Holtzman & O'Connor, 2011). This study addresses this gap by analyzing how these situational contexts collectively influence well-being over time.

Multilevel Modeling (MLM) is employed to address RQ1 as it is one of the typical methods of choice for analyzing ESM data (Bolger et al., 2013). This method allows for the examination of how various factors influence students' emotional states while accounting for the hierarchical structure of the data. In this study, each emotion was modeled as the dependent variable with contextual information such as location, activity, and companion. The reference categories for the contextual variables were 'Other' for location (n=326), 'Schoolwork' for activity (n=132), and 'No one' for companion (n=312). These categories were chosen due to their high frequency, allowing for a meaningful reference point. Only significant results with a p-value less than 0.05 are reported (see Table 3).

Table 3. *Significant Result of Multilevel Modeling*

Emotional State	Factor	Coefficient	Significance
Happiness	Activity: Leisure Activities	0.59	$p < 0.001$
	Activity: Talking with Others	0.65	$p < 0.001$
	Activity: Eating	0.73	$p < 0.001$
	Companion: Friends	0.34	$p < 0.05$
	Companion: Significant Other	0.40	$p < 0.05$
	Companion: Siblings	0.65	$p < 0.05$
Engagement	Activity: Leisure Activities	0.44	$p < 0.05$
	Activity: Talking with Others	0.43	$p < 0.05$
	Companion: Friends	0.37	$p < 0.05$
	Companion: Classmates	0.65	$p < 0.01$
	Companion: Siblings	0.92	$p < 0.01$
Anger	Activity: Talking with Others	-0.37	$p < 0.05$
	Activity: Eating	-0.60	$p < 0.05$
	Companion: Parents	0.61	$p < 0.001$
	Companion: Classmates	0.47	$p < 0.05$
Anxiety	Activity: Resting	-0.46	$p < 0.05$
	Companion: Classmates	-0.57	$p < 0.05$
Sadness	Location: School	0.67	$p < 0.01$
	Activity: Leisure Activities	-0.44	$p < 0.05$
	Activity: Talking with Others	-0.52	$p < 0.01$

The result shows that leisure activities consistently increase happiness and engagement while decreasing sadness, underscoring the importance of balancing academic work with leisure. Interactions with friends and significant others enhance positive emotions (happiness and engagement), while interactions with parents and classmates can increase negative emotions (anger and sadness), suggesting a need for improved communication and stress management strategies. Notably, the school environment is associated with increased sadness, indicating the need for a more supportive and engaging atmosphere to enhance student well-being.

3.4 Relationship among Emotional States

The RQ2 asks: How do different emotional states relate to each other over time among students? Traditional assessments focus on examining individual emotional states and their effects on student well-being (Kuppens et al., 2012). There is a gap in understanding the dynamic interactions between different emotional states over time (Lütkepohl, 2005).

To understand the relationships between different emotional states, correlation coefficients (Pearson) are analyzed. Based on the Positive and Negative Affect Schedule (PANAS), positive (happy, engagement) and negative (anger, anxiety, and sadness) emotions should negatively correlate (Watson & Tellegen, 1988). VAR is then used to capture the dynamic interdependencies among multiple emotional states, expressing each variable as a linear function of its past values and other variables (Hamilton, 1994). An additional Granger Causality Test was conducted to determine whether one emotional state can predict another, identifying causal relationships between emotional states.

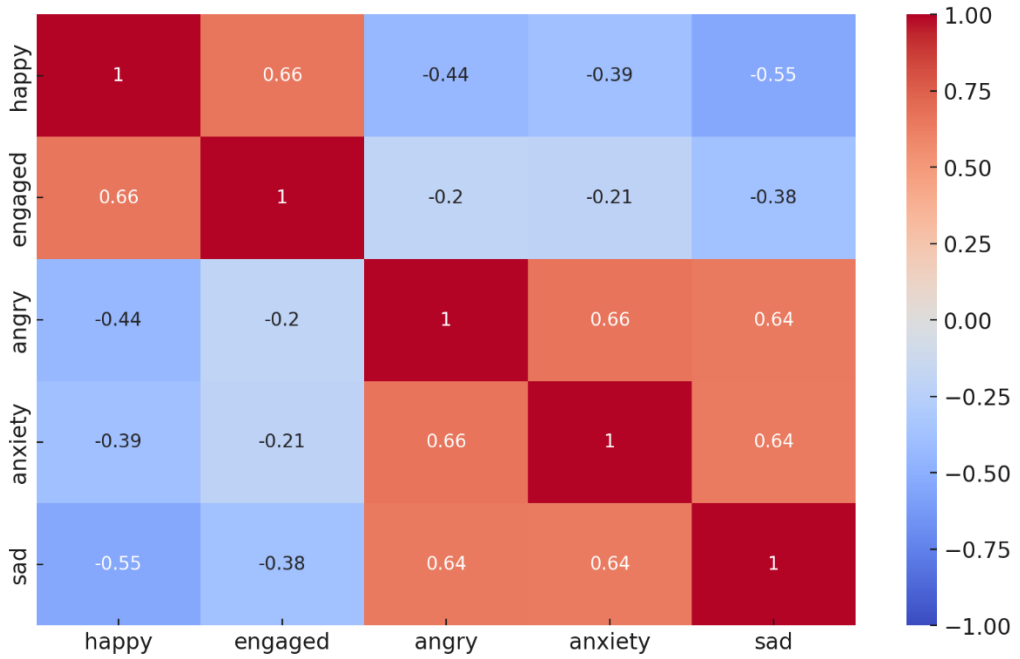

Figure 2. Correlation Matrix of Emotional States

The correlation matrix (see Figure 2) revealed a balance between positive and negative emotions:

- Happiness is negatively correlated with anger (r = -0.439), anxiety (r = -0.366), and sadness (r = -0.536), and positively correlated with engagement (r = 0.678).
- Engagement is positively correlated with happiness (r = 0.678) and negatively correlated with sadness (r = -0.381).
- Anger, anxiety, and sadness are positively correlated with each other (ranging from r = 0.637 to r = 0.668).

The VAR model, with lag 5, captured linear interdependencies among time series. Significant coefficients were found up to lag 2, with happiness significantly influenced by its past values at lag 1 (L1.happy = 0.354, $p < 0.01$) and negatively influenced by anxiety at lag 1 (L1.anxiety = -0.093, $p < 0.05$). Engagement, anger, anxiety, and sadness also showed significant autocorrelation with past values.

Granger causality tests indicated no significant causality between emotional states at both lag 1 and lag 2, with all p-values exceeding 0.05. There was no significant prediction of happiness by other emotional states, although anxiety showed a marginal effect on sadness at lag 2 (p = 0.0786).

3.5 Relationship between Daily Activities on Emotional States

RQ3 asks: What is the impact of daily activities on the transitions and stability of students' emotional states? Conventional methods are limited in capturing the dynamic nature of emotions (Hektner et al., 2007), leading to a limited understanding of how daily activities affect transitions between different emotional states and their stability over time. This study fills this

gap by exploring the processes and mechanisms by which daily activities lead to changes in emotions, whether they cause emotional states to shift or remain stable.

A Transition Matrix models the probabilities of transitioning from one state to another in a given period, providing insights into the likelihood of emotional state changes based on activities. These patterns can highlight whether the activity is emotionally stabilizing or challenging for students. These transition matrices were fed to Markov Chain Analysis (HMM) which would identify the probability of transitioning from one emotional state to another based on daily activities (Ebner-Priemer & Trull, 2009).

Lastly, we use the Kaplan-Meier Estimator, a non-parametric statistic, that estimates the survival function from lifetime data (Davidson-Pilon, 2019). In the context of emotional states, survival analysis studies the duration and stability of emotional states, helping to understand how long students remain in a particular emotional state before transitioning to another (ex. students remain ‘happy’ at state 3).

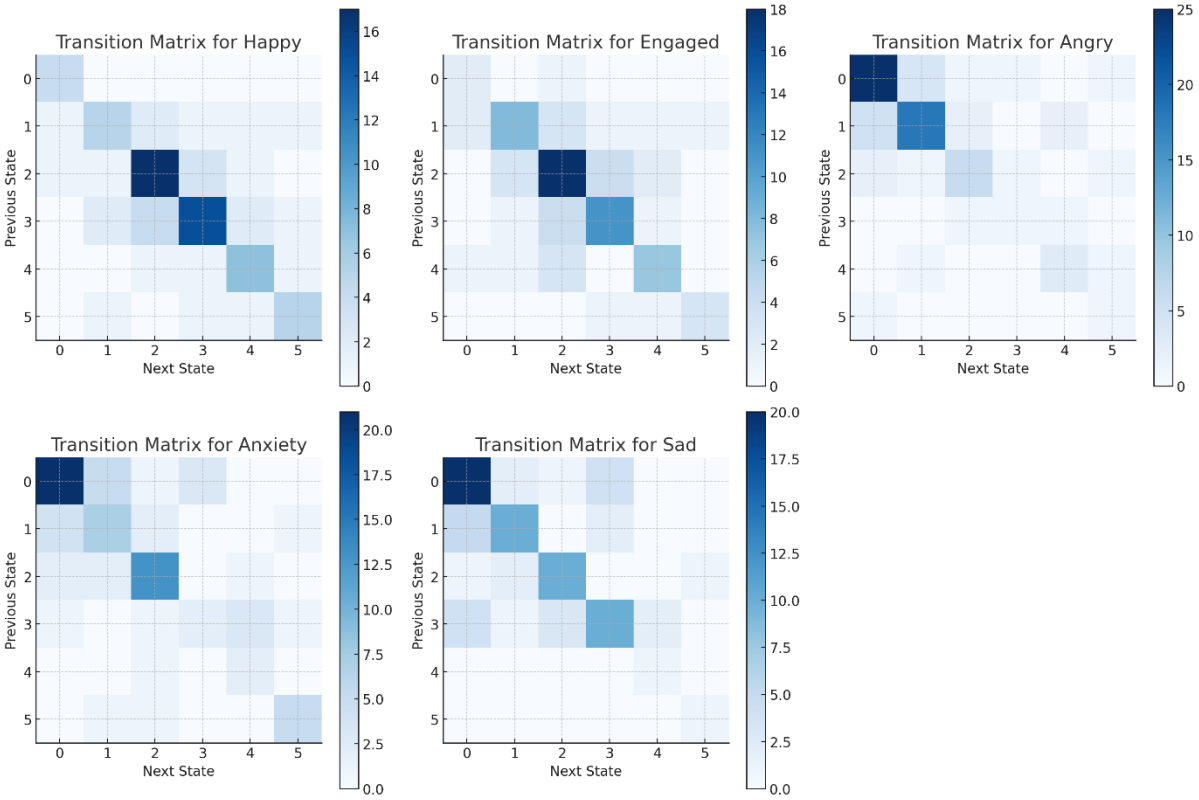

Figure 3. Transition Matrix of Emotional States for Schoolwork

To understand how daily activities influence the transitions and stability of students' emotional states, we generated transition matrices for each activity and emotional state. These matrices captured the transitions of emotional states across different activities. For example, Figure 3 shows the transition matrices of emotional states for the activity ‘Schoolwork’ represented by heatmaps. For the activity ‘Schoolwork’, we observe some consistency in emotions like "happy" and "engaged," with more transitions occurring for states like "angry" and "anxiety," suggesting variability in these emotions during the activity.

The analysis revealed that emotional stability is a common theme, particularly in mid-range happiness and engagement states (levels 2 to 3) and lower anger, anxiety, and sadness states (levels 0 to 1). Structured activities like schoolwork and leisure tend to have higher emotional stability, while activities like resting and unspecified (‘Other’) activities show more variability. Eating, sports/exercise, and talking with others contribute to maintaining stable emotional states, highlighting the importance of these activities in students' daily emotional regulation.

4. Conclusion and Recommendations

In this study, we highlight the use of the ESM in doing an estimation of student well-being, addressing the limitations of conventional well-being assessment methods. By employing the Ateneo Experience Sampling App (AESapp), data on students' emotional states, activities, and situational contexts were gathered and demonstrated student engagement. The use of data science tools and methods such as MLM, VAR, and HMM provided insights into the relationships and dynamics among emotional states over time.

In global research, ESM has been widely utilized, particularly in studies on adolescent and student well-being in Western contexts (Csikszentmihalyi & Larson, 1984; Jacques-Hamilton et al., 2022). In contrast, well-being studies in the Philippine context have predominantly focused on broader sociocultural factors, such as family dynamics and academic pressures, often relying on traditional survey methods (de Guzman & Choi, 2017). As such, this study represents one of the early efforts to apply ESM within the Philippine educational landscape, offering a novel approach to understanding student well-being in real time.

In RQ1 we look for the relationship between locations, activities, and social interactions. The finding that leisure activities enhance happiness and engagement while reducing sadness and that interactions with friends and significant others boost positive emotions is consistent with prior research (Dockray et al., 2010; Larson, 2000). Studies have shown that leisure activities and social support are critical for enhancing well-being, particularly among students who face academic and social pressures (Brajša-Žganec et al., 2011). However, the finding regarding the negative impact of interactions with parents and classmates on emotions like anger and sadness adds a nuanced understanding, particularly in the context of cultural expectations and the pressure of academic environments in the Philippines (de Guzman et al., 2017).

RQ2 investigates how different emotional states relate to each other. The findings on the balance between positive and negative emotions resonate with the existing literature on emotional regulation and its impact on well-being (Gross & John, 2003; Larsen, 2000). While previous studies have identified similar patterns, the use of data science methods like VAR provides a more detailed analysis of these dynamics.

RQ3 investigates how daily activities impact the transitions and stability of students' emotional states. The role of daily activities in stabilizing or destabilizing emotional states has been documented in prior research (Oishi et al., 2009). This study reinforces the importance of activities such as eating, exercising, and socializing in maintaining emotional stability, which is crucial for managing stress and promoting well-being among students (Kanning & Schlicht, 2010). The recommendation for schools to encourage such activities is well-supported by existing evidence, which suggests that structured programs promoting these activities can significantly enhance student well-being (Bridger et al., 2017).

Based on the findings, the following recommendations are presented:

- Data Quality Improvement: There is a need to address missing data by improving recruitment strategies and reviewing the AESapp protocol and application to enhance data quality.
- Program Development: Schools should encourage leisure activities and positive social interactions, especially for the college students in this study. Programs should focus on better communication and stress management, especially when dealing with parents and classmates, to improve student well-being.
- Future Research: Future studies should use ESM in different educational settings and with various student groups. Long-term ESM studies can give better insights into how different interventions affect student well-being and other parts of student life over time.

We stress the importance of student well-being and mental health. By adopting these recommendations, the use of ESM can complement and enhance traditional methods, offering a deeper understanding of student well-being and providing more effective support. This, in turn, can lead to better academic performance, healthier social interactions, and an overall improvement in quality of life. Additionally, it aligns with educational theories that emphasize emotional intelligence and well-being as essential skills to be cultivated in students. On a

practical level, teachers can apply these findings by integrating more collaborative and student-centered learning approaches, which may help alleviate negative emotions associated with formal academic settings.

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