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A Cluster Analysis of Identity Processing Styles and Educational and Psychological Variables Among TVET Students in the Nyanza Region of Kenya

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Abstract: This study investigated the link between identity processing styles, educational background, and psychological factors among engineering students in Kenyan TVET institutions in the Nyanza region. The research employs cluster analysis to identify student groups based on these variables. A total of 450 students from 15 public TVET institutions within the Nyanza region of Kenya comprised the study population. This pilot study included 110 students with ages ranging from 18 to 35 years. Data were collected by a self-administered online questionnaire. Based on cluster analysis, three groups of students were identified. The result revealed that 53.6% of the sample consisted of students with both diffuse-avoidant and normative identities; they were prone to academic procrastination and smartphone addiction and still possessed relatively higher levels of self-efficacy, life satisfaction, and academic performance/motivation. The second cluster included students with the highest level of informational identity (38.2%), good academic achievement, self-efficacy, optimism and life satisfaction, and motivation to learn. The third cluster consisted of students with low professional identity with poor academic performance and motivation, self-efficacy, and satisfaction with life (18.2%). The study's findings can inform the development of targeted interventions to enhance student success and contribute to the effectiveness of vocational training programs.

Keywords: identity processing styles; TVET; smartphone addiction; academic achievement; academic motivation; self-efficacy

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1. Introduction

Technical and Vocational Education and Training (TVET) has been identified to be a critical element in equipping citizens with workforce skills and driving economic growth (Osidipe, 2017; Pavlova, 2014; Wanjala et al., 2020). It provides hands-on training across various sectors through institutions like technical universities and vocational training centers, catering to all kinds of learners in various courses ranging from artisans to diploma levels (Oroni et al., 2023). Governed by the Technical and Vocational Education and Training Authority (TVETA) in Kenya, TVET programs ensure competence and quality training, which aims to enhance youth employment and productivity in the job market, as well as achieve successful economic growth (Ngware et al., 2024). Academic achievement plays a crucial role in shaping students' practical experience, contributing to knowledge and

technical skill development and career prospects, though its role is tailored to the vocational context in the TVET sector (Gaffoor & Van der Bijl, 2019). During the process of learning and skills training, the development of students' self-identity is also crucial, but we know less about its correlates.

Academic excellence serves as a foundation for skill development by providing theoretical knowledge and skills essential for the foundation of building strong technical skills, fostering problem-solving abilities vital for workplace challenges, and strengthening communication skills essential for success in many jobs (Pelser et al., 2022). Moreover, strong academic performance in TVET programs enhances employability and facilitates career progression by meeting industry standards for entry, opening doors to further education and advanced diplomas, and aligning with employer preferences for well-rounded graduates (Ademtsu & Pathak, 2023). TVET education emphasizes balancing academic success with practical skills development and industry-specific certifications to help evaluate students' capabilities, preparing them for the real world (Pelser et al., 2022). This emphasis on skill development aligns with the dynamic nature of identity formation (Sepúlveda, 2024).

TVET is an integral part of the Kenyan education system, aiming to provide practical skills and knowledge for various industries, and its evolution reflects the country's changing socioeconomic priorities and development goals over the years (Achuodho & Pikó, 2024). During the colonial era, TVET was formalized to train artisans, clerks, and manual laborers to support the colonial administration and industries. These programs were narrow in scope and designed primarily for subordinate roles, leading to a negative perception of vocational training among Kenyans (Barasa et al., 2023). Despite this negativity, the government recognized the importance of TVET for industrialization and addressing youth unemployment. Technical schools were established to train artisans, clerks, and other workers who supported the colonial administration and industries. However, systemic challenges, such as underfunding and societal bias against technical education, persisted (Oroni et al., 2023).

Recently, through the State Department of TVET, the Ministry of Education launched ambitious plans over 3.1 million KES for young people in technical colleges, supported by additional funding from the Higher Education Loans Commission (Okelo et al., 2021). While these changes have led to a rising number of students entering technical training institutes (TTIs), achieving the enrollment goal remains challenging due to issues such as negative public perceptions of TVET, limited access to loans, insecurity, and inadequate funding for TVET institutions. Despite increased public spending on TVET by the Kenyan government, the sector continues to face significant challenges, including high enrollment rates that strain the existing infrastructure, limited financial resources, outdated curricula, insufficient technology access, mismanagement of resources, and low academic achievement in engineering courses (Okelo et al., 2021; Okumu & Kenei, 2023). These challenges highlight the need to examine emerging trends in TVET policy and how identity processing styles affect academic achievement, particularly among engineering students in Kenya.

Therefore, in this study, we focused on identity processing styles, since these approaches may have great impact on TVET students' learning motivations and coping with academic challenges, providing them with core values and attitudes. We applied cluster analysis to explore their relationships with a set of educational (e.g., academic performance or motivations) and psychological variables (e.g., self-efficacy and optimism) and to get a picture of TVET students' orientations and future prospects.

2. Literature Review

2.1. Theoretical Background

2.1.1. Identity Theories

Integrating identity processing theories, such as Erikson's psychosocial theory, with self-efficacy theory (e.g., Bandura's social cognitive theory) and motivation theories (e.g., self-determination theory) offers a comprehensive framework for understanding human development and behavior (Bandura, 1978; Kruglanski et al., 2010; Ryan & Deci, 2020). Erikson's theory emphasized the importance of identity formation throughout the lifespan, suggesting that individuals progress through various stages of psychosocial development, each characterized by specific identity crises and resolutions (Sokol, 2009; Berzonsky, 1992). Bandura's self-efficacy theory complements this by highlighting the role of individuals' beliefs in their ability to succeed in different domains, including academics and practical work (Bandura, 2006). Higher levels of self-efficacy are associated with greater effort and persistence, influencing academic achievement (Hassan et al., 2015; Komarraju & Nadler, 2013).

Erikson's psychosocial theory is highly relevant to vocational education, as it explains how individuals form their sense of self through roles and social interactions (Erikson, 1968). For TVET students, this process is influenced by their engagement with technical and vocational training, which shapes their professional identities (Niittylahti et al., 2021). Students often begin their TVET journey with varied perceptions of their abilities and societal expectations, and through their learning experiences, they develop a stronger sense of belonging and competence in their chosen fields (Niittylahti et al., 2019). In the Kenyan context, where TVET is often viewed as a second choice pathway, fostering self-efficacy is particularly important. Students with high self-efficacy are more likely to embrace entrepreneurial opportunities and navigate the job market successfully, contributing to reducing unemployment and driving economic growth (Chu et al., 2024).

Additionally, self-determination theory posits that intrinsic motivation, autonomy, and competence are essential for optimal functioning and well-being (Ryan & Deci, 2020; Saeed & Zyngier, 2012). By integrating these theories, we can explore how identity processes, self-efficacy beliefs, and motivational factors interact to shape individuals' academic experiences and outcomes. For example, a strong sense of identity may foster greater self-efficacy and intrinsic motivation, leading to increased academic engagement and achievement. Conversely, identity conflicts or low self-efficacy may hinder motivation and academic performance. Understanding these interconnections can inform interventions aimed at promoting positive identity development, enhancing self-efficacy beliefs, and fostering intrinsic motivation to support academic success.

2.1.2. Berzonsky's Model of Identity Processing Styles

Berzonsky's model highlights how individuals shape their identities with three interconnected components such as process, structure, and content, which can influence academic performance and career paths (Berzonsky, 1992). Berzonsky categorized identity processing styles as informational, normative, and diffuse-avoidant, illustrating how these styles impact individuals' approaches to learning and coping with challenges. For instance, the informational style involves actively seeking, evaluating, and utilizing identity-related information for self-insight, which enhances learning motivation (Berzonsky et al., 2013). Individuals with this style respect diverse opinions, values, and beliefs; actively cope with challenges; and exhibit autonomy in academic settings (Berzonsky et al., 2013; Berzonsky & Kuk, 2005).

Conversely, normative-styled individuals conform to vocational expectations, prevailing social norms, and specific social roles (Crocetti et al., 2008). They resist considering differing ideas and values, maintain existing self-concepts, and are associated with tra-

ditional values, potentially limiting exploration (Berzonsky, 1992; Crocetti et al., 2008; Soenens et al., 2005). On the other hand, diffuse-avoidant individuals are egocentric, prioritizing immediate rewards and situational cues (Berzonsky, 1992). Their behavior varies widely based on context, often seeking attention and popularity but lacking commitment and being prone to academic procrastination, which affects their progress (Berzonsky & Ferrari, 2009).

2.1.3. Educational and Psychological Correlates of Identity Processing

Understanding these styles can aid in supporting students' success in both academic and vocational pursuits in Kenya. Above others, self-efficacy, or one's confidence in their capacity to succeed academically, determines their level of effort and perseverance in the face of challenges (Bandura, 2006). The more confident students feel about their abilities, the more likely they are to succeed academically (Caprara et al., 2011; Feldman & Kubota, 2015). Additionally, academic motivation, including intrinsic motivation driven by personal or genuine interest in the learning process and extrinsic motivation derived from external rewards or driven by goals like good grades, influences students' active participation and perseverance in their studies when things get tough (Ryan & Deci, 2020; Saeed & Zyngier, 2012).

Furthermore, satisfaction with life reflects an individual's overall sense of well-being, which can influence their motivation and active participation in academic pursuits (Ng et al., 2015). Higher levels of life satisfaction may correlate with better academic performance due to increased focus and resilience (Slavinski et al., 2021). Moreover, life orientation, encompassing an individual's outlook on life events and their sense of control over outcomes, can impact academic success. A positive life orientation, characterized by optimism and a proactive approach to challenges, may facilitate better academic outcomes through increased motivation and perseverance (Hoy et al., 2008). Academic procrastination, on the other hand, involves delaying tasks and can hinder academic success by reducing the time available for studying and completing assignments (Svartdal et al., 2020). Similarly, smartphone addiction can distract from academic achievement by causing distractions and disrupting study routines (Dontre, 2020). This is particularly relevant, since the "mobile revolution" in Africa has many advantages in everyday life and work (Otiono, 2021); however, its critical role in education has not yet explored.

By understanding these factors, educators and policymakers can implement strategies to support students in managing their time, technology usage, and overall well-being, thereby enhancing their academic achievement.

2.2. Study Aims

This study aims to examine relationships between identity processing styles; educational variables (academic motivation, academic procrastination, and academic achievement); and psychological variables (self-efficacy, life orientation, and smartphone addiction) among automotive engineering students in TVET institutions in Kenya. To the best of our knowledge, no previous studies have applied cluster analysis using both educational and psychological variables among these students. Thus, a central research aim of the present study was to explore the different cluster profiles of students based on their identity styles along the lines of these relevant psychological and educational variables. The study answers the following research questions;

(i) What are the relationships between identity processing styles and educational variables such as academic motivation, procrastination, and achievement among TVET students?
(ii) How do psychological factors, including self-efficacy, life orientation, and smartphone addiction, relate to the identity processing styles of automotive engineering students?

(iii) Can distinct student profiles be identified through cluster analysis based on identity processing styles and their associated psychological and educational variables?

3. Materials and Methods

3.1. Participants and Procedure

A total of 450 automotive engineering students from 15 public TVET institutions within the Nyanza region of Kenya comprised the study population. Data were collected by a self-administered and online questionnaire (Appendix A). The study used a Google form questionnaire, where a link was generated and shared through online communication platforms available for the students. In this pilot phase, randomly selected students were invited to participate. The data collection happened between November 2023 and April 2024, with an introductory email about the research and an invitation to participate in it. The estimated time to complete the questionnaire was 30 min, and there were no missing data in the study. Participation was anonymous and voluntary. The sample size of this pilot study included 110 students with ages ranging from 18 to 35 (mean age = 23.21 years; 92% males). The selected sample broadly aligns with the sociodemographic characteristics of automotive engineering students in Kenya. The socioeconomic status of the participants, mainly from low- to middle-income families, also reflects the demographic makeup of TVET students in Kenya, where many come from disadvantaged backgrounds (Achuodho & Pikó, 2024). However, the gender imbalance and the specific focus on automotive engineering may limit the sample's generalizability to other TVET disciplines, where gender distribution may differ. Despite these limitations, the sample provides a reasonably accurate representation of automotive engineering students in the Nyanza region, considering age, gender, and socioeconomic status.

3.2. Instruments

First, the demographic information included the level of study, age, sex, institution, number of siblings, socioeconomic situation, living status, and learning outcome. In addition, the study used eight scales.

3.2.1. Revised Identity Style Inventory (ISI-5)

This scale measured how students think about themselves and was adopted from Berzonsky et al. (2013). It contained 27 items measuring three identity processing styles (diffuse-avoidant, e.g., "I am not thinking about my future now, it is still a long way off"; normative, e.g., "I strive to achieve the goals that my family and friends hold for me"; and informational, e.g., "When making important decisions, I like to have as much information as possible") with a response option on a five-point Likert scale (1 = not at all like me, 2 = unlike me, 3 = neither like me, 4 = like me, and 5 = very much like me). The scale was reliable, with a Cronbach's alpha coefficient of diffuse-avoidant items at 0.85, informational items at 0.96, and normative items at 0.92.

3.2.2. Academic Motivation Scale

This scale measured students' level of desire and drive to succeed in their studies, and it was adopted from Kotera et al. (2021). It contained fourteen items with a response option of 1 = not at all correspond, 2 = hardly correspond, 3 = Neutral, 4 = moderately correspond, and 5 = exactly correspond. The scale was reliable, with a Cronbach's alpha coefficient of 0.89.

3.2.3. Academic Performance Scale

It measured students' academic achievement in their automotive engineering studies and contained ten items (e.g., "I want to get good grades in every subject") with a five-point

Likert scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. This 5-point scale assessment was carried out by Birchmeier et al. (2015). The scale was reliable, with a Cronbach's alpha coefficient of 0.94.

3.2.4. Academic Procrastination Scale

It measured the tendency to put off academic work with a five-point Likert scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree, and it contained 5 items (e.g., "I put off projects until the last minute"). This measurement was adopted from the work of Yockey (2016). The scale was reliable, with a Cronbach's alpha coefficient of 0.92.

3.2.5. General Self-Efficacy Scale

This scale measured students' confidence in their ability to effectively cope with stressful situations and was adopted from Schwarzer and Jerusalem (1995). It contained ten items (e.g., "I can solve most problems if I invest the necessary effort") with a response option on a five-point Likert scale: 1 = not at all true, 2 = hardly true, 3 = neutral, 4 = moderately true, and 5 = exactly true. The scale was reliable, with a Cronbach's alpha coefficient of 0.92.

3.2.6. Revised Life Orientation Test (LOT-R)

This scale measured students' overall outlook on life adopted from Scheier et al. (1994) and contains ten items (e.g., "I am always optimistic about my future"), with three reverse-scored items and four filler items. The responses were measured with a Likert scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Higher level of the mean score indicates greater optimism. The scale was reliable, with a Cronbach's alpha coefficient of 0.77.

3.2.7. Smartphone Addiction Scale—Short Version (SAS-SV)

This scale measured smartphone addiction with 10 items (e.g., "Having my smartphone in my hand even when I am not using it") with a 5-point Likert scale of 1 = strongly disagree, 2 = disagree, 3 = Neutral, 4 = agree, and 5 = strongly agree. The scale was adopted from Kwon et al. (2013) focusing on six factors of addiction: daily life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationship, overuse, and tolerance. The scale was reliable, with a Cronbach's alpha coefficient of 0.93.

3.2.8. Satisfaction with Life Scale (SWLS)

This scale was used to assess the global level of subjective well-being. The students' experience with five statements (e.g., "I am satisfied with my life") was measured with a 5-point scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. These items were adopted from Diener et al. (1985). The scale was reliable, with a Cronbach's alpha coefficient of 0.75.

3.3. Ethical Consideration

Respondents were informed about the details of the study, and their consent was obtained. Participation was voluntary and confidential. The approval of the study protocol was provided by the Institutional Review Board of the Doctoral School of Education, University of Szeged (ref. no: 20/2023).

3.4. Data Analysis

IBM SPSS version 26 for Windows software was used for the analyses. The significant level of acceptance was 0.05. Besides descriptive statistics and bivariate correlations, a

K-means clustering analysis was performed to identify the relationships between identity processing styles and other variables. This method assigns cases to pre-specified subgroups by computing centroids and repeating this step until the optimal centroid to obtain a stable cluster assignment. K-means clustering is appropriate to be applied on smaller samples, using iterations over the data points. Therefore, this method was chosen to identify group participants with similar profiles. This type of cluster method has a distance-based clustering algorithm, in which the distance is used as a measure of similarity (Wilks, 2011). The number of clusters was identified via elbow methods, and Silhouette scores were used to justify our results. The following cutoff scores were used in this study: 0 to 0.25 = no structure form, 0.25–0.50 = weak structure, 0.50–0.70 = medium, and 0.70–1.0 = strong structure (Struyf et al., 1997). After K-means clustering, Levene's tests were used to check variance homogeneity, and multivariate analysis of covariance was conducted (MANOVA). In the final step of our analysis, a series of ANOVA tests with Tukey's post hock tests were used to confirm our results. Partial eta squared (η2p) was also used as an effect size for MANCOVA and ANOVA (0.01 = small, 0.06 = medium, and 0.14 = large effect).

4. Results

4.1. Descriptive Statistics and Bivariate Relationships

Table 1 displays scores, means and standard deviations, skewness and kurtosis for the study variable, and alpha reliabilities (along with the diagonal). Cronbach's alpha coefficients were all in an acceptable range of reliability; most of them (with three exceptions) were above 0.90. Participants in the present study reported moderate levels of all the scales included, and our skewness and kurtosis values showed normally distributed variables, since all the values varied between −1.5 and 1.5 (Forero et al., 2009).

Table 1. Correlations, alpha coefficients, and descriptive statistics for the study variables (N = 110).

	1	2	3	4	5	6	7	8	9	10
1. Diffuse-avoidant	(0.85)	-	-	-	-	-	-	-	-	-
2. Informational	0.29 **	(0.96)	-	-	-	-	-	-	-	-
3. Normative	0.41 ***	0.59 ***	(0.92)	-	-	-	-	-	-	-
4. Academic Performance	0.15	0.65 ***	0.46 ***	(0.94)	-	-	-	-	-	-
5. Academic Procrastination	0.46 ***	0.01	0.31 **	−0.02	(0.92)	-	-	-	-	-
6. Academic Motivation	0.19 *	0.73 ***	0.40 ***	0.82 ***	−0.08	(0.89)	-	-	-	-
7. Self-efficacy	0.16	0.73 ***	0.57 ***	0.77 ***	0.01	0.80 ***	(0.92)	-	-	-
8. Optimism	−0.05	0.37 ***	−0.01	0.44 ***	−0.48 ***	−44 ***	0.32 **	(0.77)	-	-
9. Smartphone addiction	0.42 ***	−0.04	0.18	−0.04	0.82 ***	−0.08	−0.03	−0.43 ***	(0.93)	-
10. Satisfaction with life	0.33 **	0.17	0.32 **	0.29 **	0.58 ***	0.17	0.23 *	−0.01	0.52 ***	(0.75)
Score	9–45	9–45	9–45	8–40	5–25	22–70	10–50	13–30	10–50	5–25
Mean(SD)	26.23 (8.59)	34.14 (10.02)	29.14 (9.90)	31.35 (8.05)	12.68 (5.84)	52.35 (11.43)	37.33 (9.61)	19.97 (3.54)	26.71 (11.21)	15.10 (4.48)
Skewness	−0.013	1.091	−0.373	−1.030	0.329	−0.719	−0.991	0.599	0.212	0.080
Kurtosis	−0.108	0.562	−0.375	0.563	−0.927	0.263	0.986	−0.012	−0.705	0.159

Notes. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$. Alpha values on the diagonal.

Among the identity styles, the diffuse-avoidant type of identity was positively correlated with academic procrastination (r = 0.46, $p < 0.001$), smartphone addiction (r = 0.42, $p < 0.01$), and life satisfaction (r = 0.33. $p < 0.01$), but there was no association with self-efficacy, optimism, or academic performance. The informational type of identity had strong positive correlations with academic achievement (r = 0.65, $p < 0.001$), academic motivation (r = 0.73, $p < 0.001$), and self-efficacy (r = 0.73, $p < 0.001$). The association with optimism was also significant (r = 0.42, $p < 0.001$). The normative identity type of identity was positively related to not only self-efficacy (r = 0.57, $p < 0.001$), academic achievement (r = 0.46, $p < 0.001$), academic motivation (r = 0.40, $p < 0.001$), and life satisfaction (r = −32, $p < 0.01$)

but also to academic procrastination (r = 0.31, $p < 0.01$). There were strong intercorrelations among the academic variables. It is also worth mentioning that smartphone addiction was strongly associated with academic procrastination (r = 0.82, $p < 0.001$) and life satisfaction (r = 0.52, $p < 0.001$) and negatively with optimism (r = −0.43, $p < 0.001$). The relationship of life satisfaction with procrastination was also positive.

4.2. K-Means Clustering

To determine user profiles according to the level of identity styles and the selected educational and psychological variables, we conducted a K-means cluster analysis. This cluster method has a distance-based clustering algorithm, in which the distance is used as a measure of similarity. The number of clusters was determined based on the Elbow method, which identified the point (k = 3) when adding more clusters only minimally decreased the total cluster variance. Figure 1 represents cluster profiles based on z-scores in a spider chart. Each variable was included, and the values were connected to increase the visibility of the profiles.

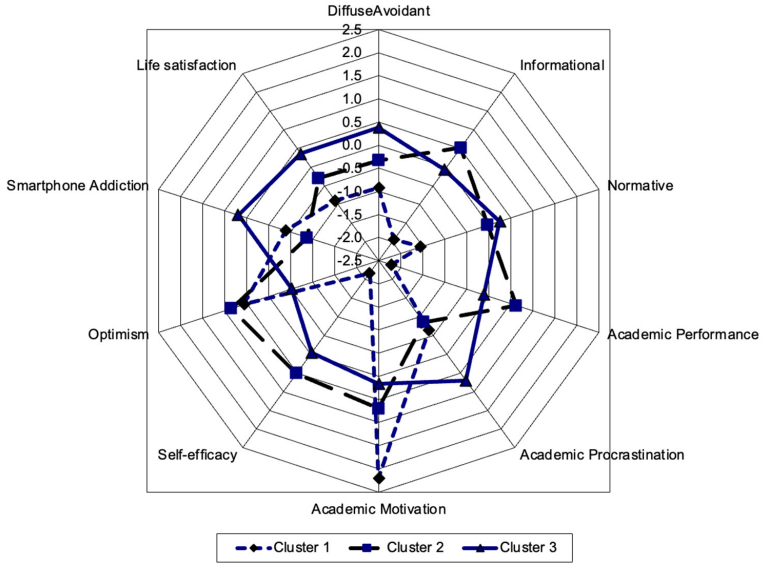


Figure 1. Student cluster profiles based on z-scores.

The students of the first cluster showed generally lower levels in all the attributes. They perceived the lowest values of academic performance (z = −2.21) and academic motivation (z = −2.20). Their highest values were smartphone addiction (z = −0.39). They also perceive a lack of appropriate self-efficacy and satisfaction with life. This cluster represented only 18.18% (n = 9) of the sample.

The second cluster included students who are academically motivated, perform well, and maintain a balanced life, with relatively low procrastination and smartphone use. They scored high levels of academic performance (z = 0.63), academic motivation (z = 0.70), and optimism (z = 0.85). Their lowest scores included academic procrastination (z = −0.85) and smartphone addiction (z = −0.88). It represented 38.18% (n = 42) of the sample.

Our last cluster includes individuals with high level of diffuse-avoidant (z = 0.38), normative identity (z = 0.25), and life satisfaction (z = 0.36). However, optimism (z = −0.52) was lower, and their smartphone (z = 0.69) addiction and academic procrastination (z = 0.71) were high. The cluster included 53.64% (n = 59) of the sample.

The Silhouette scores were 0.51 for the first, 0.31 for the second, and 0.26 for the third cluster. Despite the weak structure of the clusters, we considered it the most appropriate

one based on their interpretability and levels of associations (iteration history and post hoc tests).

In our second step, multivariate analyses were conducted to justify our results. MANOVA showed a significant results (Wilk's $\Lambda = 0.88$, $F(18) = 21.30$, $p < 0.001$, $\eta p2 = 0.42$); therefore, ANOVA was used in further analyses. Table 2 includes the means, standard deviations, z-scores, and F-values for the three clusters. In addition, based on the F-values, all the clusters are well separated along these variables, especially along the academic variables and smartphone addiction.

Table 2. Means, SD, z-scores. and F-test for identity and the psychological status (N = 110).

	Cluster 1 Mean (SD) z-Score	Cluster 2 Mean (SD) z-Score	Cluster 3 Mean (SD) z-Score	F-Value	η2p
Diffuse-avoidant	18.33 (7.02) −0.92	23.31 (8.83) −0.34	29.51 (7.08) 0.38	12.79 ***	0.19
Informational	14.67 (6.54) −1.94	39.36 (6.81) 0.52	33.41 (8.43) −0.07	38.54 ***	0.42
Normative	13.89 (7.17) −1.54	28.98 (9.59) −0.02	31.59 (8.37) 0.25	15.90 ***	0.23
Academic Performance	13.56 (4.75) −2.21	36.45 (3.69) 0.63	30.44 (6.35) −0.11	69.45 ***	0.56
Academic Procrastination	8.89 (3.26) −0.65	7.69 (2.52) −0.85	16.81 (4.53) 0.71	76.00 ***	0.59
Academic Motivation	27.11 (5.42) −2.20	60.40 (6.17) 0.70	50.47 (8.08) −0.16	83.03 ***	0.61
Self-efficacy	16.44 (8.44) −2.17	42.31 (6.03) 0.52	36.97 (7.24) −0.04	52.16 ***	0.49
Optimism	18.00 (1.22) −0.56	22.98 (3.32) 0.85	18.14 (2.25) −0.52	43.39 ***	0.45
Smartphone addiction	22.33 (9.64) −0.39	16.79 (5.86) −0.88	34.44 (8.00) 0.69	71.49 ***	0.57
Satisfaction with life	11.11 (4.73) −0.89	13.60 (4.18) −0.30	16.93 (3.98) 0.36	37.32 ***	0.17
Percentage (n)	8.18% (9)	38.18% (42)	53.64% (59)		

Notes. *** $p < 0.001$.

The Tukey's post hoc tests indicated that, in terms of diffuse-avoidant type of identity: cluster 3 > cluster 1 ($p < 0.001$) and cluster 3 > cluster 2 ($p < 0.001$). According to informational identity, all clusters significantly differed from the others ($p = 0.001$ or below). For normative identity, cluster 1 showed a significantly lower level from cluster 2 and cluster 3 ($p < 0.001$). Regarding academic achievement, all the clusters significantly differed from the others ($p < 0.001$). In terms of academic procrastination, cluster 3 > cluster 1 and cluster 3 > cluster 2 ($p < 0.001$ in both cases). In the case of academic motivation and self-efficacy, all clusters significantly differed from the others ($p = 0.001$ or below). Regarding optimism, cluster 2 > cluster 1 and cluster 2 > cluster 3 ($p < 0.001$ in both cases). For smartphone addiction, cluster 3 > cluster 1 and cluster 3 > cluster 2 ($p < 0.001$ in both cases). Finally, satisfaction with life showed a similar picture: cluster 3 > cluster 1 ($p = 0.001$) and cluster 3 > cluster 2 ($p = 0.002$).

5. Discussion

The study aimed to explore automotive engineering students' clusters based on their identity processing styles and to examine differences among these groups by means of psychological and educational variables in TVET institutions in Kenya.

Among the identity styles, the diffuse-avoidant type of identity was positively correlated with academic procrastination (and slightly with academic motivation) and smartphone addiction, as well as with life satisfaction. This implies that, in TVET institutions, where hands-on learning and timely completion of practical assignments are essential, students with a diffuse-avoidant identity style would tend to procrastinate more in their academic tasks. In addition, they would also struggle to commit to tasks, leading to last-minute cramming and missed deadlines, which may, in turn, lower their academic achievement, as well as limit their opportunities for mastery and success in their vocational courses. Diffuse-avoidant styles, in particular, have been identified as having potential implications for academic success (Rydz & Romaneczko, 2022). The findings of this study were further supported by other studies (Cadely et al., 2011; Hejazi et al., 2009; Seabi & Payne, 2013) suggesting that students with diffuse-avoidant identity may have lower academic performance throughout high school and college. Several studies have found that students with diffuse-avoidant styles tend to have lower levels of academic self-efficacy, leading to decreased motivation and engagement in academic activities (Hejazi et al., 2009; De Clercq et al., 2017; Jakubowski & Dembo, 2004; Leader, 2010). Furthermore, in the context of TVET, our results revealed that the diffuse-avoidant students might turn to excessive smartphone use as a coping mechanism. This can lead to more distraction from academic work, which, in turn, may lower their concentration and focus. Moreover, there was a lack of association with self-efficacy, optimism, and academic performance, which might create a worrying impression, since these students might not believe in their academic strength (low self-efficacy). Combining this with academic procrastination and smartphone addiction may lower the student's academic achievement in the end. However, we should note here that these correlations do not mean cause-and-effect relationships, only one way for an explanation.

In turn, the informational type of identity was positively related to academic performance and motivation, self-efficacy, and optimism. This implies that students who are information-oriented may be more likely to engage deeply in their studies, finding the subjects interesting and developing a strong desire to learn and master the subject and practical skills. These findings can be directly linked to intrinsic motivation to fuel and improve their academic performance. Other investigators have established that informational identity style is correlated positively with issue-oriented coping, academic and emotional autonomy, and self-regulation (Leader, 2010). This is also in tandem with the study of Bouizegarene et al. (2018) on a correlation between informational identity and passion, which motivated students to perform highly. Similarly, Mohamadi and Mokhtari (2016) revealed that the informational style was the most effective predictor of academic achievement and skill development. It can be explained that information-oriented students believe in their ability to succeed academically, allowing them to approach difficult tasks with a positive attitude and endure to overcome challenges and achieve their goals. This kind of student may tend to look at life with optimism, which is a powerful tool for dealing with academic problems and maintaining motivation. This attitude also implies setting clear academic goals, developing effective study strategies, and taking full responsibility for their academic success. Its correlation with normative identity suggests that these attitudes may be formed by social norms of the institutions and learning environment. Further, longitudinal studies should strengthen these associations.

The normative identity type was positively related to not only self-efficacy, life satisfaction, academic performance, and motivation but also to academic procrastination. This finding may be explained by the assumption that normative-oriented TVET students are likely to believe in their strengths and capabilities (self-efficacy), which may be due to their critical focus on meeting expectations to achieve their set goals; this can fuel their

academic performance. The urge to meet (normative) expectations can turn into academic motivation, since they are driven by the desire to please parents, friends, teachers, or future employers. This may lead them to invest more effort in their studies. The combined effect of self-efficacy and academic motivation may act as a positive outcome in academics for these students through setting goals, working towards them, and becoming high achievers. Earlier studies explored the potential impact of normative identity processing styles on academic achievement. For instance, normative identity processing styles were positively correlated with academic achievement among adolescents (Crocetti et al., 2008). This suggests that individuals who prioritize conformity to societal norms in their identity development may exhibit higher levels of engagement and motivation in academic pursuits. Likewise, the active exploration of normative identities was positively associated with academic achievement in emerging adults (Luyckx et al., 2011; Zarrin et al., 2017). Self-esteem and self-efficacy can act as potential mediators between normative identity processing styles and academic achievement (McKay et al., 2022).

Finally, we explored three clusters. One was a group of students with a lack of identity and low levels of academic performance, motivation, self-efficacy, and satisfaction with life; thankfully, only a minority of students belonged to this cluster, which seems to be the most vulnerable. This finding was supported by Komarraju and Dial's study, which found that students with a socially oriented approach tended to exhibit lower levels of academic self-efficacy, reduced self-determined motivation, and a preference for performance-based goals (Komarraju & Dial, 2014). In contrast, studious students demonstrated higher self-efficacy and showed a stronger inclination toward learning-oriented goals. The findings of Çelik et al. revealed that life satisfaction had a direct and significant impact on both academic self-efficacy and organizational identification, with an additional significant indirect effect on organizational identification mediated by academic self-efficacy (Çelik et al., 2020).

Nevertheless, it was promising that the balanced, not vulnerable smartphone users belonged to the second-largest group. These students scored the highest level of informational identity subscale; they were high achievers and motivated to learn and showed a higher level of optimism, life satisfaction, and self-efficacy. Xiao et al. (2024) supported the observation that students with balanced smartphone use, who demonstrated high informational identity and were motivated, optimistic, and high achievers, might benefit from the positive perceptions of upward mobility and hopeful attitudes (Xiao et al., 2024). Approximately half of the sample consisted of students with both diffuse-avoidant and normative identity; they were prone to academic procrastination and smartphone addiction but still possessed relatively higher levels of self-efficacy, life satisfaction, and academic performance/motivation. Subjective norms may also have a psychological effect on optimism and attitudes towards life satisfaction, which can affect students' abilities and drive for excellence, and they might benefit from the positive perceptions of upward mobility and hopeful attitudes (Sany et al., 2023).

The presence of both diffuse-avoidant and normative identity in cluster 3 suggests that the students may experience conflicting academic motivation and societal pressure with personal desires and goals. The students may feel compelled to conform to academic norms, societal norms, and expectations (normative) while simultaneously struggling with indecision, avoidance, and procrastinating on school tasks (diffuse-avoidant). Berzonsky's earlier research highlights that normative-oriented students often rely on social norms for guidance but may also avoid or distance themselves from stressors that threaten their self-perceptions (Berzonsky, 1992). It appears that TVET students do delay task completion, but they apparently procrastinate or complete similar types of academic and nonacademic tasks (Ferrari & Scher, 2000). Their adherence to norms could be limited to academic achievement, while they avoid exploring other aspects of their identity (diffuse-avoidant).

They may not be aware of their identity styles leading to inconsistencies in their responses. Moreover, normative identity might have different meanings in the Kenyan educational settings compared to other educational settings and other cultures. Traditional gender roles, social obligation, respect for the elderly, and a collectivist orientation are deeply ingrained in Kenyan culture. These elements are significant in the ways students perceive themselves within their social context and internalize the expectations, roles, and responsibilities ascribed to them. Because social cohesion and respect are important in Kenyan culture, students may suppress their aggressiveness for the sake of group consensus. This might affect the student's participation in debates or decision-making procedures. In most Kenyan contexts, respect for authority has been inculcated into people since they were young; this may influence the way students relate to their teachers or how they react to criticism or rebuke. A collectivist culture may influence preferences for group-based learning (Kunwar, 2021). However, this conflicts with the individualistic assessment methods commonly adopted in international schooling systems. Irrelevant cultural curriculum materials can prevent students from relating to the curriculum, which could result in lower school engagement and academic achievement. The same cultural expectations that motivate, such as family success, may simultaneously lead to anxiety or reduced self-efficacy in struggling students.

Smartphones play an important role in young adult life; they can provide immediate gratification and distraction (Dontre, 2020). Our finding suggests that students may derive short-term satisfaction from smartphones, leading to addiction with negative consequences. For these students, smartphone use may possibly act as a coping mechanism or source of temporary pleasure. While procrastination is typically associated with negative outcomes, such as decreased academic performance and increased stress, it can also provide short-term relief from anxiety or discomfort. Although negative procrastinators perform worse than neutral procrastinators, they still manage to achieve a certain level of success within the institution environment (Klassen et al., 2008). In the context of normative identity processing, individuals may procrastinate due to a fear of failure or a desire to meet societal expectations of success. Thus, these students may exhibit procrastination as a normative response to academic pressure, seeking short-term relief while still adhering to societal norms of achievement.

In terms of the interrelationship between educational and psychological variables, a previous study examined whether the students' identity and motivation dimensions could be combined into profiles that might predict academic achievement. Although identity was not associated with academic achievement and only motivation was, the combined motivation–identity profiles predicted student achievement and their dropouts (Meens et al., 2018). This finding is in line with our results, suggesting that both identity and motivation can be taken into account in evaluating students' endeavors and attitudes toward learning.

Nevertheless, these findings connect to the global TVET concerns by showing varied student profiles with differing degrees of motivation, self-efficacy, and flexibility. This is in line with global aims such as the promotion of inclusivity for poorly performing students (Ainscow, 2020), the resilience and optimism of high achievers (Sarkar & Fletcher, 2014), and addressing students' digital habits in more technology-driven educational institutions (Hansson & Sjöberg, 2019). Moreover, these observations lend credibility to the global movement to adapt TVET systems to the diversified needs of learners in rapidly changing labor markets.

Strengths and Limitations

The use of cluster analysis in this pilot study allowed for the identification of subgroups or profiles within the student population based on their identity styles and educational and

psychological variables that allowed for more targeted interventions, support, or educational strategies in automotive engineering courses. The focus on automotive engineering students in TVET institutions in Kenya revealed an area that is underrepresented in research even across the globe, and it addressed the unique challenges and opportunities informing targeted interventions and policies. This study focuses on identity processing styles, a relatively new research field, particularly within the context of automotive engineering in Kenya, leading to novel insights. The findings of this study have practical implications for educators, policymakers, and counselors in TVET institutions in Kenya and can be used to develop educational programs and interventions that address the specific needs of different student profiles. However, the findings of the study are limited in their generalizability due to the specific context of automotive engineering students in Kenya and the weak structure of the cluster profiles. Furthermore, participants are exclusively drawn from the Nyanza region, which may limit the findings' applicability to other regions or national contexts. The sample is predominantly male (92%), and the findings might differ for female students. Finally, we acknowledge that socially desirable responding (SDR) can significantly influence survey results, particularly in self-report data collection methods such as questionnaires. This study only considers a specific set of identity processing styles relating to educational and psychological variables, neglecting other potentially relevant aspects of identity. The Silhouette scores indicated a relatively weak structure; in the future, we should strengthen it. Furthermore, using online questionnaires may have excluded students without consistent internet access, introducing potential selection bias; resulting in skewed sample representation; and predominantly attracting participants with reliable internet access, digital literacy, and a willingness to engage. This may lead to the underrepresentation of rural or socioeconomically disadvantaged populations, thereby limiting the generalizability of the findings. Finally, the limitation of the small sample size (110 participants) in this pilot study is acknowledged. Pilot studies, however, are primarily exploratory and are not intended to produce fully generalizable results but to test the feasibility of the research design, identify potential challenges, and refine methods for larger-scale studies (Leon et al., 2011). We therefore recommend longitudinal research with a greater sample size to be conducted to provide more robust evidence of the dynamics between identity processing styles and educational/psychological variables over time, including other aspects of identity. Especially, seeking further explanations for the combination of identities and how these may influence students' academic performance would be essential in future studies.

6. Conclusions

This study explored the interplay between identity processing styles, educational background, and psychological factors among automotive engineering students in Kenyan TVET institutions. Three clusters emerged: a low-performing group, a high-achieving group with high informational identity, and a group with conflicting academic motivations (diffuse-avoidant and normative identity). Students with a diffuse-avoidant identity were more likely to procrastinate and struggle academically, while those with an informational identity showed stronger academic achievement and motivation. Normative identity students exhibited a mix of positive and negative associations, with a positive correlation between self-efficacy and achievement but also a surprising link to procrastination. These findings highlight the importance of identity development for academic success, with informational and normative styles offering advantages while the diffuse-avoidant style presents challenges. Interrelationships among the variables also support the role of culture in identity processing; thus, the research provides valuable insights for educators and policymakers in Kenyan TVET institutions, and by understanding student identity styles,

targeted interventions can be developed to address specific needs and challenges. This can lead to improved learning outcomes, increased student well-being, and a more successful TVET system in Kenya. We therefore propose the following recommendations: (a) TVET institutions should develop targeted interventions to boost academic motivation and self-efficacy, such as mentorship programs, personalized career counseling, and life skills training, and integrate well-being initiatives to enhance life satisfaction, which could indirectly improve academic outcomes (cluster 1). (b) Institutions should also reinforce positive behaviors by providing opportunities for advanced learning, leadership roles, and skill-based competitions, which can further motivate high-achieving students and sustain their optimism and self-efficacy while minimizing potential distractions (cluster 2). (c) Lastly, the institutions should implement workshops to address procrastination and smartphone addiction alongside strategies to channel normative-driven motivation into structured goal-setting and time management, as this could improve their academic consistency (cluster 3).

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Appendix A

1. **Questionnaire for Automotive Engineering Students**

Thank you for your interest in participating in this survey. The purpose of this study is to collect data on the interplay of identity processing styles, self-efficacy, and academic achievement among Automotive Engineering students in public TVET institutions in Kenya.

This questionnaire will be used to collect data for a PhD in Educational Sciences at the University of Szeged, Hungary and is completely anonymous. Your answers will be treated with confidentiality. Please indicate the correct option as honestly and as correctly as possible by putting a tick ($\surd$) on one of the options. For the questions that require your opinion, please complete the blanks.

Section A: Demographic Information

Indicate your answer below:

1. Course of study. . .
2. Age. . .
3. Sex. . .
4. Your Institution. . .

(a) **Identity Style Inventory Scales**

Instructions

You will find several statements about beliefs, attitudes, and/or ways of dealing with issues. Read each carefully and use it to describe yourself. On the answer sheet, select the number that indicates the extent to which you think the statement represents you. There are no right or wrong answers. For instance, if the statement is very much like you, mark a tick (√) in the space below 5, if it is not like you at all, tick (√) in the space below 1. Use the 1- to 5-point scale to indicate the degree to which you think each statement is uncharacteristic (1) or characteristic (5) of you.

1 = not at all like me
2 = unlike me
3 = neither like me
4 = like me
5 = very much like me

		1	2	3	4	5
Defuse-avoidant items: *Cronbach's alpha: 0.85*						
1	When personal problems arise, I try to delay acting as long as possible					
2	I'm not sure where I'm heading in my life; I guess things will work themselves out					
3	My life plans tend to change whenever I talk to different people					
4	Who I am changes from situation to situation					
5	I try not to think about or deal with problems as long as I can					
6	I try to avoid personal situations that require me to think a lot and deal with them on my own					
7	When I have to make a decision, I try to wait as long as possible to see what will happen					
8	It doesn't pay to worry about values in advance; I decide things as they happen					
9	I am not thinking about my future now, it is still a long way off					
Informational items: *Cronbach's alpha: 0.96*						
1	When making important decisions, I like to spend time thinking about my options					
2	When facing a life decision, I take into account different points of view before making a choice					
3	It is important for me to obtain and evaluate information from a variety of sources before I make important life decisions					
4	When making important decisions, I like to have as much information as possible					
5	When facing a life decision, I try to analyze the situation to understand it					
6	Talking to others helps me explore my personal beliefs					
7	I handle problems in my life by actively reflecting on them					
8	I periodically think about and examine the logical consistency between my values and life goals					
9	I spend a lot of time reading or talking to others trying to develop a set of values that makes sense to me					
Normative items: *Cronbach's alpha: 0.92*						
1	I automatically adopt and follow the values I was brought up with					
2	I think it is better to adopt a firm set of beliefs than to be open-minded					
3	I think it's better to hold on to fixed values rather than to consider alternative value systems					
4	When I make a decision about my future, I automatically follow what close friends or relatives expect from me					
5	I prefer to deal with situations in which I can rely on social norms and standards					
6	I have always known what I believe and don't believe; I never really have doubts about my beliefs					
7	I never question what I want to do with my life because I tend to follow what important people expect me to do					
8	When others say something that challenges my personal values or beliefs, I automatically disregard what they have to say					
9	I strive to achieve the goals that my family and friends hold for me					

Adopted from Berzonsky et al. (2013, p. 897).

(b) **Self-Efficacy Scale**

Instructions

You will find several statements about beliefs, attitudes, and/or ways of dealing with issues. Read each carefully and use it to describe yourself. On the answer sheet, select the number that indicates the extent to which you think the statement represents you. There are no right or wrong answers. Five responses are given to each statement.

1 = not at all true, 2 = hardly true, 3 = neutral, 4 = moderately true, and 5 = exactly true.

		1	2	3	4	5
1	I can always manage to solve difficult problems if I try hard enough					
2	If someone opposes me, I can find the means and ways to get what I want					
3	It is easy for me to stick to my aims and accomplish my goals					
4	I am confident that I can deal efficiently with unexpected events					
5	Thanks to my resourcefulness, I know how to handle unforeseen situations					
6	I can solve most problems if I invest the necessary effort					
7	I can remain calm when facing difficulties because I can rely on my coping abilities					
8	When I am confronted with a problem, I can usually find several solutions					
9	If I am in trouble, I can usually think of a solution					
10	I can usually handle whatever comes my way					

Adopted from Schwarzer and Jerusalem (1995). Cronbach's alpha: 0.92.

(c) **Academic Motivation Scale**

Instructions

Please answer the following questions about yourself by indicating the extent of your agreement using the scale provided. Be as honest as you can throughout and try not to let your response to one question influence your responses to the other questions. There are no right or wrong answers.

1 = not at all correspond, 2 = hardly correspond, 3 = neutral, 4 = moderately correspond, and 5 = exactly correspond.

		1	2	3	4	5
1	For the pleasure I experience when I discover new things never seen before.					
2	Because my studies allow me to continue to learn about many things that interest me					
3	For the pleasure that I experience while I am surpassing myself in one of my personal accomplishments.					
4	Because college allows me to experience personal satisfaction in my quest for excellence in my studies					
5	For the pleasure that I experience when I read interesting authors.					
6	For the pleasure that I experience when I feel completely absorbed by what certain authors have written					
7	Because I think that a college education will help me better prepare for the career I have chosen					
8	Because eventually, it will enable me to enter the job market in a field that I like					
9	Because of the fact that when I succeed in college I feel important					
10	Because I want to show myself that I can succeed in my studies					
11	In order to obtain a more prestigious job later on.					
12	In order to have a better salary later on					
13	I can't see why I go to college and frankly, I couldn't care less					
14	I don't know; I can't understand what I am doing in school					

Adopted from (Kotera et al., 2021). Cronbach's alpha: 0.89.

(d) **Life Orientation Test**

Instructions

Please answer the following questions about yourself by indicating the extent of your agreement using the scale provided. Be as honest as you can throughout and try not to let your response to one question influence your responses to the other questions. There are no right or wrong answers.

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

		1	2	3	4	5
1	In uncertain times, I usually expect the best					
2	It's easy for me to relax					
3	If something can go wrong for me it will					
4	I am always optimistic about my future					
5	I enjoy my friends a lot					
6	It is important for me to keep busy					
7	I hardly ever expect things to go my way					
8	I don't get upset too easily					
9	I rarely count on good things happening to me					
10	Overall, I expect more good things to happen to me than bad					

Adopted from Scheier et al. (1994). Cronbach's alpha: 0.77.

(e) **Academic Achievement Scale**

Instructions

Please answer each question using the 5-point scale so that it accurately reflects what you do or have done as a student. Be as honest as possible, because the information can be utilized to discover areas of strength.

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

		1	2	3	4	5
1	I made myself ready in all my subjects					
2	I pay attention and listen during every discussion.					
3	I want to get good grades in every subject.					
4	I actively participate in every discussion.					
5	I start papers and projects as soon as they are assigned.					
6	I enjoy homework and activities because they help me improve my skills in every subject.					
7	I exert more effort when I do difficult assignments.					
8	Solving problems is a useful hobby for me.					

Adopted from Birchmeier, Grattan, Hornbacher, and McGregory. Cronbach's alpha: 0.94.

(f) **Smartphone Addiction Scale**

Instructions

The Smartphone Addiction Scale (SAS) is a scale for smartphone addiction consisting of factors influencing students' academic achievement in 10 items with a 5-point Likert scale. The factors are daily life disturbance, positive anticipation, withdrawal, overuse, and

tolerance while in a learning environment. Please answer each question using the 5-point scale so that it accurately reflects what you do or have done as a student. Be as honest as possible, because the information can be utilized to discover areas of strength.

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

		1	2	3	4	5
1	Missing planned work due to smartphone use					
2	Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use					
3	Feeling pain in the wrists or at the back of the neck while using a smartphone					
4	Won't be able to stand not having a smartphone					
5	I feel impatient and fretful when I am not holding my smartphone					
6	Having my smartphone in my mind even when I am not using it					
7	I will never give up using my smartphone even when my daily life is already greatly affected by it					
8	I constantly check my smartphone so as not to miss conversations between other people on Twitter or Facebook					
9	Using my smartphone longer than I had intended					
10	The people around me tell me that I use my smartphone too much.					

Adopted from (Kwon et al., 2013). Cronbach's alpha: 0.93.

(g) **Academic Procrastination Scale**

Instructions

Please answer each question using the 5-point scale so that it accurately reflects what you do or have done as a student. Be as honest as possible, because the information can be utilized to discover areas of strength.

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

		1	2	3	4	5
1	I put off projects until the last minute.					
2	I know I should work on schoolwork, but I just don't do it.					
3	I get distracted by other, more fun, things when I am supposed to work on schoolwork.					
4	When given an assignment, I usually put it away and forget about it until it is almost due.					
5	I frequently find myself putting important deadlines off.					

Adopted from (Yockey, 2016). Cronbach's alpha: 0.92.

(h) **Satisfaction With Life Scale**

Instructions

Below are five statements that you may agree or disagree with. Using the 1–7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responses.

1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neither agree nor disagree, 5 = slightly agree, 6 = agree, and 7 = strongly agree.

		1	2	3	4	5	6	7
1	In most case my life is close to my ideal.							
2	The conditions of my life are excellent.							
3	I am satisfied with my life.							
4	So far I have gotten the important things I want in life.							
5	If I could live my life over, I would change almost nothing.							

Source: (Diener et al., 1985). Cronbach's alpha: 0.75.

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