

## Investigation of Pre-Service Science Teachers' Social Media Usage Preferences:

### An Integrated Structural Equation Modelling and Artificial Neural Network Approach in the Context of Creativity and the Big Five Personality Traits

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#### ABSTRACT

Today, social media is widely used for many purposes, from socialization to communication and education to commerce. This study examines the social media use of pre-service science teachers in the context of creativity and the Big Five Personality Traits Theory. For this study, the participants were pre-service science teachers selected to represent the target group for examining the research objectives. Data from science teachers included in the study group were collected through an online questionnaire using purposive sampling, allowing for a focused examination of specific characteristics within this group. The data obtained from the questionnaires were analyzed and interpreted using an integrated SEM-ANN method. The findings obtained as a result of the study revealed that creativity and personality traits in the Big Five Personality Traits Theory affect the social media use of pre-service science teachers.

#### KEYWORDS:

Social media, theory of the big five personality traits, Science teachers, creativity, structural equation modeling, neural network analysis

#### Article history:

Received: May 24, 2024

Received in revised form: December 30, 2024

Accepted: December 30, 2024

ISSN 2354-0036

DOI: 10.2478/ctra-2025-0002

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## INTRODUCTION

People's communication habits have changed significantly with the rapid development of information and communication technologies. In this process, many communication tools such as telephone, radio, television, and even computers have allowed people to communicate with each other throughout time. At the beginning of the 21<sup>st</sup> century, the opportunities offered by Web 2.0 technology paved the way for the emergence of social media networks, which function as mass communication tools today (Ekemen, 2022). In this process, social media networks are online environments and have become an indispensable part of our lives by allowing global communication individually or as a community. Social media networks are internet-based systems where users can view their names, profiles, and posts and share them in a restricted system by creating an open or semi-open profile (Boyd & Ellison, 2007).

Research shows that most studies conducted with young people focus on social media use (Deniz & Tutgun-Unal, 2019; Tutgun-Önal & Deniz, 2016; Tutgun-Önal, 2020a). Many studies conducted in this context have investigated the frequency, purposes, and preferences of different groups' social media use. It has been questioned whether it is used for particular purposes, such as education, reading news, meeting, and playing games (Deniz & Tutgun-Unal, 2019; Tutgun-Önal, 2020a, 2020b; Celik et al., 2021; Swart, 2023).

The popularity of social media networks has enabled them to be used by many professional groups, including teachers, for entertainment, communication, playing games, and personal and academic development. When the studies on teachers' use of social media networks were examined, it was determined that there were many studies in the literature on social media networks such as Twitter (Carpenter et al., 2023), Facebook (Kelly & Antonio, 2016), and Reddit (Karnovsky & Gobby, 2024). Teachers use social media networks to share ideas and communicate with colleagues outside school. For example, it has been determined that teachers use Pinterest to get ideas, organize, and share in-class subject materials (Schroeder et al., 2019). Teachers can use these platforms to build professional communities and create new communities of practice (Hydnman & Harwey, 2019). Twitter, for example, has recently been used extensively by professional organizations, protests, and actions (Staudth Willet, 2019).

This study examines participants' social media use in the context of the five essential personality traits and creativity theory. For this purpose, within the scope of the study, an integrated model in which creativity is integrated into the Five Big Personality Traits Theory was preferred for pre-service teachers' use of social media. Figure 1 shows the theoretical model proposed within the scope of the research.

In this study, discussion of the relationship between social media use and creativity and the Five Factor personality traits (extroversion, openness, agreeableness, conscientiousness, and neuroticism) has a unique significance, particularly for science teacher candidates. Basis: Extraversion—Extroverts tend to be more talkative, leading to more sharing on the platform. Openness—This trait can correlate with creativity, allowing for new ideas that enable the production of fresher content.

Learning by doing enhances willingness to cooperate and develop a routine for producing regular content, which can benefit academia. Creativity—Makes teaching resources creative and aids in developing a more effective social media learning tool. Such personality traits and creative ability will later play a role in the content that future teachers can promote via social networks, supporting their professional development. Therefore, science teacher candidates in this study, with higher perception scores regarding using digital tools in their classes and a more positive influence above the significance level, helped use social media effectively to reveal qualified learning-education practices *via* social media

## THEORETICAL BACKGROUND

### The Big Five Personality Trait Models

Although no generally accepted definition of personality exists, the research mainly focuses on the five-factor personality model. This theory (McRae & Costa, (1987), is a comprehensive explanation and observation of personality traits and classification of personality traits in five basic dimensions (McCrae & Costa, 2006; Demirci et al., 2007). Five-factor personality model: It is a model consisting of five dimensions: openness, conscientiousness, extraversion, agreeableness and neuroticism (Burger, 2006; Goldberg, 1990; McCrae & Costa, 2008).

Openness is a personality trait that distinguishes creative and imaginative individuals from habitual individuals who look at the world superficially. In other words, openness to experience refers to being unique and inclined to have different experiences (Costa & McCrae, 1992). Individuals with high openness are in search of traditional and non-simple methods against stagnation (Thoms et al., 1996); they question authority (Rothmann & Coetzer, 2003) and want to have different experiences intellectually and socially (Bruck & Allen, 2003).

Conscientiousness refers to how individuals take control of their instincts. This personality dimension describes the degree to which a person is achievement-oriented, trusted, disciplined, and responsible (McCrae & John, 1992, p. 178). Individuals with high conscientiousness are known for their strong ability to regulate purposeful impulses. They focus on details, strive to complete tasks precisely, and approach responsibilities diligently. They are also less likely to shy away from responsibilities, demonstrating a dependable and accountable nature (Bruck & Allen, 2003; Costa & McCrae, 1991). These individuals, who focus on success and desire to achieve more challenging goals, are highly efficient, act rationally in their decision-making processes, and show commitment to the organization by exhibiting ethical behaviors within the organization (Barrick et al., 1993; Costa & McCrae, 1991).

Extraversion refers to people who are primarily social, enjoy being with others, and are energetic, happy, and assertive. Dominant extraversion in individuals positively affects the work environment and working environment (Barrick et al., 1993; Alarcon et al., 2009).

Agreeableness reflects an individual's ability to maintain harmonious and cooperative relationships with others, emphasizing empathy, kindness, and a willingness to get along. (McCrae &

John, 1992; Zellars et al., 2000). People with a high agreeableness factor are reliable, meek, truthful, self-sacrificing, dignified, optimistic, willing to compromise with other individuals, and reliable and collaborative (Bono et al., 2002). Agreeable individuals behave according to the structure of their environment. In the face of any adverse situation, they act moderately and calmly and seek a solution (Madran & Akdoğan, 2010). Agreeable individuals demonstrate a strong ability to collaborate within group settings due to their emphasis on fostering mutual understanding and striving toward shared objectives. This trait is often accompanied by a pronounced sense of loyalty to their affiliated groups, alongside a readiness to adhere to established norms and expectations. In the context of the Big Five Personality Theory, agreeableness encapsulates characteristics such as altruism, trust, compliance, and cooperation, all of which contribute to effective teamwork and harmonious interactions within organizational frameworks (Tran, 2012).

Neuroticism is related to emotional balance. Neurotic individuals tend to experience negative emotions, such as anger, anxiety, frustration, grief, and fear. In this respect, individuals with a high level of neuroticism are known as introverted, angry individuals who do not trust anyone (Costa & McCrae, 1995). Research looking at the correlation between Big Five personality traits and social media usage found that these characteristics notably impact social media behavior (Ross et al., 2009; Correa et al., 2010; Amichai-Hamburger & Vinitzky, 2010; Ryan & Xenos, 2011; Moore & McElroy, 2012; Hughes et al., 2012). When faced with complex and unsettling situations, neurotic individuals who cannot maintain their internal balance experience such negativities as anxiety, anger, and depression, and they tend to lose their self-confidence (Bitlisli et al., 2013) and move away from the conditions that cause this situation (Puher, 2009).

## **Creativity**

A simple definition of creativity refers to any new and appropriate product, such as an idea, solution, artwork, or story (Kaufman & Sternberg, 2007). A new product could have yet to be considered (i.e., generating electricity in a remote village using an air turbine). A suitable product, on the other hand, is logical, practical, and valuable. The essence of creativity is manifested in the combination of new and appropriate components.

A literature review on creativity shows that we face a complex and multifaceted phenomenon. Researchers have studied creativity not only in a product-oriented way but also with a focus on creative processes and related personality dimensions (Feist, 2010; Rahimi & Shute, 2021). Multiple theories of creativity have been developed, various moderators (e.g., age, gender, culture) have been identified, and creativity has been defined in different contexts (e.g., industry, education, sports). During this period, the use of social media and studies on creativity have increased significantly (Upshaw et al., 2021).

Although there are indications that the link between social media and creativity is not yet fully understood, some approaches argue that social media negatively affects creativity (Upshaw et al., 2021). Runco (2015) claimed that social media inhibits creativity and called this situation a “crisis of creativity.” A study of design students found that social media is associated with creative expression

(Chai & Fan, 2018). According to the study, a positive correlation was found between accessibility to and functionality of social media and the ability to capture inspiration and challenge. However, it has been noted that excessive use of social media can interfere with real-world understanding and inspiration (Chai & Fan, 2018).

Manca and Ranieri (2016) suggest that social media provides the functions of recording, storing, instant sharing, and exchanging that facilitate the capture of inspiration. However, it is emphasized that social media makes the audience feel the need to appeal to and garner likes instead of expressing the artist's artistic vision. The fact that the source of verification of the work produced by the artist is outside is considered as emptying of the content of creativity (Agamben, 1999; Benjamin, 2018).

While numerous studies have explored the influence of social media on creativity, the inverse relationship—how creativity shapes social media use—remains under-researched. To address this gap, our study builds upon the theoretical framework of the Five-Factor Personality Traits Model, which offers a reliable basis for understanding user behavior on social media. Personality traits significantly affect individuals' preferences and habits on these platforms, shaping their communication styles and the types of content they create and share. Additionally, the dynamic relationship between creativity and social media warrants attention, as these platforms can simultaneously foster and constrain creative expression. By examining how personality traits and creativity collectively influence social media engagement, this research seeks to advance the understanding of both personality theory and creativity studies while addressing an overlooked area in the existing literature. Although the theoretical model presented here defines the Five-Factor Personality Traits and Creativity separately, emphasizing the connection between these structures will strengthen the model. Research indicates that some personality traits impact creativity; for instance, openness is strongly linked to creativity, while conscientiousness fosters discipline in creative projects (Akpur, 2024). These interactions allow us to examine the influence of traits and creativity on social media behavior within a more comprehensive framework.

## Hypotheses

Considering the literature presented within the scope of the study, the following hypotheses emerged:

- H1: Agreeableness predicts pre-service teachers' social media usage objectives.
- H2: Conscientiousness predicts the purpose of pre-service teachers' use of social media.
- H3: Extraversion predicts the purpose of pre-service teachers' use of social media.
- H4: Openness to experience predicts pre-service teachers' social media usage purposes.
- H5: Neuroticism predicts pre-service teachers' social media usage purposes.
- H6: Does creativity predict the purpose of pre-service teachers' use of social media?

Such hypotheses find support through literature, showing that both personality traits and creativity influence the purposes of social media use:

- H1: Agreeableness—People with high agreeableness are likelier to foster positive relationships on social media platforms, gravitating toward content that promotes cooperation and social interaction (Moore & McElroy, 2012).
- H2: Conscientiousness—Individuals high in conscientiousness often use social media for professional or educational goals, displaying more planned and goal-oriented social media behavior (Bruck & Allen, 2003).
- H3: Extraversion—Those who are extroverted and seek social connections tend to be more active on social media, with studies like Ryan and Xenos (2011) indicating that extraversion correlates with increased social media engagement.
- H4: Openness—People with high openness Individuals who exhibit high levels of openness often engage more actively on social media platforms in search of new ideas and sources of creative inspiration. Their presence tends to be especially noticeable on visually dynamic and innovative platforms, where creativity and discovery are central. These users not only consume content but also participate in creating, sharing, and interacting with material that aligns with their imaginative tendencies (Ross et al., 2009).
- H5: Neuroticism—Neurotic individuals may prefer social media as a source of emotional support, helping to ease anxiety through passive observation or supportive content (Correa et al., 2010).
- H6: Creativity—Creative individuals use social media to share innovative ideas and artistic expressions, with creativity fostering collaboration and interaction in the social media space (Chai & Fan, 2018; Manca & Ranieri, 2016).

These hypotheses demonstrate that social media use can vary according to personality traits.

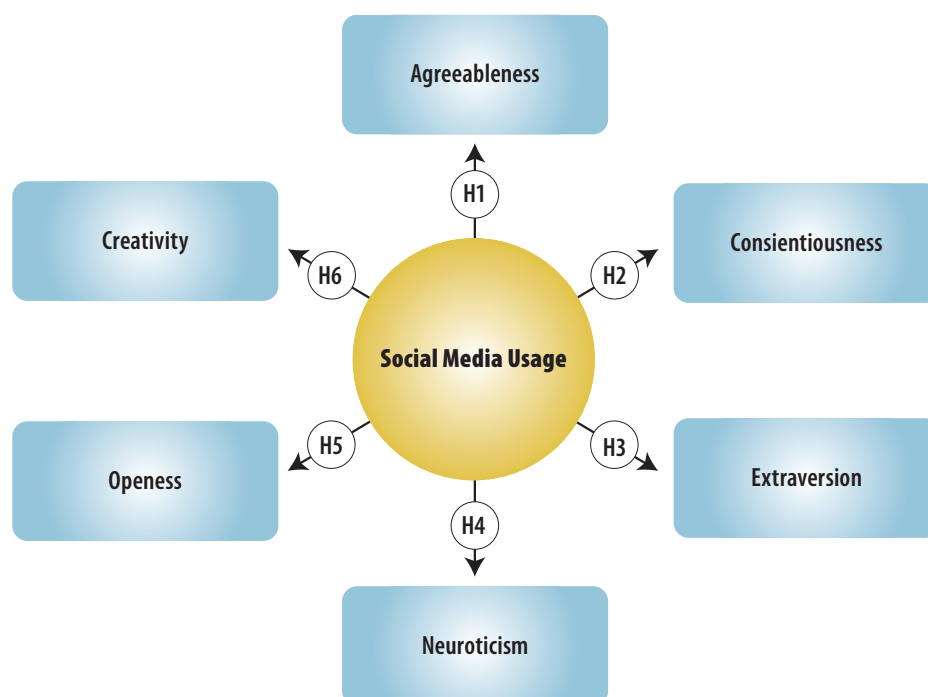


Figure 1. Theoretical model of the research

## METHODOLOGY

### Research Objective and Tasks

Based on the research problem, the objective of this empirical research is to investigate the influences of the Big Five personality traits and creativity on the use of social media. This research also aims to show how prospective teachers' use of social media is influenced by their five major personality traits (agreeableness, conscientiousness, extraversion, neurocism and openness) and their disposition toward creativity. A combined model of two theoretical frameworks was used in this research to understand whether personality traits and creativity are the factors influencing the purpose of social media use.

Therefore, the tasks that have been undertaken in this study are as follows:

- To examine the effects of Big Five Personality Traits and creativity tendencies on social media use among pre-service teachers.
- To determine whether significant relationships exist among personality traits, namely agreeableness, conscientiousness, extraversion, neurocism and openness to Experience and the use of social media.
- To disclose whether creativity tendencies determine the purposes of using social media.
- To analyze the personality traits that correspond more to the use of social media by pre-service teachers in the context of the research hypotheses.
- Based on this, develop suggestions for educators in associating social media usage with creative processes.

To this end, the present study, which falls in line with the stated purposes, aims to pinpoint those personal and creative factors that will eventually present consequences of the use of social media by pre-service teachers and create a framework for using social media in education in return from the obtained results. The findings obtained in this research will go a long way in explaining how the utilization of social media relates to personality traits and creativity within the bounds of education. This dataset for this study was collected during the spring academic year 2022–2023.

### Participants

The study sample consisted of prospective science teachers at two universities in Turkey. Individuals who met specific criteria were selected using purposive sampling. Participation was entirely voluntary, with students being provided with detailed information about the confidentiality of their data and the purpose of the study. This choice was made because the research aimed to evaluate the experiences and opinions of a specific group of prospective science teachers. Data were collected using a cross-sectional approach through an anonymous online survey hosted on a web-based platform like Google Forms. Participants were informed that the survey would take approximately 25 to 40 minutes. The researchers distributed questionnaires randomly; however, 6.6% were re-

turned incomplete, leading to a response rate of 93.4%. As a result, the sample size used to test the study's hypotheses was sufficient for structural equation modeling (Chuan & Penyelidikan, 2006).

We have derived the hypotheses from the theories, paraphrasing their wording to suit the electronic learning context. A confirmatory factor analysis was performed to confirm the measurement model. Then, refinements in the final structural model were made using Structural Equation Modeling to test the hypotheses of the theoretical construct and improve the model's fit. Table 1 presents the age distribution of the participants, as well as the distribution of their class levels and the amount of time they spent on social media platforms.

The key to this approach is the powerful SEM-ANN technique, which helps researchers explain complex relationships and dig deep into the analysis. SEM is a statistical method generally used in psychology, education, and social sciences. The technique is based on confirmatory factor analysis and is suitable for testing indirect relationships and causal connections among variables. Only in SEM analysis are latent variables examined with observed variables, which increases the model's accuracy. Conversely, ANN is an artificial learning model that works like the human brain. Artificial neural networks are robust in pattern recognition and data classification. So, the ANN provides flexibility and accuracy in analyzing the relationship between variables determined in SEM. Thus, the two-stage analysis process of SEM-ANN factorizes the strength of both methodologies to provide corresponding comprehensive and reliable results.

The reasons for the choice of this method are as follows:

**Holistic Theoretical Modeling with SEM:** SEM is used in testing relationships between observable and latent variables, and this modeling is ideal for verifying or validating theoretical frameworks (Hair et al., 2017). SEM supports complex relationship analysis by allowing the understanding of the indirect and direct effects between the variables.

**Enhanced Understanding of Relationships with ANN:** ANN is mighty in nonlinear and complex data. The complex relationships present within SEM are processed by utilizing ANN, which can deliver a more detailed analysis of those relationships. Moreover, through its ability to learn adaptively, ANN provides more accurate results by learning the complex structure present in data (Yegnanarayana, 2009).

**Higher Prediction Power:** Since SEM targets the investigation of cause-effect relationships, ANN increases prediction performance. Thus, the combination of SEM-ANN ensures theoretical validity from the model, offering high accuracy in its use for making predictions. It provides more robust and reliable results to the researcher and practitioner alike (Ahani et al., 2017).

### Scales (Measurements)

The online survey was divided into four sections. The first section gathered demographic information about the participants, while the second focused on assessing their creativity. The third section evaluated their personality traits using the Big Five Inventory Scale (BFI-3), and the final section asked about their purposes for using social media. The BFI-3, created by Benet-Martinez and John (1998), is a 44-item Likert scale with five response options designed to measure five key personality traits: extraversion (8 items), Openness (10 items), Agreeableness (9 items), neuroticism (8 items), and Conscientiousness (9 items). For this study, the BFI-3 was translated into Turkish using Brislin's (1986) Back Translation Technique, and the Turkish version was finalized with input from experts in the field. The Cronbach's alpha values for the scale's sub-dimensions were: Extraversion = .88, Agreeableness = .79, Conscientiousness = .82, Neuroticism = .84, and Openness = .81 (Benet-Martínez & John, 1998). The data analysis process was carried out using SPSS.

Additionally, the questionnaire adapted and included items from Diliello and Houghton's (2008) study on creativity. The "Social Networking Sites Usage Purpose Scale" by Karal and Kokoç (2010) was used to explore the participants' reasons for using social media. This scale consists of three sub-dimensions: "social interaction and communication," "recognition and awareness," and "educational use." As a result of the research, a Cronbach Alpha value of 0.83 was obtained as a coefficient (Karal & Kokoç, 2010).

The Social Network Sites Usage Purpose Scale used in the present study was designed to serve multidimensional purposes for which individuals have used social network platforms. The instrument consists of 14 personal, social, educational, and cultural items when using social media sites. In this regard, items like "create a special space" (M1), "share my thoughts with people" (M9), and "join interesting groups" (M10) indicate an individual's desire to create social communication and share some content. Thus, these characteristics indicate their ability to be creative. These items demonstrate one's capabilities in showing creativity and coming up with new ideas using social media. They argue that Karal and Kokoç (2010) make these characteristics possible. Therefore, the scale is essential in determining participants' ways of expressing themselves and their innovative social media usage behaviors.

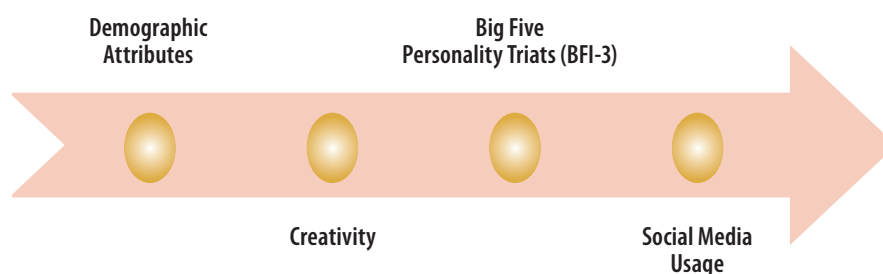


Figure 2. Categories

## RESULTS

### Descriptive Analysis of Demographical Variables

As shown below (Table 1), 64.8% of the 520 respondents were female. In terms of age distribution, 46.5% of the participants were between 20 and 30 years old, while 30.3% were 19 years old. Additionally, 23% of the participants were 21 years old. It was revealed that most respondents (72.6%) use Instagram for less than an hour daily, 17.4% for 1 to 3 hours, and 10% for less than 3 hours.

Table 1. Participants' demographics

| Variable          | Characteristics | Frequency | Rate (%) |
|-------------------|-----------------|-----------|----------|
| Age               | ≤19 years old   | 158       | 30.3     |
|                   | 20 years old    | 242       | 46.5     |
|                   | 21 years old    | 120       | 23.2     |
| Gender            | Female          | 337       | 64.8     |
|                   | Male            | 183       | 35.2     |
| Use cases (Daily) | <1 hour         | 378       | 72.6     |
|                   | 1< INS<3 hour   | 90        | 17.4     |
|                   | <3 hour         | 52        | 10       |
| Class             | First           | 201       | 38.6     |
|                   | Second          | 230       | 44.2     |
|                   | Third           | 89        | 17.2     |

### Non-response and standard method bias

The Levene test in this research is only employed to test the equality of variance across groups and cannot identify non-response bias itself. As Armstrong and Overton (1997) suggested, these methods for testing non-response bias should be primarily applied to analyze whether there is a systematic difference between early and late respondents.

The one-way ANOVA results indicated no significant differences between early and late respondents, confirming that non-response bias did not affect this study. Furthermore, Harman's single-factor test was utilized to conduct a principal component analysis to assess common method bias. This analysis revealed that a single factor explained only about twenty percent of the total variance, well below the 50% threshold, indicating that common method bias is not a concern in this research (Podsakoff et al., 2003). These findings appear consistent with previous studies (Ali et al., 2018; Leong et al., 2020; Al-Sharafi et al., 2022).

Two significant issues commonly affecting most social science research studies involve item non-response and missing data. How does missing data or the failure to answer specific questions have adverse effects on the internal validity of the research and also affect the generalization of results? Hence, this study analyzed the missing data problem using various statistical methods, showing the potential bias effects.

**Non-response Bias:** Given that non-response can create systematic differences between respondents and non-respondents or between items that were not responded to, it could potentially impact the research study results. This test is insufficient to measure bias in non-response directly, as the Levene test only analyzes the equality of the variance of the groups. Following Armstrong and Overton's suggestion (1997), participants were divided into two groups for a more reliable solution for assessing non-response bias: these were early and late responders, and the differences between these two groups were analyzed with one-way ANOVA. The results showed no significant difference between early and late responders; hence, no non-response bias was effective in this study. This scenario allows research findings to be more reliable.

**Methods for Handling Missing Data:** There are three commonly used methods for missing data processing: listing method, filling with mean, and multiple imputation. The listing method means completely removing the observations containing missing data from the study; however, this may result in data loss and reduce the statistical power since the sample size will be reduced. Filling with mean fills the missing responses with the variable's mean value. However, this method may reduce the variance and cause biased results.

In the present study, this rate was low—for example, less than 5% of the participants had missing responses—it was believed that the problem of missing data would not have a severe effect; therefore, the missing observations were removed using the listing method in this study. If the rate of missing data were more significant, resorting to more complex methods would have been necessary. The multiple imputation method was one of the best practices in order not to let the missing data create a systematic bias, and it may be preferred in future studies that include the process of missing data in a more reliable way.

Within this regard, the potential problems of missing data and non-response bias were evaluated carefully within the study, and we observed that elements that could affect the reliability of the findings were limited. On the other hand, the study has acceptable reliability levels because it identifies low rates of missing data, and the non-response bias was ineffective.

### **Measurement Model Assessment and CB-SEM Results**

This section carefully evaluated the data's reliability, normality, and validity. The internal reliability of the scales was measured using Cronbach's alpha ( $\alpha$ ) and composite reliability (C.R.). The Cronbach's  $\alpha$  values ranged from 0.621 to 0.827, indicating satisfactory internal consistency. Data were typically distributed when kurtosis and skewness values fell within the  $\pm 2$  range (Field, 2009). An acceptable range for kurtosis and skewness is typically between  $-1$  and  $+1$  (Hair et al., 2017). As shown in Table 2, the skewness (S.E. = 0.196) and kurtosis (S.E. = 0.221) values confirm that the normality assumption is met.

Table 3 presents a correlation matrix (CM) showing the linear relationships between the variables. The findings revealed a positive and significant correlation between creativity and social media use. In addition, extraversion, conscientiousness, openness, and neuroticism were positively associated with social media. In contrast, a negative and significant relationship was observed

between agreeableness and social media use. Confirmatory factor analysis was applied to examine the construct validity of the measurement models. The correlation analyses presented in Table 3 were tested for significance at some confidence level. However, several high correlation coefficient values did not show statistical significance. This could be related to the sufficiency of the sample size or the data structure. Although the sample size was determined to give a power of analysis in this study, some methodological limitations may effectively explain the insignificance between some of the correlations.

**Table 2. Normality Statistics and Reliability**

| Construct         | Mean  | SD   | $\alpha$ | C.R. | Skewness | Kurtosis |
|-------------------|-------|------|----------|------|----------|----------|
| Conscientiousness | 37.2  | 4.72 | .621     | .631 | .196     | -.425    |
| Extraversion      | 31.8  | 4.24 | .638     | .618 | .102     | -.028    |
| Neuroticism       | 26.56 | 4.62 | .642     | .654 | -.196    | .351     |
| Openness          | 39.56 | 4.81 | .713     | .784 | -.051    | -.237    |
| Social media      | 11.36 | 2.94 | .827     | .891 | -.094    | -.751    |

**Table 3. CM values**

| Construct             | E    | A    | C    | O    | N   |
|-----------------------|------|------|------|------|-----|
| Creativity            | -    |      |      |      |     |
| Extraversion (E)      | .29* | -    |      |      |     |
| Agreeableness (A)     | -.11 | .04  | -    |      |     |
| Conscientiousness (C) | .10  | .54  | .23  | -    |     |
| Openness (O)          | .17  | .60  | .10  | .70  | -   |
| Neuroticism (N)       | -.08 | -.03 | -.22 | -.30 | .09 |

\* $r > 10, p < .01, p < .05$

Measurement models fitted well, as illustrated in Table 4; thus, their validation was supported. Hypotheses H1, H2, H3, and H4 were supported in subsequent structural model analysis. However, the results of SEM analysis indicated no significant relationship between openness and social media use,  $\beta = 0.079, p > 0.05$ , and thus H5 was rejected.

According to Table 5, openness ( $\beta = 0.07, p < 0.05$ ) was positively and significantly related to social media, while another factor showed a negative and significant association. Extraversion ( $\beta = 0.23, p > 0.05, p > 0.001$ ) was not significantly related to social media. These results suggest that certain personality traits significantly connect to social media. Consequently, hypotheses H1, H2, and H4 are supported, whereas H3 and H5 are not. Together, these factors account for a significant portion of the variance in social media ( $R^2 = 0.80$ ).

The proposed measurement models for the analyzed constructs were tested independently. However, a CFA of the analysis of all constructs has not been carried out for specific reasons: incompatibilities between the scales, limitations in the use of data, or for having focused on the analysis of other different constructs.

**Table 4. Fit coefficients of the models**

| Fit Indices | Measurement Models |            | Threshold Values |
|-------------|--------------------|------------|------------------|
|             | Big Five           | Creativity |                  |
| $\chi^2$    | 734.200            | 712.235    |                  |
| p-value     | .001               | < .001     |                  |
| $\chi^2/df$ | 2.192              | 2.431      | <3               |
| GFI         | 0.877              | 0.853      | $\geq 0.80$      |
| AGFI        | 0.932              | 0.942      | $\geq 0.90$      |
| NFI         | 0.838              | 0.956      | $\geq 0.90$      |
| TLI         | 0.826              | 0.968      | $\geq 0.90$      |
| CFI         | 0.837              | 0.964      | $\geq 0.90$      |
| IF          | 0.848              | 0.959      | $\geq 0.90$      |
| RMSEA       | 0.069              | 0.059      | $\leq 0.07$      |
| SRMR        | 0.087              | 0.050      | $\leq 0.08$      |

**Table 5. Hypotheses Tests Results (CB-SEM)**

| Hypotheses                                             | Standard beta | P-values | T-values |
|--------------------------------------------------------|---------------|----------|----------|
| H1: Agreeableness $\rightarrow$ Social Media Usage     | 0.094         | 0.001*   | 1.109    |
| H2: Conscientiousness $\rightarrow$ Social Media Usage | 0.124         | 0.033    | 0.867    |
| H3: Extraversion $\rightarrow$ Social Media Usage      | 0.237         | 0.001*   | 1.804    |
| H4: Neuroticism $\rightarrow$ Social Media Usage       | 0.048         | 0.001*   | 2.236    |
| H5: Openness $\rightarrow$ Social Media Usage          | 0.079         | 0.041    | 2.506    |

\* $p < .001$ ,  $p < .05$

Table 6 shows the measurement model fit statistics that test the validity of the scales measuring the latent constructs. The values of CFI and TLI were found to be above 0.90. On that basis, the model was found to be a good fit. Usually, the values of RMSEA and SRMR are less than 0.08 and are found acceptable (Browne & Cudeck, 1993).

**Table 6. Fit Statistics for Measurement Model and Structural Model**

| Model             | CFI  | TLI  | RMSEA | SRMR |
|-------------------|------|------|-------|------|
| Measurement Model | 0.95 | 0.94 | 0.06  | 0.04 |
| Structural Model  | 0.92 | 0.90 | 0.07  | 0.05 |

CFI: Comparative Fit Index, TLI: Tucker-Lewis Index, RMSEA: Root Mean Square Error of Approximation, SRMR: Standardized Root Mean Square Residual

In the structural model, the causal relationships between latent constructs are tested. The CFI and TLI values should be higher than 0.90 at this stage. Table 8 shows that RMSEA and SRMR again have the same values of 0.08 or below, indicating an acceptable fit index. In this respect, the results signal appropriateness for the literature (Schreiber et al., 2006; Kline, 2011).

Because of this, the fit statistics reported separately for both models enable the reader to gauge the fit of the measurement and structural parts of the model separately. This enhances clarity in the analysis process and supports the reliability of the results.

### ANN results

This study also used Artificial Neural Network (ANN) analysis to detect nonlinear relationships between variables. Internal structures such as social media usage were divided into three levels: high, medium, and low ( $<6-11<12$ ). In the ANN model, only the factors found to be significant according to the CB-SEM results (agreeableness, extraversion, social media, openness, and neuroticism) were used as inputs. Such relationships were analyzed using the results of the CB-SEM. Within the framework of the results obtained, we included the significant factors as inputs to the ANN model. However, ANN models can learn even nonlinear relationships; thus, the ANN model also evaluated nonlinear relationships among the variables. Thus, the capability of the ANN model to reveal more complex interactions of the variables was used, and in this direction, the results of CB-SEM were taken only as a starting point.

In this study, a single-layer ANN model was preferred to understand the nonlinear relationships between the variables. Due to a small sample size, it was evaluated that a simpler architecture would be suitable instead of more profound or more complex structures. Despite the recent suggestions of Lee et al. (2020), the complexity of the variables examined in this study could be meaningfully modeled by a single-layer ANN because some alternative methods were also investigated: logistic regression and support vector machines. It was decided that ANN would be more suitable because of the nonlinear structuring of the variables. The sigmoid function activated latent and output neurons (Alkawsii et al., 2021). In order to optimize the performance, the input and output values were normalized in the range of [0, 1] (Ahani, 2017). In order to minimize the risk of overfitting, 10% of the data was separated for testing and 90% for training. A ten-fold cross-validation technique was also applied (Al-Sharafi et al., 2022). While the scale assumption slope method was used to determine the contribution of each independent variable to the dependent variable, the batch training method was implemented to increase the accuracy of the weights (Aryadoust & Baghaei, 2016).

ANNs were chosen because, by construction, they can model nonlinear relationships in data. ANN may better detect complex patterns and nonlinear interactions, enabling us to understand the nonlinear relationship between social media and personality traits evaluated within our study. Yes, in general, ANNs work more effectively with larger data sets. However, literature on studies indicates that ANNs performed well using a small dataset (Zhang & Friedrich, 2003). Other supervised machine learning methods, such as logistic regression and SVM, have also been investigated. However, the ANN model was preferred, as it had been assumed to represent the complex structure of the data better.

Table 6 shows the classification accuracy of the Artificial Neural Network (ANN) model in predicting the dependent variable, considering three significant independent variables. The model achieved an overall classification accuracy of 80.8% for the training set and 76.1% for the test set. For the training set, the model predicted low, medium, and high social media with accuracies of 81.4%, 86.5%, and 63.7%, respectively (sum of squares error = 61.78, incorrect predictions = 15.29%). For the test set, the prediction accuracies were 72.7% for low, 81.5% for medium, and 62.5% for high social media (sum of squares error = 5.49, incorrect predictions = 19.8%). Additionally, the Root Mean Square Error (RMSE), a commonly used metric in previous studies (Arpaci et al., 2022; Baig et al., 2023), was calculated to assess the accuracy of the ANN model. As shown in Table 7, the average RMSE values for training and testing were 0.470 and 0.496, respectively. These results suggest that the Artificial Neural Network (ANN) model demonstrates vital predictive accuracy in reflecting social media.

**Table 7. RMSE values**

| Network            | RMSE-TR*    | RMSE-Ts     |
|--------------------|-------------|-------------|
| 1                  | 0.431       | 0.462       |
| 2                  | 0.452       | 0.492       |
| 3                  | 0.426       | 0.446       |
| 4                  | 0.449       | 0.501       |
| 5                  | 0.446       | 0.507       |
| 6                  | 0.455       | 0.431       |
| 7                  | 0.467       | 0.443       |
| 8                  | 0.452       | 0.521       |
| 9                  | 0.491       | 0.492       |
| 10                 | 0.471       | 0.452       |
| Mean               | 0.470       | 0.496       |
| Standard deviation | 0.014565145 | 0.053973082 |

\*Training, Testing

Contributions of social media to the relative importance (R.I.) and normalized importance (N.I.) indices were calculated based on independent variables. These indices, shown in Table 8, reflect the potential impact on the prediction when an independent variable was removed from the model. The results reveal that habit ( $RI=0.194$ ,  $N.I.=97.1\%$ ) is the most influential factor in predicting social media, followed by openness ( $RI=0.175$ ,  $N.I.=83.3\%$ ) and social media itself ( $RI=0.121$ ,  $N.I.=57.1\%$ ).

**Table 8. R.I. and N.I. values**

| Neural networks  | R.I.  | N.I.  |
|------------------|-------|-------|
| 1. Agreeableness | 0.194 | 97.1% |
| 2. Extraversion  | 0.175 | 83.3% |
| 3. Social media  | 0.121 | 57.1% |
| 4. Openness      | 0.098 | 46.5% |
| 5. Neuroticism   | 0.068 | 31.9% |
| 6. Creativity    | 0.055 | 25.8% |

ANN was conducted to analyze the nonlinear relationships in the theoretical model. Exploring the nonlinear relationships not covered by SEM methodology, which has traditionally focused on the linear relationships between variables, presented some patterns. Integration of these two methods thus enables us to review the relationships in the theoretical model more holistically. However, these methods were represented as complementary by underlining that the role of ANN analysis was far more limited in the theoretical model and highlighting that the effects of some interactions remained at a low level.

ANN and SEM analyses are representative of complementary research results. While SEM checks linear structural relationships, ANN reveals complex nonlinear relationships. While SEM confirms the model's validity, ANN allows for complex relationships between variables with nonlinear effects. Therefore, when both analyses are used simultaneously, their findings can be interpreted more comprehensively, and the reliability of the results increases.

The Artificial Neural Network (ANN) model was evaluated with training and test data to classify social media usage levels (low, medium, high). In the training set, the model predicted low social media usage with 91.4% accuracy, medium social media usage with 90.5% accuracy, and high social media usage with 92.7% accuracy. In the test set, the model correctly classified low social media usage with 91.7% accuracy, medium social media usage with 90.4% accuracy, and high social media usage with 92.5% accuracy. These results show that the model achieved high training and test set accuracy and successfully predicted social media usage levels.

The Artificial Neural Networks (ANN) model was tested using the F1 score to evaluate the performance of classifying social media usage levels (low, medium, high). In the training set, F1 scores were found to be 0.91 for low social media usage level, 0.90 for medium level, and 0.93 for high

level. In the test set, F1 scores were 0.92 for low social media usage, 0.91 for medium, and 0.93 for high, respectively.

These F1 scores show that the model predicts each class with high accuracy and precision by balancing it. The high F1 scores of the model support the successful classification performance of social media usage levels.

## DISCUSSION

According to the findings, motivational factors such as agreeableness, extraversion, and openness significantly predicted the use of social media. The results here appear consistent with the literature. Agreeableness emerged as a particularly influential differentiator among these factors, suggesting its crucial role in shaping usage patterns. This result is consistent with previous work (Giancola et al., 2021; Leong et al., 2019). From this point of view, students can work in harmony with others. Agreeableness is essential to success in this platform, as there is a platform where they can collaborate on social media, especially on Instagram, without knowing each other, as in a face-to-face meeting. It is easy for educators to adapt to other educators through the Instagram platform during the agreeableness process. Mutual comments, likes, and related posts can be made. New projects and activities can be produced with agreeable collaborations, and mutual support can be provided. Here, you can join Instagram groups and contact other instructors based on their areas of expertise. In this way, the opportunity to meet other people face-to-face is offered. This can lead to stronger connections and opportunities. In this way, wider audiences are reached. It can offer users incredible opportunities for self-development and success. It is assumed that this will significantly improve the creativity of the students. Studies confirm a significant positive relationship between agreeableness and social media, consolidating our findings (Seidman, 2013; Wang et al., 2012).

When examined in the context of socio-demographic characteristics, we encounter the age factor in particular. In general, it has been observed that younger people actively use the Instagram platform. This is especially evident in the data on agreeableness. Students have a significant impact when using social media. Shaninah and Mohd Noor (2024) confirm our findings in their study. They stated that neuroticism brought about negative results according to many factors. A similar result was obtained in our study. In another study on social media and neuroticism, it was observed that Facebook users mentioned that their neuroticism was a negative maladaptive relationship and that neuroticism and passive Facebook use increased (Abbasi & Drouin, 2019; Rozgonjuk et al., 2019; Gentzler et al., 2023). As can be seen from the studies, they are generally carried out on the Facebook platform. Creativity studies on the Instagram platform alone are limited. Therefore, the unstudied literature is expected to fill the critical gap in this field, and the importance of our study compared to other studies can be seen here.

Conscientiousness proved to be of significant value in our work. From this point of view, there is a positive relationship between social media and conscientiousness. Conscientiousness, as a per-

sonality trait, is widely recognized for its significant role in achieving success and reaching goals (Costa & McCrae, 1992). Individuals with high levels of conscientiousness tend to be more organized in their use of social media and excel at finding valuable information. Platforms such as Instagram, in this context, provide a supportive space that encourages teamwork and the sharing of information. At the same time, students with conscientious personality traits are even more advanced in their academic success. Individuals with high conscientiousness participate in social media to maintain existing relationships, while individuals who do not have this trait use social media for news and information (Kircaburun et al., 2020; Ryan & Xenos, 2011). Individuals with high openness to experience share more personal information on their social media timelines (Amichai-Hamburger & Vinitzky, 2010) and post more selfies. They participate less in activities related to liking and commenting (Kircaburun et al., 2020; Ryan & Xenos, 2011). Komarraju, Karau, Schmeck, and Avdic (2011) conducted an in-depth examination of this issue in their research. Similarly, the results reported by Uslu and Durak (2022) align closely with our findings. In this context, it can be stated that certain studies within the existing literature, such as those by Ahmed et al. (2022), provide substantial support for our conclusions.

Significant values were found in extraversion, which is one of the other findings of our study. Dilawar et al. (2022) observed findings parallel to our study and found similar results. Their study noted a significant value between social media and extraversion. In their study, Marengo et al. (2020) stated that the role of extraversion is significant. This is consistent with what has been reported by our studies. It is worth noting that although the trends towards social media use vary here, the personality relationships described are well aligned with the literature. However, the differences between the groups are generally minor and can be detected due to sample size. Here, students are more willing to express themselves on Instagram. The tendency to be more willing may stem from personality traits that encourage social interaction, self-satisfaction, and a desire for attention. Individuals with such characteristics often thrive in settings where they can connect with others and become the focus of social dynamics. This idea is reinforced by the research of Chou and Chiu (2015), who provide empirical support for this observation.

Here, it can be explained that extraversion is a strong predictor of social media use due to high motivation from this personality trait for social interaction and communication. Extraverted people use social networks intensively for social purposes: to get acquainted with new people, maintain their existing relationships, and manifest themselves. This is associated with their attitudes about social media platforms serving as an adequate social space and, hence, individuals' tendency to be more active on these sites.

Previous literature also reveals that extraversion is one of the crucial traits in using social media sites and platforms (Bowden-Green et al., 2020; Krämer & Winter, 2008). Extraverted people tend to share more on social media and become more active in online communication than those characterized by other personality traits (Huang, 2019; Pagani & Goldsmith, 2013). In this context, extraversion is the most powerful predictor of social media usage, and it also presents how effective social media platforms meet the socialization needs of people. Depending on personality traits, social

media platforms gain different functions: For extroverts, it becomes an area that fulfills their need for communication.

## CONCLUSIONS

In summary, using the SEM-ANN approach, this study examined the connection between social media use and creativity among pre-service teachers. The results revealed that personality traits—openness, conscientiousness, extraversion, agreeableness, and neuroticism—significantly influence creativity, providing essential insights for educational practices. Additionally, the research underscores the need to consider demographic factors, such as gender and socio-economic status, when predicting creativity. These factors may interact with personality traits, potentially enhancing students' creativity and enriching their academic experiences.

However, since the research was conducted in Turkey, it may not overlap with the context of other regions. Further research in various cultural and educational settings is necessary to understand the relationship between personality traits and creativity comprehensively. While this study primarily examined creativity, it is essential to recognize that other personality traits or factors could also significantly influence creative abilities, suggesting additional research to explore these variables more thoroughly.

The sample characteristics could introduce bias, suggesting that our findings might be more comprehensive if the research included all social media platforms. Building on previous research (e.g., Sharma and Behl, 2022), we observed significant differences in demographics and personality traits when considering creativity, depending on participants' specific combination of social media platforms.

Our study found that participants with higher levels of extraversion and openness were more likely to engage in activities on social networks. Extraversion was significantly and positively linked to sharing, education, and learning behaviors, while Openness was associated with organization, monitoring, and learning. Neuroticism was positively related to relaxation. Conscientiousness and agreeableness were positively associated with learning, with many pre-service teachers using social networks primarily for relaxation and learning. We recommend further research to explore how other psychological characteristics influence social network behaviors.

Our work fills the gaps in knowledge in the field and offers new perspectives. First, to our knowledge, the relationship between personality traits and social media use among pre-service teachers has not been extensively explored before. This research aimed to bridge that gap by examining social media use within the framework of creativity and the five major personality traits, informed by a thorough review of existing studies on the motivations behind social media engagement. Second, while previous research has often focused on creativity in the context of technology adoption, this study uniquely linked critical components of the model to creativity, further validating its significance in understanding creative processes. Third, although the data supported

many of the hypothesized relationships, the study did not find a strong connection between effort expectation, facilitating conditions, openness, and creativity. This highlights the need for further investigation into the role of social media in nurturing creativity, particularly in developing countries like Turkey.

Based on the results, pre-service science teachers with high creativity levels may recognize the significant potential of educational social media in enhancing education. They believe educational social media can engage students, making learning more enjoyable and practical and fostering creativity. Therefore, pre-service science teachers must develop their creativity skills to use educational social media effectively. Providing creativity training for these future teachers would be beneficial. Additionally, incorporating creativity-focused content into educational social media applications could further enhance their educational potential.

The results of this study have some important implications for science teachers regarding how they could shape their educational strategies to develop creativity in students through social media. The impact of personality traits in using social media gives the teacher several clues on how to adapt the in-class and out-of-class learning activities to enhance creativity among students.

### **Use of Social Media by Teachers for Educational Purposes**

The findings show that science teachers can use social media to inspire learning besides entertaining or communicating with their students. The teachers may attract students' attention through organizing, following, and sharing educational content. Social media might offer stages that support students' open-minded and creative thinking skills. It means that teachers can encourage their students to share, create content, and exchange ideas on social media to have them adopt a creative and participative approach toward learning.

### **Creating Content to Support Creativity on Social Media**

Teachers can enhance students' creative capacities by designing activities integrating social media as a medium for expression. For instance, students could produce short videos that explore scientific phenomena or address pressing environmental issues. These projects serve a dual purpose: they enable students to acquire knowledge while crafting and presenting their unique ideas. Social media platforms, in this context, act as dynamic showcases, allowing students to exhibit their individual contributions—whether in the form of scientific discoveries, innovative environmental solutions, or creative explorations of academic concepts.

### **Creative Digital Projects and Collaboration**

Projects with social media will support student project-based learning activities and, therefore, increase their creativity. For example, students can be asked to work on a project regarding nature conservation with science classes from other cities. In this way, they will share ideas and develop more creative solutions since they have learned different perspectives from social media.

### **Responsive and Effective Sharing on Social Media**

The study found that personality traits such as conscientiousness and agreeableness in science teachers have a positive influence on their ability to use social media effectively for educational purposes. They would guide the students to produce conscious content about social media use, like how they should safely and responsibly use internet-mediated social media. This would help them communicate healthier through social media and develop presentations appropriate for creative projects.

### **Inclusion of Creativity-Focused Content in Teacher Education Programs**

This study has established that social media content effectively evokes creativity among students. Thus, content about practical usage of social media tools may be included in teacher education curricula. If the candidates are trained to create attractive and informative social media content, the students can constructively facilitate their creative thinking. The knowledge of teacher candidates about the digital tools supporting creativity will also contribute to future educational processes.

These might be suggestions directing teachers to use social media to develop students' creativity. Conscious and creative use of social media tools in educational environments supports students' creative and critical thinking skills.

### **Limitation and Recommendations**

The limitations of this study are as follows: First, the use of a purposive sampling strategy restricts the ability to make broad generalizations about the true prevalence of different social media usage patterns in the wider population. However, the large sample size strengthens the findings on the relationships between emerging social media usage patterns, demographic variables, and personality traits. Another limitation is that all participants were drawn from a public university in Turkey, which means the results may not apply to other populations in different countries, educational institutions, or levels of education or to studies involving more diverse groups. Future research could address this limitation by comparing these findings with results from different contexts.

Research can be expanded to include people/students with different cultural backgrounds, not just from a single country or culture. Additionally, the study's reliance on self-reported and cross-sectional data is another limitation. Future research could overcome this by incorporating longitudinal and qualitative data, providing a more comprehensive understanding of the phenomena under study. Examining the impact of educational social media on students' academic achievement could also be an essential research topic. Future research should consider incorporating creativity training and developing creativity-focused content within social media platforms to improve learning outcomes. This approach could make learning more interactive, engaging, and effective for students. Although specific correlation coefficients in this study were notably high, they did not reach statistical significance—likely due to the limited sample size. This limitation warrants careful consideration, as it may impact the reliability of the observed correlations between the variables in

the dataset. Future studies should aim to utilize larger samples, allowing for a more precise investigation of these relationships.

Regarding model architecture, a single-layer artificial neural network (ANN) was chosen due to the dataset's size. While this choice suited the current data, it might restrict the model's ability to capture more intricate patterns. Employing deeper network structures may be significantly more appropriate in future studies if the dataset size expands to support more complex architectures.

The ANN analysis approach in this study used a combined variable instead of the original continuous dependent variable. This adjustment was made to simplify the analysis and enhance the model's practical applicability, yet it may reduce the level of detail in the results. Furthermore, the methodology lacks a detailed explanation of the 'scale assumption slope method,' which could affect the overall model validity. Including more comprehensive methodological details to bolster the robustness and clarity of future analyses would be beneficial.

### **Study Limitations and Future Research Recommendations**

Using self-reported data introduces potential biases, as it relies on participants' self-perceptions. A common issue with self-reports, especially in the context of personality traits, is that individuals often present themselves in a socially favorable light. This inclination toward socially acceptable or positive responses could distort the accuracy of the findings, leading to social desirability bias. Furthermore, self-reported measures of social media use may be affected by participants' tendency to idealize their behavior, potentially creating a gap between reported and actual behavior. Future research could consider incorporating observational or mixed-method approaches to minimize biases and provide a more nuanced view.

### **Recommendations for Future Research**

To address this limitation, incorporating multiple data collection methods could enhance the reliability of findings. In addition to self-report surveys, more objective approaches like digital monitoring, direct observations, or log file analysis could be employed to measure participants' social media use more accurately. Additionally, qualitative methods such as focus groups or in-depth interviews offer richer insights, allowing researchers to explore participants' perspectives more thoroughly. These methods provide a more nuanced and realistic view of how individuals interact with social media.

Longitudinal studies also offer valuable insights by tracking the relationship between personality traits and social media usage patterns. Tracking these trends over time would provide valuable insights into how personality traits shape social media behaviors. It would also allow researchers to identify evolving patterns and shifts as they develop.

These comprehensive data collection strategies would bolster study reliability and yield more accurate, objective findings. Including examples and detailed methodological descriptions of implementing these techniques in future studies would add significant depth and value to the research literature.

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