

Article

No Anxious Student Is Left Behind: Statistics Anxiety, Personality Traits, and Academic Dishonesty—Lessons from COVID-19

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Abstract: Scholarly studies have revealed that exposure to statistics courses affect students' anxiety levels and that this has been associated with unethical misconduct. Thus, the present research's main objective is to comprehend the mediating role Statistics Anxiety plays on the relationship comprising students' personality traits and academic dishonesty as manifesting before and during the COVID-19 pandemic. Its aim is to understand this phenomenon and provide theoretical tools for fostering sustainably personalized distance learning and instruction. Data were collected from students studying for a bachelor's degree in the social sciences at three different Israeli colleges. The sample comprises 316 participants and data were analyzed using Structural Equation Modelling (SEM). The results show a significant mediation manifested by an indirect effect between personality traits and academic dishonesty via statistics anxiety only in emergency remote teaching, although no parallel significant mediation was observed in the face-to-face course. These results could be explained by differences in delivery methods. Thus, we recommend that in the emergency remote teaching environment instructors' presence include: (1) supportive, emphatic interaction to reduce virtual distance and (2) Social Emotional Learning (SEL) strategies, which foster students' learning challenges and prevent anxiety and academic dishonesty.

Keywords: statistics anxiety; personality traits; academic dishonesty; face-to-face learning; emergency remote teaching; COVID-19



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1. Introduction

Constant technological advances compel educators to permanently improve the competences necessary to promote personally sustainable development [1] and education, including focusing on students' personality traits and their relation to academic performance [2]. The foregoing poses a challenge to current educators' tasks and methodologies [3], as these are required to develop their own and their students' digital competences, along with the skills necessary for lifelong self-development. In these circumstances, the pedagogic notion of personalized learning has allowed shifting from normative requirements and standards to learners' personalities, thus centering on their specific inclinations, skills, and talents as determined by different national and cultural contexts, etc. [1]. One may accordingly hold that the foregoing demands a more sustainable and personalized type of education, including educational data mining techniques [3], and statistical literacy, which has become an indispensable asset in many educational fields [4].

In this context, scholarly studies have revealed that exposure to statistics courses affects student's anxiety levels [5–7], which is a well-known difficulty emerging while teaching and learning quantitative material. Moreover, statistics anxiety has been associated with unethical misconduct [8–10] and academic dishonesty [11]. More specifically, academic dishonesty has become a common global phenomenon [12] continuously increasing and having a negative impact on quality education and subsequent professional

practices. Consequently, scholars have argued, educational institutions need to formulate and apply new strategies to avoid it [13], while keeping, at the same time, high educational standards for sustainable education, including distance education.

The foregoing has become a pressing need due to the COVID-19 pandemic, which has compelled educational institutions around the globe to redesign education [14] and move from traditional learning environments to online distance ones [15]. In other words, the virus outbreak has posed a new educational challenge, thus demanding that scholars rethink higher education's institutional post-pandemic future [16], including the needs and solutions that may allow the continuity of high-quality education and efficient digital instruction for successful learning [15,17]. In this context, the COVID-19 pandemic has a major theoretical importance. The deeply disruptive reality it has brought about represents an unprecedented case study, the conclusions of which could allow educators worldwide to prepare and plan more effectively to assure optimal learning in future unexpected scenarios [18].

In other words, theorizing on the above requires considering the 2030 Agenda for Sustainable Development [19], which urges authorities to reformulate educational practices according to the Education for Sustainable Development (ESD) criteria. (The current educational system was conceived in the eighteenth century. It was further developed in the context of the economic circumstances following the nineteenth century industrial revolution [20]. One may therefore argue that there is a pressing need to update it. Interesting as it may be, the discussion of this topic remains beyond the scope of this research.) As a fundamental part of quality education, this has been planned to promote the development of sustainable competencies, i.e., statistical literacy, which has become predominant and fundamental for different daily professional practices, including health [4] and social sciences [7].

Furthermore, educational practices need to be supplemented with moral values, as these are undergoing rapid degeneration [21], which leads to increased academic dishonesty. In this context, the notion of ESD was developed to promote those competencies leading individuals to reflect on and become aware of their actions [22], i.e., ethical behavior. Accordingly, ESD provides learners with moral values, skills, and competences, thereby fostering quality education and positive personal and community changes, which are key to it.

Otherwise stated, current socioeconomic and health circumstances (i.e., the COVID-19 pandemic) have revealed that there is a need to promote the development of skills and knowledge focusing on the formation of statistically literate citizens [23], for which statistics education is imperative. Hence, identifying students' propensity to develop statistics anxiety in introductory statistics courses as determined by their specific personality traits may allow to prepare instructors for intervening [24] and preventing academic dishonesty whenever needed.

The present research's main objective is to comprehend the mediating role statistics anxiety plays in the relationship comprising students' personality traits and academic dishonesty, as manifesting before and during the COVID-19 pandemic. It shows that changes influencing students' motivation and emotional state affect their mental health and academic performance negatively [25], thus threatening their acquisition of statistical skills, which, in addition, is exacerbated by rapid shifts to unprecedented educational, pedagogical, and technological formats. Accordingly, there is a need for empirical work to guide educators in shaping the landscape of higher education worldwide during challenging times. The latter should allow to prepare for future crisis contexts, thereby fostering sustainable personalized learning and instruction, including in the distant learning field.

In addition, this research offers countermeasures to promote a sustainable development of statistics literacy free of anxiety and the propensity to engage in dishonest conduct. This is accomplished in line with the need to endow educational systems with an increased learning flexibility, to which UNESCO's Sustainability Goals for Education (SDG4) has long been committed [19].

2. Theoretical Background

2.1. Statistics Anxiety

Statistics anxiety has been known and defined as a transitory feeling of anxiety arising while being exposed to statistical contents or taking statistic courses [26]. Previous scholarly research has identified statistics anxiety as one of the most frequent obstacles interfering with teaching and learning quantitative material. It manifests as a recurrent type of anxiety negatively affecting performance and learning processes [27]. Statistics anxiety is further characterized as an individual feeling of apprehension associated with the study of statistics, the antecedents of which are: (1) Personal factors such as gender, ethnicity, and age [6]. (2) Dispositional factors such as personality: e.g., the traits comprising the Five-Factor Model [28]. (3) Situation-related factors and attitudes connected to statistics [27,29]: e.g., mandatory introductory courses in statistics taking place in different learning environments. Moreover, research has revealed that statistics anxiety could awaken recurrent worrying, troubling thoughts, radical tension, nervousness, apprehension, and panic, thus conditioning one's learning processes and working memory [7].

Recent studies [30] have provided evidence of a strong correlation between academic performance and Statistics Anxiety. Its most frequent outcomes are failing in exams and in completing statistics related assignments. Negatively linking anxiety to performance is an additional outcome, leading students to higher procrastination rates and to avoiding statistics-related tasks [5]. This notwithstanding, the nature and antecedents of statistics anxiety as mediated in different learning environments (i.e., face-to-face, emergency remote teaching) are still unclear [11].

The six-factor model [7] is a widely accepted approach identifying and methodically integrating the components of statistics anxiety: (1) interpretation anxiety—the anxiety experienced when being required to interpret statistical data; (2) test and class anxiety—the anxiety experienced in course attendance and tests; (3) fear of asking for help—the anxiety experienced while trying to ask for help in understanding statistics; (4) computational self-concept—one's self-perception of their mathematical competence for learning statistics; (5) worth of statistics—the relevance and usefulness of learning statistics; and (6) fear of statistics teachers—a student's perception of statistics teachers. The foregoing represents the six elements comprising the common statistics anxiety rating scale (STARS). It covers anxious emotions as well as learners' attitudes towards statistics.

2.2. Academic Dishonesty

Research has identified an increasing trend to academic misbehavior [31–33], largely acknowledged as academic dishonesty. More specifically, the latter refers to different misbehaviors comprehending fraudulent conduct, plagiarizing, and cheating [34], all of which pose practical problems to both learners and instructors [35]. Academic dishonesty represents a complex issue [36]. On the one hand, cheating undergraduates obtain credentials on skills that they have not truly developed. Whereas, on the other hand, this leads to professional incompetence, which at times has life-threatening consequences, as, for instance, in medical practice. Furthermore, incessant unethical behavior has a detrimental impact on professional performance, thus eroding people's confidence in institutions [36]. The foregoing poses a severe objection to the true extent of learning and the sustainability of ensuing professional life [37].

Studies have shown that students engage in academic dishonesty at some point of their careers [38]. Although international research on academic dishonesty has been extensive [12,39], its connection to statistics anxiety has been scantily researched, including with regard to behavior determination by situational circumstances [40]—e.g., pandemics, such as the COVID-19 outbreak. This study fills this gap by examining the mediation role played by statistics anxiety on the relationship between personality Traits and academic dishonesty as it manifests in undergraduate students in the social sciences before and during the COVID-19 outbreak. Drawing from the research literature, we discuss the implications and results leading to better sustainable personalized statistical education.

2.3. Statistics Anxiety and Academic Dishonesty

The general concept of anxiety has been widely researched [41]. It comprises physiological and psychological responses to specific threatening situations, whereby individuals react by engaging in avoidance behavior [42]. According to some scholars, general anxiety affects academic performance negatively [43]. Research has shown that anxiety and unethical or dishonest behavior correlate [8]. Accordingly, the higher the level of anxiety students experience, the more they engage in unethical conduct [11]. Anxiety often awakens self-threatening emotions, thus leading individuals to reestablish confidence unethically [10]. In this context, students working on difficult educational tasks are likely to behave dishonestly [38] to evade potentially anxious experiences and situations. In the particular context of statistics anxiety, research has shown that students' negative attitudes and views about statistics courses are reflected in their achievements and grades [44]. Furthermore, research has additionally shown that statistics anxiety may comprise negative emotions leading to avoidance behaviors [25]. This, per-se, poses a challenge for those students who are less motivated, thus leading them to vastly discouraging learning attitudes [45]. The same applies to highly anxious students planning to cheat in tests. Accordingly, we posit:

Hypothesis H1 (H1). *Statistics anxiety will have a positive impact on academic dishonesty.*

2.4. Personality Traits

The theoretical notion of personality comprehends typical thoughts, emotions, and behaviors. Thereby, research distinguishes among individuals and predict, with different certainty degrees, their future thoughts, feelings, and behavior. The foregoing has been the object of intensive research in recent years. The well-known Five-Factor Model is one of the most prominent outcomes thereof [46].

The Five-Factor Model [47] divides personality into five different traits: Openness to Experience: individuals scoring highly on Openness to Experience are intellectually curious and often interested in new experiences; Conscientiousness: conscientious individuals are characterized by their planful, organized, and goal-directed orientation; Extraversion: extraverted individuals are likely to enjoy social settings; Agreeableness: agreeable individuals tend to be likable, warm, and trusting persons, and are often concerned with others' welfare; and Emotional Stability/Neuroticism [48]. Whereas emotionally stable individuals are predictable, consistent in their emotional reactions, and show low mood changes, neurotic individuals show self-conscious inclinations leading them to experience emotional instability. They are vulnerable to stress, and hence, they are more likely to experience negative emotions.

2.4.1. Personality Traits and Statistics Anxiety

Previous research on the relationship between personality traits and statistics anxiety is scant [49]. Nonetheless, it has established a relationship between statistics anxiety and the Five-Factor Model which has shown that: Openness to Experience correlates negatively with worth of statistics, fear of asking for help, and fear of statistics teachers. Students scoring high on Openness to Experience often find statistics courses worthwhile. Accordingly, they exhibit low levels of anxiety while seeking their peers' and instructors' help. Conscientiousness does not correlate with statistics anxiety [49]. Although some research studies have identified contradictory connections, it usually correlates negatively with stress and anxiety [50]. As a result, scholars have concluded that anxiety and Conscientiousness may coexist. Moreover, studies have revealed that Extraversion correlates with stress and anxiety negatively [48], albeit positively with statistics anxiety, as manifesting in interpretation anxiety, test and class anxiety, and fear of asking for help [49]. Agreeableness has been found to negatively correlate with stress [48], and particularly with worth of statistics, fear of asking for help, and fear of statistics teachers, thus leading to negative statistics anxiety. Research has shown that individuals exhibiting low levels of emotional stability are vulnerable to stress, and hence, they are more likely to experience negative

emotions such as anxiety and depression [48,51], which may lead to statistics anxiety. This manifests in their fear of statistics instructors and asking for help [52].

To sum up, scholarly research has shown that adaptive traits such as Openness to Experience, Extraversion, Conscientiousness, Agreeableness and Emotional Stability positively correlate with stress coping (i.e., COVID-19), albeit negatively with anxiety. In other words, lower levels of Emotional Stability are related to maladaptive traits (Neuroticism), which negatively correlate with stress coping, albeit positively with anxiety [48]. Relying on the above, we posit:

Hypothesis H2 (H2). *Students' personality traits will have an impact on statistics anxiety.*

2.4.2. Personality Traits and Academic Dishonesty

Research on the relationship between students' personality traits and academic dishonesty is vast. In this context, the Five-Factor Model has been extensively employed to assess the impact of personality traits on academic dishonesty [31,32]. More concretely, studies have shown that personality determines cheating behavior due to its impact on individuals' beliefs about themselves and others, their attitude towards learning and studying, and their goal attainment approach [36].

Research has revealed that individuals possessing the Openness to Experience trait usually disapprove of academic dishonesty [31]. More concretely, this trait has an almost insignificant relationship with academic dishonesty [53,54] and is a highly trustworthy predictor of academic integrity. Individuals scoring high on it are typically reflective of ideas and their consequences [36]. Studies on the Conscientiousness trait have provided evidence that conscientious students are often academically well prepared, and hence, exhibit a low cheating proclivity. In addition, they are achievement-oriented, and yet responsible, honest, and capable of regulating their behavior. More specifically, their behavior has a strong inverse relationship to cheating conduct. Individuals scoring high on Conscientiousness are often persistent students succeeding in different tasks. They obtain better grades and achieve higher self-efficacy, thus discarding cheating strategies. Individuals scoring high on Extraversion are prone to cheat. In addition, Extraversion has been shown to have a small to a nonexistent relationship to academic dishonesty [36,53,54]. Agreeableness has been found to have a significantly negative correlation to academic dishonesty [31]. Research studies have shown that it is inversely related to academic dishonesty [54]. Yet, recent research has provided evidence as to the existence of an almost insignificant inverse relationship between Agreeableness and academic dishonesty [36]. Moreover, students scoring high on Neuroticism (that is, low on Emotional Stability) tend to perceive difficult assignments and tests as potential threats. Academic dishonesty ensues due to their typically stressful character and poor coping strategies [54]. Studies could additionally determine that neuroticism has a relatively insignificant relationship to academic dishonesty [36].

Thus, based on Sections 2.4.1 and 2.4.2, we posit:

Hypothesis H3 (H3). *Statistics anxiety will mediate the relationship between students' personality traits and academic dishonesty.*

2.5. Learning Environment before and during COVID-19

Learning environments embody the physical, digital, cultural, or contextual domains determining "where" and "how" educational processes take place. They are informed by the actors operating in them, the technologies these employ, their physical layout, their social and cultural atmospheres [55], and the educational methodologies instructors apply in them [56]. Research dealing with the shift from conventional face-to-face to online instruction is extensive [57]. Yet, it is crucial to distinguish between planned online learning and emergency remote teaching [17,58,59]. Whereas the former is prearranged and designed, the latter implies moving, temporarily, from a face-to-face modality to an online one, without any prior planification or revision [59].

Traditional face-to-face learning environments are characterized by their employment of conventional teaching methods, most of which are still used in academic practices [60]. In this context, the scholarly research has shown that as to course completion, grades, and subsequent college matriculation, students usually exhibit worse performances in online settings than in traditional face-to-face ones [61].

The Coronavirus (COVID-19) pandemic outbreak has forced educational institutions to reorganize academic dynamics as a result of the physical distancing measures adopted by most governments worldwide [62]. More specifically, it compelled the academic community to adapt to emergency remote teaching (ERT) environments [63–65], thus, posing an unusual challenge to both learners and educators [66]. Notwithstanding the COVID-19 outbreak, previous research on online learning during emergencies is not new [67]. Studying and learning during crisis situations (e.g., natural catastrophes (earthquakes, floods, pandemics, etc.), man-made catastrophes (conflict or war zones), or industrial accidents) requires exceptional preparedness, both logistic (online platforms) and educational (instructors' immediacy), as students are under conditioned stress and trauma because of them [68]. Yet, despite ERT modality's advantages (flexible learning as to time and place), educators have been compelled to recreate learning interaction and adapt it to the virtual classroom [69].

Recent research on ERT [17,64,70] has stated that its aim is to allow instruction continuity when unexpected events take place. Accordingly, this learning environment compels educators to simultaneously complete the study curricula and deal with phenomena such as student anxiety [69]. Its main characteristics are the absence of pre-planned resources and infrastructures [55]. More specifically, educators delivering lessons in the ERT modality tend to be unprepared for unexpected changes, thus being compelled to deal with unfamiliar pedagogical settings. The minimal planning time they have at their disposal, along with the pressing need to reshape and adapt course contents and pedagogical methodologies to online environments, is the reason why these abrupt conversions are seen as emergency remote teaching experiences, rather than authentic online instruction [71].

Learning environments are determined by students' personal characteristics and different circumstances, e.g., physical distancing due to COVID-19 pandemic. In this context, one may mention students' knowledge motivation, active participation, attitudes towards the knowledge imparted, and approach to course delivery, all of which affect academic achievement [72]. In addition, research studies have distinguished between traditional face-to-face (F2F), planned online environments (POE), and emergency remote teaching (ERT), each of which conditions students' learning level differently [73].

Despite the myriad of research comparing face-to-face to online academic performance [74,75], relatively little is known about the relationship between personality traits and student performance in different learning environments (face-to-face, online). For example, Abe [75] has found that Conscientiousness and Openness to Experience are predictive of positive academic performance in F2F and POE, whereas Extraversion or Neuroticism hinder academic performance in POE.

Thus, based on previous research [11] focusing on the direct effect of Statistics Anxiety on academic dishonesty, which has shown that higher levels of anxiety anticipate academic dishonesty, especially in POE, based on the ambiguous results comprising the relationships between the FFM and learning environments [75], and following the effects of the COVID-19 pandemic, we hypothesize:

Hypothesis H4 (H4). *There will be differences between learning environments in the relationship between personality traits and academic dishonesty.*

2.6. Research Model

Based on the literature above, our research model (see Figure 1) theorizes that academic dishonesty is a result of personality traits mediated by statistics anxiety and students' achievements.

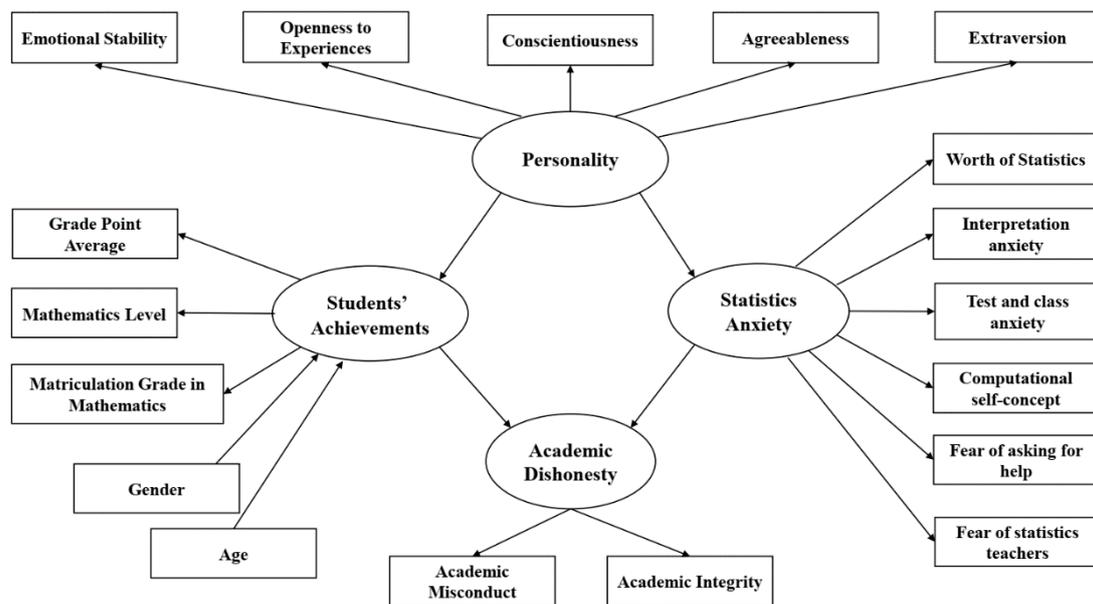


Figure 1. Structural Model for Determinants of Academic Dishonesty.

The research model presents personality (measured by Extraversion, Agreeableness, Conscientiousness, Openness to Experience, and Emotional Stability), with a mediation of the latent variable of statistics anxiety (measured by worth of Statistics, interpretation anxiety, test and class anxiety, computational self-concept, fear of asking for help, and fear of statistics teachers) and of the latent variable of students' achievements (measured by mathematics level, grade point average and matriculation grade in mathematics) as the factors assumed to influence academic dishonesty).

3. Materials and Methods

3.1. Sample and Procedure

Data were collected from students studying for a bachelor's degree in the social sciences at three different Israeli colleges. The data were collected in Qualtrics software and distributed to students in the period after the end of the course and before the final exam. The sample comprises 316 participants, of whom 12% are male and 88% are female students. The participants' median age is 23 years. After obtaining the Ethics Committee's approval, questionnaires were administered to the participants in two different types of course modalities: 32% of them enrolled in F2F and 68% in ERT courses through an on-line platform. The average time for filling the questionnaires was 12 min. Of the participants, 14% were excluded from the data analysis since their survey instruments were either incomplete (less than 80%), or carelessly completed. Among the participants, 7.3% reported high statistics anxiety (the mean higher than 4 on the scale from 1 to 5). However, no significant difference was found between the two learning environments ($t_{(314, 0.95)} = 1.644$, $p > 0.05$) ($M = 2.81$, $SD = 0.89$ for F2F and $M = 2.64$, $SD = 0.83$ for ERT). Around 55% reported to have engaged at least once in academic dishonesty in an F2F learning environment, compared to 43.5% in the ERT modality.

3.2. Instruments

Statistics Anxiety: The Hebrew variety of the Statistics Anxiety Rating Scale (H-STARS) employed in this research is an abridged version of Cruise et al.'s [76] original STARS scale. It is tailored to the Israeli context and it has been found to be valid and reliable [7]. The 30-item Hebrew variant of STARS employs six different subscales: (a) interpretation anxiety (e.g., trying to understand the statistical analyses presented in empirical papers); (b) test and class anxiety (e.g., studying for an examination in a statistics course); (c) fear of asking for help (e.g., asking a fellow student for help in understanding research results); (d)

computational self-concept (e.g., “I can’t even understand seventh-grade math; How could I understand statistics?”); (e) worth of statistics (e.g., “I’m never going to use statistics, so why should I learn it?”); (f) fear of statistics teachers (e.g., “Statistics teachers talk too fast, and I am not able to logically follow them”). Participants answered questions focusing on different potentially anxiety-inducing settings on a 5-point scale, in which 1 implies no anxiety, and 5—a great deal thereof. Steinberger [7] reported internal consistency reliability values ranging from 0.80 to 0.94, which are consistent with the values reported by Cruise et al. [76]. Following the authors’ recommendation, the calculation of the overall score represents an average of all questionnaire items. Hence, the higher a student’s score, the higher their anxiety level.

Academic dishonesty has been measured through the Academic Dishonesty Scale [77], which allows a direct measurement of academic dishonesty, and the Academic Integrity Inventory [78], which measures academic dishonesty indirectly. Both scales have been suited to and validated in the Israeli context. The Academic Dishonesty Scale comprises 10 items. Its reliability was calculated with Cronbach’s alpha of 0.91. An example of a question is: “How frequently have you engaged in copying material and presenting it as your own work?” An exploratory factor analysis employing varimax rotation determines the factor structure of academic dishonesty, which has been conceived as a multidimensional phenomenon integrating two different dimensions with sums of squared loadings ranging from 0.63 to 0.86. The Academic Integrity Inventory [78] includes questions on the likelihood of pondering misconduct. It is based on an 8-item scale, the reliability of which was calculated with Cronbach’s alpha of 0.75. An example of a question is: “I have repeatedly seen students cheating during exams in my institution” Participants answered questions using a five-point Likert scale, in which 1 means “Very unlikely” and 5 means “Very likely”.

Personality traits: The survey applies the TIPI scale (a short version of the Big Five Personality Measure, 1992) by Gosling et al. [79]. It comprises 10 items measuring participants’ personality traits: Extroversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience. Each trait comprises two statements. The questionnaire’s reliability was calculated with Cronbach’s alpha of 0.63.

Socio-demographic variables: The questionnaire includes a series of socio-demographic items referring to participants’ prior academic achievements: high school’s math level, grade average, matriculation grade in mathematics, and modality of course enrolment (face-to-face vs. emergency remote teaching).

3.3. Plan of Analysis

Data has been analyzed through the Structural Equation Modelling (SEM). Full information and maximum likelihood estimates have been computed through the Analysis of Moment Structures (AMOS) program [80]. The model has been examined for goodness of fit using χ^2 , comparative fit index (CFI), and root mean square error of approximation (RMSEA) fit indices. CFI values above 0.90 and 0.95 indicate adequate and good model fit, respectively, and RMSEA values below 0.08 and 0.05 indicate adequate and good model fit, respectively [81,82].

In addition, descriptive statistics and Pearson correlations were conducted to analyze the data. Reliability analysis was performed as well.

4. Results

The descriptive statistics, reliability, and correlations between the different research variables are presented in Table 1.

Table 1. Descriptive Statistics, Reliability and Intercorrelations among Variables.

Sample	Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12–13
F2F	1. Extraversion	3.43	0.83	==											
	2. Agreeableness	3.60	0.70	0.042	==										
	3. Conscientiousness	4.10	0.69	0.046	0.221 *	==									
	4. Openness to Experiences	3.81	0.82	0.446 ***	0.073	0.245 *	==								
	5. Emotional Stability	3.55	0.85	0.258 *	0.192	0.339 **	0.416 ***	==							
	6. Worth of Statistics	3.01	1.14	−0.109	−0.078	−0.097	−0.352 ***	−0.416 ***	0.92						
	7. Interpretation anxiety	2.91	0.94	−0.057	−0.056	−0.042	−0.323 **	−0.296 **	0.404 ***	0.85					
	8. Test & class anxiety	3.05	1.14	−0.046	−0.073	−0.107	−0.355 ***	−0.422 ***	0.559 ***	0.817 ***	0.91				
	9. Computational self-concept	2.60	1.10	−0.080	−0.047	−0.130	−0.294 **	−0.460 ***	0.768 ***	0.538 ***	0.694 ***	0.88			
	10. Fear of asking for help	2.64	1.09	−0.084	−0.031	−0.044	−0.372 **	−0.349 ***	0.414 ***	0.811 ***	0.826 ***	0.577 ***	0.89		
	11. Fear of statistics teachers	2.63	1.00	−0.150	−0.111	−0.246 *	−0.328 **	−0.467 ***	0.661 ***	0.505 ***	0.553 ***	0.740 ***	0.466 ***	0.84	
	12. Academic Misconduct	3.02	0.62	0.016	−0.254 *	−0.111	−0.010	−0.054	0.084	0.028	−0.021	−0.046	0.042	0.135	0.61
	13. Academic Integrity	1.28	0.53	−0.031	0.076	−0.093	−0.003	−0.117	−0.060	0.035	−0.070	0.091	−0.034	0.130	0.93
ERT	1. Extraversion	3.27	0.74	==											
	2. Agreeableness	3.62	0.69	0.176 *	==										
	3. Conscientiousness	4.19	0.73	0.164 *	0.254 ***	==									
	4. Openness to Experiences	3.77	0.74	0.299 ***	0.126	0.370 ***	==								
	5. Emotional Stability	3.58	0.80	0.191 **	0.265 ***	0.306 ***	0.205 **	==							
	6. Worth of Statistics	2.85	1.06	−0.010	−0.080	−0.151 *	−0.267 ***	−0.259 ***	0.90						
	7. Interpretation anxiety	2.74	1.00	−0.139 *	−0.102	−0.130~	−0.299 ***	−0.310 **	0.463 ***	0.89					
	8. Test & class anxiety	2.95	1.09	−0.105	−0.087	−0.167 *	−0.294 ***	−0.335 ***	0.485 ***	0.776 ***	0.88				
	9. Computational self-concept	2.48	0.97	−0.084	−0.162 *	−0.236 ***	−0.226 **	−0.390 ***	0.744 ***	0.492 ***	0.580 ***	0.85			
	10. Fear of asking for help	1.38	1.04	−0.164 *	−0.144 *	−0.235 ***	−0.316 ***	−0.339 ***	0.440 ***	0.798 ***	0.737 ***	0.585 ***	0.89		
	11. Fear of statistics teachers	2.43	0.90	−0.091	−0.179 **	−0.186 **	−0.231 **	−0.356 ***	0.671 ***	0.469 ***	0.551 ***	0.752 ***	0.504 ***	0.82	
	12. Academic Misconduct	2.30	0.56	−0.122	−0.219 **	−0.196 **	−0.073	−0.201 **	0.073	−0.028	0.013	0.093	0.053	0.134 *	0.56
	13. Academic Integrity	1.21	0.50	−0.198 **	−0.184 **	−0.368 ***	−0.157 *	−0.144 *	0.090	0.172 *	0.137 *	0.071	0.228 **	0.087	0.92

Notes: Reliability coefficients appear on the diagonal in bold. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; $n = 100$ for the F2F sample and 216 for the ERT sample.

Results show positive significant correlations among all Statistics Anxiety's components in both learning environments. In addition, there are significant negative correlations between Agreeableness and academic dishonesty ($r_p = -0.254, p < 0.05$), both in the F2F sample and in all the five personality traits in the ERT sample ($r_p = -0.198, p < 0.01$ for Extraversion, $r_p = -0.184, p < 0.01$ for Agreeableness, $r_p = -0.368, p < 0.001$ for Conscientiousness, $r_p = -0.157, p < 0.05$ for Openness to Experience and $r_p = -0.144, p < 0.05$ for Emotional Stability). Accordingly, the higher the levels of personality of an individual on each of the five personality traits, the lower their tendency to cheat. Furthermore, the ERT sample provides evidence of significant positive correlations between some statistics anxiety components and academic dishonesty: interpretation anxiety ($r_p = -0.172, p < 0.05$), test and class anxiety ($r_p = -0.137, p < 0.05$), fear of asking for help ($r_p = -0.228, p < 0.01$) and fear of statistics teachers ($r_p = -0.134, p < 0.05$). In other words, the more anxious students get, the more they tend to engage in academically dishonest behavior.

Results show significant negative correlation between the personality traits of Openness to Experience and Emotional Stability and all statistics anxiety components in both learning environments, so that higher levels of Openness to Experience display lower levels of anxiousness. Nonetheless, significant negative correlations have been found between the personality traits of Extraversion, Agreeableness and Conscientiousness and some of statistics anxiety components.

The ERT sample additionally shows: Extraversion and Interpretation anxiety ($r_p = -0.139, p < 0.05$) and Fear of asking for help ($r_p = -0.164, p < 0.05$); Agreeableness and Computational self-concept ($r_p = -0.162, p < 0.05$), Fear of asking for help ($r_p = -0.144, p < 0.05$) and Fear of statistics teachers ($r_p = -0.179, p < 0.01$); Conscientiousness and all the components of Statistics Anxiety ($r_p = -0.151, p < 0.05$ for Worth of Statistics, $r_p = -0.130, p = 0.056$ for Interpretation anxiety, $r_p = -0.167, p < 0.05$ for Test and class anxiety, $r_p = -0.236, p < 0.001$ for Computational self-concept, $r_p = -0.235, p < 0.001$ for Fear of asking for help and $r_p = -0.186, p < 0.01$ for Fear of statistics teachers). This means that the higher a student's Statistics Anxiety, the more likely is they to engage in academic misconduct.

Similarly, significant positive correlations between Academic Dishonesty and some of the components of Statistics Anxiety have been found in the ERT sample only, such as ($r_p = -0.172, p < 0.05$ for Interpretation anxiety, $r_p = -0.137, p < 0.05$ for Test and class anxiety, $r_p = -0.228, p < 0.01$ for Fear of asking for help and $r_p = -0.134, p < 0.05$ for Fear of statistics teachers).

The Academic Dishonesty variable has been modelled according to the variables of Academic Misconduct and Academic Integrity, as well as by the latent variable of Personality Traits (measured by Extraversion, Agreeableness, Conscientiousness, Openness to Experiences and Emotional Stability), mediated by the latent variables of (1) Statistics Anxiety (which itself measured Worth of Statistics, Interpretation anxiety, Test and class anxiety, Computational self-concept, Fear of asking for help, Fear of statistics teachers) and (2) Students' Achievements (which measured the Mathematics Level, Grade Point Average and Matriculation Grade in Mathematics). Data fit the Academic Dishonesty model marginally well ($\chi^2 = 725.032, N = 316, df = 262, p < 0.001, CFI = 0.745, RMSEA = 0.075$).

4.1. Academic Misconduct Analysis—Before COVID19 (F2F) Sample

The structural model of Academic Misconduct in F2F sample is illustrated in Figure 2.

Analysis results indicate that there is a significant impact of personality traits on statistics anxiety ($\beta = -0.60, p < 0.01$), thus confirming H₂. In other words, the higher students score on one of the following personality traits: Extraversion, Conscientiousness, Openness to Experience and Emotional Stability (Agreeableness has no effect in the F2F sample), the lower will their level of statistics anxiety be. However, the direct effect of statistics anxiety on academic dishonesty was not found in the ERT sample ($\beta = -0.24, p > 0.05$). Therefore, H₁ was not obtained.

Moreover, the analysis results reveal that the variance in academic dishonesty is not explained by students' personality traits as mediated by statistics anxiety. In order to test

the indirect effect of statistics anxiety on academic dishonesty, the unstandardized indirect effects were computed for each of the 200 bootstrapped samples. The 95% confidence interval was computed by determining the indirect effects at the 2.5 and 97.5 percentiles. The bootstrapped unstandardized indirect effect of statistics anxiety as a mediator of students' personality traits and academic dishonesty is -0.11 ($p > 0.05$). The 95% confidence interval ranges from -1.003 to 0.145 . Accordingly, this indirect effect is statistically insignificant, and hence, support for H_3 was not obtained in the F2F sample before the COVID-19 outbreak.

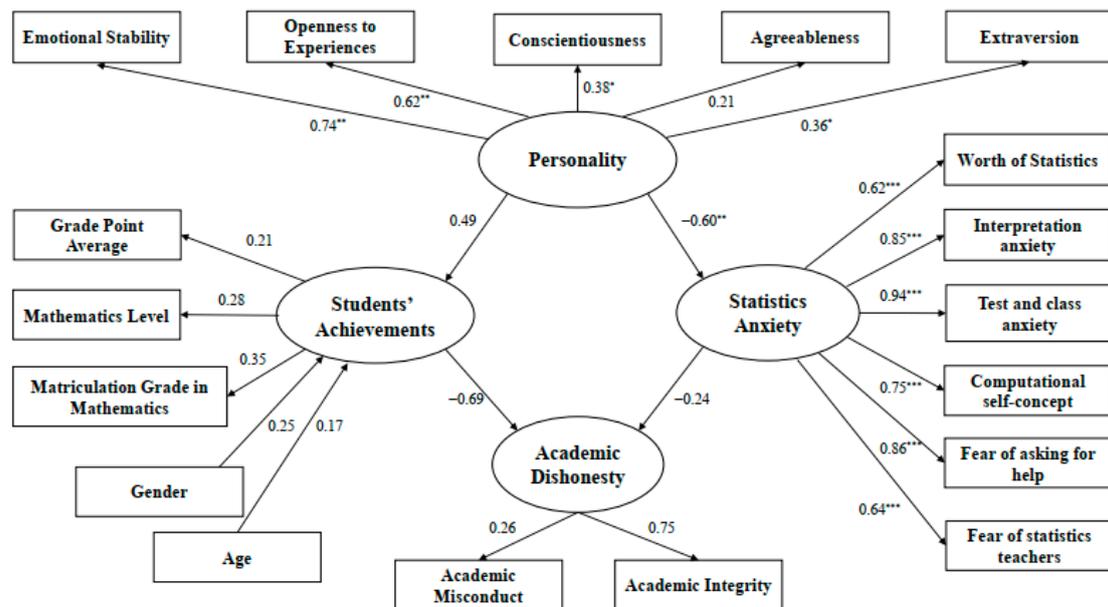


Figure 2. Structural model for determinants of academic dishonesty—before COVID-19 (F2F). Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

4.2. Academic Misconduct Analysis—During COVID-19 (ERT) Sample

The structural model of academic misconduct in the ERT sample is illustrated in Figure 3.

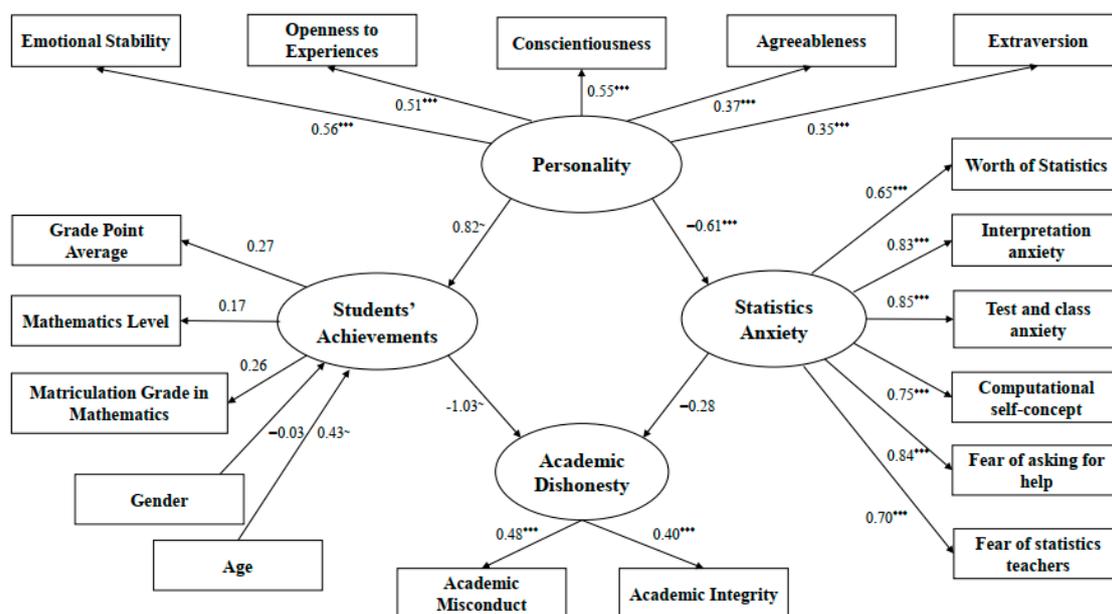


Figure 3. Structural model for determinants of academic dishonesty—during COVID-19 (ERT). Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Analysis results indicate that there is a significant impact of personality traits on statistics anxiety ($\beta = -0.61, p < 0.001$), thus confirming H_2 . In other words, the higher students' levels of the five personality traits, the lower their level of statistics anxiety. However, the direct effect of statistics anxiety on academic dishonesty was not found in the ERT sample ($\beta = -0.28, p > 0.05$). Therefore, H_1 was not obtained.

Nevertheless, the analysis results show that the variance in academic dishonesty is explained by students' personality traits with a mediation of statistics anxiety, using the computation of unstandardized indirect effects, which have been computed for each of the 200 bootstrapped samples. The 95% confidence interval was computed by determining the indirect effects at the 2.5 and 97.5 percentiles. The bootstrapped unstandardized indirect effect of statistics anxiety as a mediator between students' personality traits and academic dishonesty is $-0.69 (p < 0.05)$. The 95% confidence interval ranges from -0.180 to -1.458 . Accordingly, this indirect effect is statistically significant, and hence, support for H_3 is obtained in the ERT sample.

Table 2 summarizes the testing results for the research hypotheses.

Table 2. Hypotheses testing results.

Course Type	Constructs	Hypothesis	β	SE	CR	p -Value	Support
F2F	Statistics Anxiety \rightarrow Academic Dishonesty	H_1	-0.24	0.07	0.85	0.394	No
	Personality Traits \rightarrow Statistics Anxiety	H_2	-0.60	0.54	-2.63	0.009 **	Yes
	Personality Traits \rightarrow Statistics Anxiety \rightarrow Academic Dishonesty	H_3	-0.11		$(-1.003; 0.145)$	0.232	No
ERT	Statistics Anxiety \rightarrow Academic Dishonesty	H_1	-0.28	0.07	1.63	0.104	No
	Personality Traits \rightarrow Statistics Anxiety	H_2	-0.61	0.40	-4.24	***	Yes
	Personality Traits \rightarrow Statistics Anxiety \rightarrow Academic Dishonesty	H_3	-0.69		$(-0.180; -1.458)$	0.010 *	Yes

Notes: β = standardized regression weight; SE, standardized error; CR, critical ratio. * $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$. Confidence interval of 95% in Brackets.

As shown in Table 2, the results of the analysis indicate that the significant effect of personality traits and students' achievements on academic dishonesty through the mediation of statistics anxiety is found in the ERT sample only. The analysis results reveal a significant difference between F2F and ERT course types: NFI Delta-1 = 0.024, $df = 34, p < 0.05$, thus confirming H_4 .

5. Discussion

The present research enlightens how statistics anxiety mediates the relationship comprising personality traits and academic dishonesty. In line with the research literature and the 2030 Agenda for Sustainable Development [19] it explains how sustainably better educational outcomes in statistical literacy are possible. In addition, it reveals the crucial role played by learners scoring high on moral educational values, for these are key to counteracting the aforementioned degeneration in moral values [21], which leads to academic dishonesty.

More specifically, one may think of today's undergraduates as tomorrow's workforce [11]. Accordingly, one may expect the former to act ethically in socially sustainable environments once they complete their studies [35]. In this context, the present research assists educators, instructors, and academic institutions in developing pedagogical infrastructures to avoid unwanted behaviors such as academic dishonesty and phenomena such as statistics anxiety. Differently expressed, one may think of this research as a step in fostering those personalized pedagogical strategies which are still needed [83] to promote statistical literacy and eradicate academic dishonesty. For this reason, this research focuses on academic dishonesty in scenarios in which pandemic challenges are linked to students' stress and the increment of the tendency to engage in unethical behavior [13], such as academic dishonesty.

Based on the literature on statistics anxiety, personality traits and academic dishonesty, we create a research model that evaluates the mediating role played by statistics anxiety on the relationship comprising personality traits and academic dishonesty. The results concerning the impact of personality traits on statistics anxiety (H_2) show that there is a negative relationship between personality traits and statistics anxiety in the two learning environments discussed in this research. In other words, the lower the level of Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Emotional Stability, the higher the anxiety level in both F2F and ERT courses. The foregoing is supported by the research literature [48]. Lower levels of Emotional Stability (Neuroticism) are related to maladaptive traits, which correlate positively with anxiety. However, the results regarding the direct effect of statistics anxiety on academic dishonesty (H_1) were not substantiated in the F2F and ERT contexts. Accordingly, students who experience high levels of statistics anxiety are not necessarily prone to engaging in unethical conduct. Previous research [11] has shown that statistics anxiety may relate to academic dishonesty only in planned online courses, although not in face-to-face and ERT ones.

The results regarding the role of statistics anxiety as a mediator between personality traits and academic dishonesty (H_3) was substantiated in the ERT context only, thus supporting the Structural Model for Determinants of Academic Dishonesty (Figure 1). This result supports the impact of learning environments on the suggested mediation model (H_4). Thus, the multigroup analysis supported H_4 indicating a significant mediation manifested by an indirect effect between personality traits and academic dishonesty via statistics anxiety only in ERT, and no parallel significant mediation was found in the F2F course. These results could be explained by the differences in the delivery methods, and established despite the challenges posed by synchronous distance learning (e.g., Zoom, Teams or Webex platforms). For example, in face-to-face learning environments (before COVID-19), lecturers could perceive their students' expressions and know whether they had 'lost' them, whether they disconnected themselves from the lesson's sequence, and felt apprehensive or stressed. In such cases, lecturers could immediately interrupt their lesson's flow and react accordingly. This ability is crucial for teaching and learning anxious content, such as those associated with numerical anxiety [84], such as statistics anxiety. In contrast, in synchronous distance learning environments (ERTs during the COVID-19 pandemic), a teacher's immediacy and direct interpersonal interaction are limited. This restricts their ability to perceive their students' body language and facial expressions. Students are alone at home sitting in front of a PC screen. Some of them keep their cameras off. Even when turning them on, multiparticipant courses do not allow lecturer to see all participants on their monitors.

Summing up, certain personality traits per se do not necessarily lead to academic dishonesty during a statistics course. However, unethical behavior may manifest in certain circumstances. That occurs when students, due to their personality profile are prone to suffer from statistics anxiety and find themselves in specific learning circumstances characterized by limited interpersonal communication and social interaction that may intensify their statistics anxiety. In such a case, students may end up engaging in unethical conduct.

Explaining this may not be possible unless one understands students' learning experiences in their transition from face-to-face learning to distance synchronous learning on digital platforms. In face-to-face learning, students facing difficulties, apprehension, or pressure can immediately contact the lecturers standing in front of them or talk to them during lesson breaks. In addition, face-to-face lessons allow lecturers to maintain eye contact with their students. Thereby, they can identify their students' distress feelings, stop the lesson's flow, calm them down if necessary, repeat their explanations, and initiate interpersonal communication. Yet, in the emergency learning modality via digital platforms, teachers are not immediately available to students. Moreover, students feeling pressure or apprehension in physical classrooms during face-to-face lessons can discuss this with their classmates and potentially find out that other students experience the same. And it is in this context, that much has been written about the need of designing optimal teaching

and learning processes that incorporate Social Emotional Learning (SEL), as this makes it possible to manage stress [85].

6. Conclusions and Practical Implications

Our research shows that statistics anxiety mediates the relationship comprising personality traits and academic dishonesty in ERT environments. This is because instructors' presence and immediacy in face-to-face courses reduce students' anxiety levels [86]. Thus, we recommend that in an ERT environment, instructors' presence include supportive, emphatic interaction in order to reduce virtual distance [87]. Furthermore, we recommend including Social Emotional Learning (SEL) strategies, which foster students' learning challenges and prevent the manifestations of anxiety and academic dishonesty.

Moreover, online learning has been growing substantially due to the propagation of the internet, facilitated by its and convenient nature [60]. Yet, we suggest that the intricate pedagogy behind online distance initiatives (understood as a combined result of instructional planning, technological tools, and personal teacher/student characteristics aimed to adapt these to student's individual requirements and necessities) be further clarified. In addition, online distance education is a dynamically developing field, the rapid development of which has posed new challenges [13], such as a growing number of learners [88] on the one hand, and high dropout rates [89] on the other. Accordingly, continued research in this field is key to optimizing and promoting the aforementioned learner-centered experiences [83], as well as a personalized sustainable education in statistics courses. In this context, recent research has shown that quality in knowledge acquisition is vital for improving both subsequent professional competitiveness and realizing individual value [88].

Altogether, the theoretical contribution of this research to the scientific literature on personalized sustainable education is: (1) it clarifies the relationship between statistics anxiety, personality traits and academic dishonesty, and (2) enriches scientific knowledge on the need of adapting educational pedagogies to students' needs, so that these reduce statistics anxiety levels. In addition, the studies presented in this research offer empirical evidence that personality traits affect academic dishonesty when mediated by statistics anxiety, as well as that it may be determined by additional circumstances (future research may further clarify this issue).

Social interaction and personal acquaintance were interrupted during the COVID-19 outbreak. Yet, distance learning allowed students to continue with their learning process. ERT platforms have promoted electronic communication among classmates. Nonetheless, one may argue, anxious students have felt alone and have not been able to know whether other classmates experiencing difficulties felt like them. In this context, one may infer that exposition to similar classmate cases could contribute to reduce students' anxiety intensity.

In line with the SDG4 [19], we conclude thus: there is a need to recognize and empathize with those students whose statistics anxiety levels are high, and create a personalized effective learning environment, as the above is a critical issue affecting quality education [90]. The next section discusses some recommendations for building "education in emergencies" while supporting "the ethos of 'Leave No One Behind'" [90].

The following possible suggestions may be useful to promote personalized sustainable learning, and reduce statistics anxiety in the synchronic online distance learning environment:

- (1). Introducing components of Social Emotional Learning (SEL) focusing on self-awareness, self-management, responsible decision-making, relationship skills, and social awareness, as these skills are vital for success in life [85]. For example, via:
 - a. Different online collaborative tools which fosters students' engagement and collaborative learning activities, for instance, breakout rooms, Padlet, etc.
 - b. Gamification which contributes to experiencing learning, as well as to creating a positive classroom climate and reducing anxiety [91].
- (2). Employing assessments at different assessment modes throughout courses, thereby monitoring learning processes and preventing dropouts.

- (3). Diversifying learning tasks, so that they suit different learner types. In this context, one may additionally focus on tasks pertaining to a student's world and reflecting the value and importance, which statistics literacy has in daily life [86]. Accordingly, students could either analyze database information pertaining to current topics or collect data from their fields of interest (for example, collect data and analyze the positions of people against Coronavirus vaccination).

Research Limitations and Future Study

In 'pre-post' research designs, it is preferable that comparisons be in a within-subjects design. Accordingly, measurements should track the same participants and measure them at two different time points: the first, before the change takes place (in this research's case, the routine face-to-face learning period preceding the COVID-19 outbreak), and the second, during it (i.e., during the ERT period). The latter was not possible in the case of this research. The COVID-19 pandemic broke out in the beginning of 2020. ERT changes followed unexpectedly within a few weeks. As a result, it was not possible to obtain a pre-pandemic measurement, which compelled us to employ data from a sample reflecting course learning before COVID-19's eruption. Because of this limitation, we recommend that future research discusses the potential impact, which moving from face-to-face to virtual classrooms, has on statistics anxiety, and by extension, on academic dishonesty. It may be assumed that the above transitions interfere with teachers' ability to create an optimum lesson climate and personalized contact with their students.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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