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Assessing and Controlling Response Bias in Measuring Students' Happiness in Learning: A Factor-Analytic Approach

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Abstract

As open and distance learning options continue to grow, accurately assessing student happiness is crucial for promoting engagement and academic success. However, self-reported data in such settings can be affected by response bias, including social desirability and acquiescence bias. This study explores how these biases influence the measurement of learning happiness among 336 undergraduate students enrolled in an open university programme. Using exploratory factor analysis, we found that acquiescence bias significantly distorts the measurement, particularly its effect on negatively worded items about academic dissatisfaction. Adjusting for acquiescence bias revealed a substantial realignment of these items' factor loadings, suggesting potential underestimation of academic dissatisfaction in unadjusted analyses. In contrast, social desirability bias appeared to have less impact on the overall content factor. Items designed to measure social desirability had distinct loadings compared to content items, indicating that student responses to content questions more likely reflected their genuine learning experiences rather than a desire to present themselves favourably. By systematically controlling for social desirability and acquiescence biases, our study disentangles their unique effects on the accuracy of the content factor. We recommend utilising factor scores in survey analysis to mitigate these biases and enhance the representational validity of student sentiment. This research underscores the critical importance of recognising and correcting social desirability and acquiescence biases to ensure the validity and reliability of educational measurement outcomes in open and distance learning environments.

Keywords: acquiescence bias, assessing response bias, factor-analytic approach, happiness in learning, happiness measurement, social desirability bias

1. Introduction

The rapid growth of distance learning programmes, such as those offered at Sukhothai Thammathirat Open University (STOU), marks a significant transformation in educational delivery methods. In this evolving landscape, accurately assessing undergraduate student happiness within distance learning environments becomes crucial. Student happiness transcends mere contentment, encompassing a spectrum of positive emotions, overall well-being, and psychological states related to the educational experience (Unoma, 2013; Smith et al., 2018). Its profound role in enhancing learning efficiency, bolstering memory retention, and fostering continuous academic engagement has been firmly established by educational psychologists. Recognising these impacts, accurately measuring student happiness becomes paramount, especially in light of potential measurement challenges posed by response bias.

Extensive research has demonstrated that student happiness, which spans positive emotional states such as joy, enthusiasm, and gratitude, as well as an overall sense of well-being, exerts a substantial influence on both individual academic performance and long-term educational outcomes (Fredrickson, 2001; Lyubomirsky et al., 2005). A positive, happy learning experience has been inextricably linked to improved mental health, reduced stress levels, and a greater sense of fulfilment among students (Fredrickson, 2001). Institutions prioritising and actively cultivating student happiness often experience higher retention rates and lower dropout rates, underscoring the direct correlation between student well-being and academic success (Helliwell et al., 2020). For instance, universities implementing initiatives like counselling services, recreational facilities, and stress management workshops frequently report improved student satisfaction and persistence. However, measuring student happiness is not without its challenges, particularly in the context of self-reported data, which can be susceptible to response biases such as social desirability (SD) and acquiescence (AC) biases (Crowne & Marlowe, 1960; Podsakoff et al., 2003). SD bias stems from the tendency of respondents to present themselves in a socially desirable light, potentially distorting their responses to align with perceived cultural norms or expectations. AC bias, on the other hand, refers to the propensity of respondents to agree with statements regardless of their content, which can lead to inaccurate representations of their true sentiments.

In the contemporary landscape of distance learning, where physical interactions are limited, and the educational experience is primarily mediated through digital platforms, assessing student happiness has emerged as a crucial metric for evaluating the effectiveness and impact of these programmes. Against this backdrop, our study, stemming from the measurement challenges posed by response biases, aims to deepen our understanding of accurately assessing student happiness in distance learning contexts. Consequently, we employ rigorous methodological approaches, particularly exploratory factor analysis (EFA), to analyse and control for SD and AC biases' influence, as Ferrando et al. (2009) recommended.

This study investigates how SD and AC biases impact the measurement of student happiness in distance learning environments, exploring how these biases can lead to oversimplifications or complications in the underlying factor structure (Brown, 2015; Kline, 2016). Furthermore, the interpretability and validity of the instruments can be affected by altered factor loadings resulting from these biases (Costello & Osborne, 2005; Brown, 2015). By systematically controlling for SD and AC biases, our study aims to disentangle their unique effects on the accuracy of the content factor, offering a more authentic representation of student happiness in distance learning environments.

2. Literature Review

Various aspects of literature related to the importance of happiness in open and distance learning, assessing students' happiness in open and distance learning, and assessing and controlling response bias in psychological measurement are reviewed in the following sub-sections.

2.1. Importance of Happiness in Open and Distance Learning

The importance of happiness in open and distance learning is underscored by the democratisation of education by removing traditional barriers such as location, cost, social status, class size, and admission criteria, as highlighted by Gunawardena and McIsaac (2004). The advent of digital technologies, observed by Kruse et al. (2022), further enhances this inclusivity by granting learners anytime-anywhere access to educational resources, making online learning more appealing and convenient. However, while beneficial, the shift towards digital platforms like Massive Open Online Courses and Open Education Resources also presents challenges. Moroz and Moroz (2022) noted that online learning tools, despite their utility, only partially address quality concerns in distance education. Sungsri (2006) identified deeper issues such as reduced interaction with educators and peers, which can lead to isolation and stress among students, adversely impacting their happiness, motivation, and retention. Therefore, while open learning expands access, it also requires a balanced approach that embraces technological advancements and prioritises the socio-emotional well-being of learners. Ensuring happiness in learning environments is crucial as it directly impacts students' well-being, academic performance, and long-term educational outcomes. Happy students tend to achieve higher grades, are more motivated to learn, and exhibit greater retention rates (Fredrickson, 2001; Helliwell et al., 2020; Lyubomirsky et al., 2005). Thus, addressing the socio-emotional aspects of learning by fostering interaction, reducing isolation, and providing support is essential. Institutions prioritising student happiness create more supportive and effective learning environments (Deci et al., 1991). This comprehensive approach not only enhances educational experiences but also ensures students' long-term success and satisfaction. Fostering happiness in open and distance learning is key to creating enriching educational journeys that benefit individual learners and educational institutions.

2.2. Assessing Students' Happiness in Open and Distance Learning

Assessing students' happiness in learning is crucial as it directly impacts their well-being, academic performance, and long-term educational outcomes (Fredrickson, 2001; Lyubomirsky et al., 2005). A positive learning experience enhances students' mental health, reduces stress, and fosters a sense of fulfilment, which are fundamental components of well-being (Fredrickson, 2001). Research has shown that happy students achieve higher grades and are more motivated to learn (Lyubomirsky et al., 2005). In open and distance learning environments, where physical interactions are limited, ensuring student happiness is even more critical to counteract potential feelings of isolation and stress (Gunawardena & McIsaac, 2004). The democratisation of education through digital technologies grants learners anytime-anywhere access to educational resources, enhancing the appeal and convenience of online learning (Kruse et al., 2022). However, this shift is not without challenges. Despite their utility, online learning tools only partially address quality concerns in distance education (Moroz & Moroz, 2022). Issues such as decreased interaction with educators and peers can lead to feelings of isolation and stress, adversely affecting students' happiness, motivation, and retention (Sungsri, 2006). Institutions that prioritise student happiness in these settings experience greater retention rates and reduced dropout rates (Helliwell et al., 2020). Understanding what aspects of learning contribute to student happiness also informs instructional design and educational policy, ultimately creating a more supportive and effective learning environment (Deci et al., 1991; Helliwell et al., 2020). Thus, assessing and addressing students' happiness in learning, particularly in open and distance learning environments, is paramount for immediate and long-term educational success, impacting individual well-being and institutional effectiveness. This leads to assessing and controlling response bias in psychological measurement.

2.3. Assessing and Controlling Response Bias in Psychological Measurement

Assessing and controlling response bias in psychological measurement is fundamental for upholding the validity and reliability of gathered data. Response bias encompasses various forms, such as SD and AC bias, both of which lead to misleading conclusions (Podsakoff et al., 2003). SD bias, identified by Crowne and Marlowe (1960), involves participants providing responses they perceive as socially acceptable rather than their genuine beliefs or feelings, distorting research outcomes as participants aim to present themselves favourably. Conversely, AC bias entails individuals consistently agreeing with statements, irrespective of their content, skewing data accuracy. To mitigate response bias, methods such as self-report scales like the Marlowe-Crowne SD Scale, forced-choice questions, and randomisation of item order are employed. Control measures include ensuring participant anonymity and confidentiality, randomising conditions, providing clear instructions, and conducting pilot testing to identify and rectify potential response bias issues. Addressing response bias conscientiously elevates the quality of psychological measurements, making findings more robust and insightful for understanding human behaviour and cognition. Ferrando et al. (2009) explored methods for correcting response bias, developing a factor-analytic procedure to adjust measurement scores by eliminating the influence of AC and SD biases. This study employed their method to assess and control bias in measuring students' learning happiness, effectively mitigating AC and SD biases. Factor analysis was used to determine the structure of the factors, allowing the creation of a residual inter-item correlation matrix free from distortions caused by SD and AC responses. This matrix was then utilised in factor analysis to determine the questionnaire's factor structure, ensuring the measure's quality and accuracy. By addressing these biases, the study enhances the reliability of its findings on student learning happiness. Controlling these biases is particularly pertinent in educational settings where accurate assessment of student sentiments is crucial for designing effective interventions and policies. In this context, the factor-analytic approach reveals the underlying constructs' true structure and ensures that the measured data reflects genuine student experiences free from systematic distortions. Moreover, eliminating SD and AC biases allows for a clearer understanding of the factors contributing to student happiness and satisfaction, enabling educators and policymakers to create more supportive and enriching learning environments. This comprehensive approach to mitigating response bias underscores the necessity of rigorous methodological frameworks in psychological research, emphasising that the accuracy of self-reported data can be significantly improved through careful design and execution of data collection and analysis procedures. Thus, by employing these advanced techniques, a more accurate and nuanced picture of student happiness in learning can be obtained, ultimately contributing to developing educational strategies that foster both academic success and personal fulfilment. These considerations set the stage for the primary objective of this study.

The primary objective of this study is to enhance the accuracy and reliability of measuring student happiness in open and distance learning environments by addressing and mitigating the influence of response biases, particularly SD and AC biases.

3. Research Method

3.1. Samples

This study investigates the perceived happiness within the learning environment among undergraduate students enrolled in the 2022 academic year across distance learning programs at STOU, spanning 11 academic programmes: Liberal Arts, Communication Arts, Educational Studies, Management Science, Law, Economics, Political Science, Agriculture and Cooperatives, Human Ecology, Health Science, and Science and Technology. To enhance the study's reach and diversity, we collaborated with provincial student clubs to obtain a list of names and contact information, enabling us to send targeted email invitations and QR codes for easy access to an online survey. Participants were first presented with an informed consent form detailing the study's objectives, procedures, confidentiality assurances, and voluntary nature, requiring students' acknowledgement before beginning the survey. While this approach might not fully represent the entire undergraduate demographic, it adheres to Comrey and Lee's (1992) and Tabachnick and Fidell's (2013) guidelines for factor analysis, which recommend a minimum of 300 participants to ensure ethical compliance and practicality in data collection.

3.2. Materials and Tools

The study employed a modified version of Laosum's (2023) undergraduate student learning happiness questionnaire. The questionnaire, utilising a 5-point rating scale, assesses various dimensions of students' learning happiness. To mitigate AC bias, items q3, q12, q17, q23, and q28 were rephrased with negative wording following Ferrando et al. (2009) methodology. The initial questionnaire included five questions aimed at identifying SD responses. However, EFA identified that item q37, "I am always honest, even when it is difficult," had a low factor loading (0.18) on the SD factor and was subsequently removed for not adequately capturing this construct within the learning context. The remaining four items showed strong factor loadings (greater than 0.60) and aligned with established SD definitions (Crowne & Marlowe, 1960). The questionnaire's Cronbach's alpha coefficient remained high at 0.90, indicating very good reliability (George & Mallery, 2010). Thus, with its four SD items, the revised instrument is considered accurate and reliable for this study's context.

3.3. Data Analysis

Data analysis, structured in two phases, was pivotal in examining response biases in measuring students' happiness in learning. The first phase entailed a detailed descriptive statistical analysis using the 'psych' package in R (Revelle, 2018), focusing on skewness (Sk) and kurtosis (Ku) to identify potential non-normal distributions in the data, as detailed in Table 1. For instance, all items exhibited significant skewness and kurtosis values, suggesting deviations from normality. In the second phase, we applied EFA using the Unweighted Least Squares (ULS) method through R's Very Accurate Multiresolution Python Routines (VAMPyR) package. This phase was instrumental in assessing and controlling for SD and AC biases. We further expanded the analysis to consider the combined impact of SD and AC on the data. The use of Promax rotation enabled us to explore the correlations between factors intricately. This factor-analytic approach was critical in understanding and controlling the response biases, providing clearer insights into the true nature of student happiness in a learning environment. Post-factor analysis, we conducted a comparative assessment of results, which is crucial for understanding the dynamics of student happiness in distance learning. We compared indices like Cronbach's alpha coefficients before and after applying bias control techniques, which measured each factor's internal consistency and reliability. By examining factor loadings and their variations pre- and post-bias adjustment, we evaluated the contributions of individual items to their respective factors. This comparative approach enriched our understanding of the true dynamics of student happiness, highlighting specific areas particularly susceptible to response biases, such as students probably providing socially acceptable responses instead of genuine ones to present themselves favourably and consistently agreeing with statements regardless of content, as evidenced by higher factor loadings of items on SD and AC factors compared to the content factor. The insights gained from this analysis were instrumental in developing more refined educational strategies and interventions, targeting the vulnerabilities identified within the distance learning framework.

4. Findings and Discussion

4.1. The First Phase Result of Descriptive Statistical Analysis.

In the survey, respondents were analysed at STOU, and responses from 336 undergraduate students were analysed, providing a comprehensive overview of students' learning happiness. The demographic data revealed a balanced gender composition, with 161 male students (47.92%) and 175 female students (52.08%). The age distribution among respondents varied significantly, with the largest group being those aged 36-40 (66 students, 19.64%). The diversity in age was mirrored across various academic disciplines, with Management Science being the predominant field, followed by Educational Studies, Liberal Arts, and other disciplines.

The descriptive statistics of the 39 items from the learning happiness questionnaire, detailed in Table 1, depicted a diverse range of learning happiness levels among students. Key findings include high mean values on several items, indicating strong levels of learning happiness. For instance, item q1, which assesses learning happiness with university academic services, had a mean (M) value of 4.29 and an SD value of 0.73. However, lower mean values on certain items, such as q3 ("I am not satisfied with the university guidance and counselling services") at 2.59, highlighting potential areas of concern.

Table 1. Descriptive statistics of the variables

Item	Statement	M	SD*	Sk	Ku
q1	I am satisfied with the university academic services, particularly the remedial learning services.	4.29	0.73	-0.84	0.73
q2	I am satisfied with the university learning resources, particularly textbooks, journals, and digital learning sources.	4.12	0.73	-0.47	-0.18
q3(-)	I am not satisfied with the university guidance and counselling services.	2.59	1.33	0.40	-1.03
q4	I am satisfied with other university academic services that facilitate learning, particularly the radio and TV broadcasting.	3.98	0.81	-0.37	-0.20
q5	I am satisfied with the university learning media and materials.	4.04	0.84	-0.61	0.10
q6	I feel anxious about learning due to the lack of higher education distance learning skills.	2.86	1.20	0.11	-0.84
q7	I feel lonely in learning due to the lack of classmates.	2.44	1.19	0.51	-0.57
q8	I feel exhausted when the exam result does not come out as expected.	2.96	1.31	0.03	-1.06

Item	Statement	M	SD*	Sk	Ku
q9	I feel bored with the required curriculum activities.	2.12	1.05	0.92	0.45
q10	I feel stressful and pressured when I cannot finish my texts before the exam date.	3.39	1.22	-0.38	-0.70
q11	I am satisfied with cooperative activities between the lecturer and the students and also among students ourselves.	4.14	0.76	-0.57	0.13
q12(-)	I am not satisfied with assessment techniques used by the university, particularly the mid-term exam together with student participation activities.	2.29	1.15	0.71	-0.15
q13	I am satisfied with my lecturer.	4.38	0.69	-0.82	0.17
q14	I am satisfied with my colleagues.	4.18	0.79	-0.62	-0.09
q15	I am satisfied with the curriculum management, particularly the arrangement for student- lecturer contact.	4.07	0.81	-0.65	0.40
q16	I am enthusiastic to learn.	4.06	0.77	-0.27	-0.82
q17(-)	I don't enjoy self-learning and wish to learn new things.	2.08	1.02	0.95	0.57
q18	I try hard to learn even though it is a difficult subject and I never give it up.	4.27	0.68	-0.47	-0.59
q19	I love listening, speaking, reading, and writing.	3.88	0.82	-0.20	-0.50
q20	I discipline myself for self-learning.	3.85	0.83	-0.28	-0.21
q21	I feel relax and happy to learn.	4.05	0.77	-0.21	-0.97
q22	I love and be proud of myself.	4.39	0.71	-0.93	0.28
q23(-)	I am not satisfied with my academic performance.	2.46	1.19	0.44	-0.63
q24	I am satisfied that I have learned what I like and that what I wish to learn.	4.32	0.65	-0.42	-0.70
q25	I feel that I am valuable as compared with others.	4.06	0.92	-0.91	0.83
q26	I am confident that my personal characteristics are suitable with the open- university distance learning system.	4.05	0.74	-0.17	-0.89
q27	I accept my own competence.	4.18	0.75	-0.61	0.12
q28(-)	I feel bored to comprehend important concept of what I read.	2.54	1.04	0.27	-0.34
q29	I am enthusiastic to learn once I receive financial support from my family at the time in need.	3.54	1.07	-0.53	-0.04
q30	I am very pleased to receive moral support from the family.	4.36	0.75	-0.99	0.69
q31	I am self-confident in the new learning environment, particularly in adjusting myself to group work and participation.	4.29	0.71	-0.99	1.91
q32	I feel ready to learn once I have sufficient academic backgrounds to learn.	4.21	0.72	-0.83	1.43
q33	I am happy to gain skills to search for new knowledge beyond what I can learn from the text.	4.04	0.72	-0.21	-0.62
q34	I feel ready to learn since I have sufficient budget for learning.	3.84	0.95	-0.42	-0.27
q35	I used to say some things that weren't good about some people.	3.06	1.08	0.18	-0.34
q36	I often procrastinate.	2.80	1.06	0.31	-0.23
q37	I feel ashamed every time I have to do something immoral.	3.94	1.08	-0.71	-0.21
q38	I used to take advantage of some people.	2.12	0.94	0.84	0.89
q39	I used to take things that weren't mine as my own.	1.93	0.92	1.02	1.30

*Note: (-) in the first column indicates negative items for AC items.

The skewness and kurtosis across the survey items revealed heterogeneity in student responses. This was evident in both positively and negatively worded items, with varying degrees of skewness indicating concentrations of responses at different ends of the scale. Notably, items q35 to q39, classified as SD items, demonstrated unique patterns, including high kurtosis values as depicted in Figure 1, which may reflect more sensitive aspects of student learning happiness.

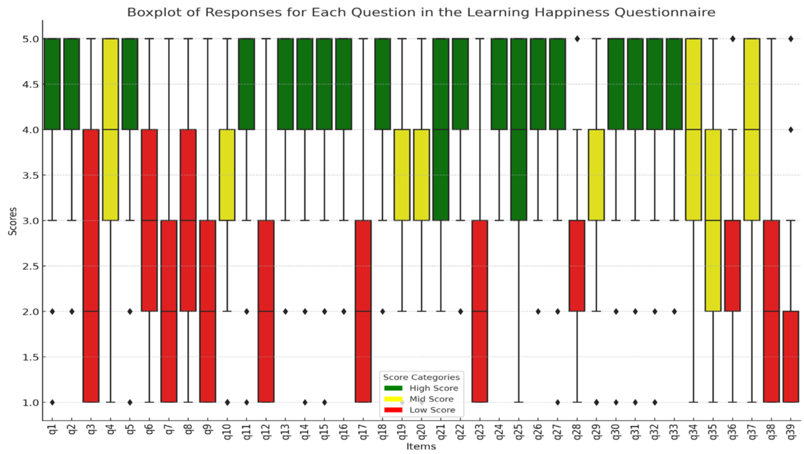

Figure 1. Boxplot analysis of learning happiness questionnaire responses

The heatmap in Figure 2 visually represents the correlations between survey items, where varying shades from blue to red denote the strength and direction of each correlation. The intensity of blue signifies stronger positive correlations, reaching up to a perfect correlation of 1, while deeper reds indicate stronger negative correlations, with -1 representing a perfect inverse correlation. The heatmap is strategically structured into clusters, with a notable blue-bordered section in the lower left emphasising items (q3, q23, q9, q28, q12, q17, q10, q6, q7, and q8) that are highly positively correlated, suggesting consistency in participants' perceptions. Correspondingly, the upper right blue-bordered section comprises items (q18, q20, q19, q21, q24, q22, q27, q26, q33, q1, q2, q4, q5, q11, q15, q13, q14, q25, q29, q37, q34, q32, q30, and q31) that also display significant positive correlations. Crucially, this segment includes the SD items (q38, q39, q35, and q36), which are crucial for gauging participants' tendencies to choose responses they believe will be viewed favourably by others—a factor that can be pivotal in interpreting the overarching patterns and insights gleaned from the survey data.

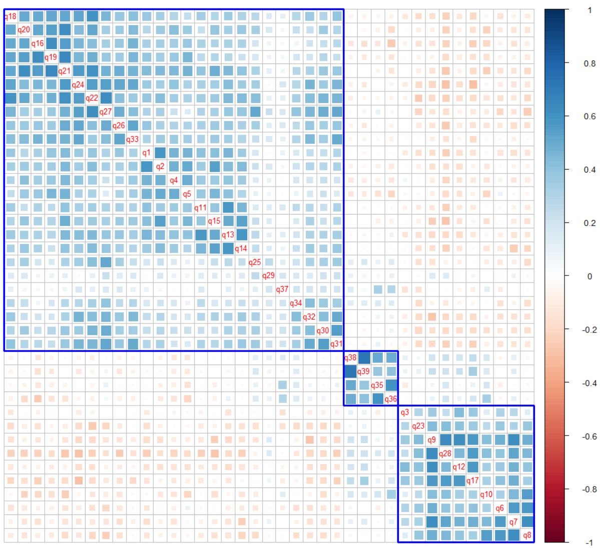

Figure 2. Correlation heatmap of learning happiness questionnaire items

4.2. The second phase of the EFA focused on assessing and controlling for response bias

Building upon the foundational research conducted by Laosum (2023). This study investigated the structural complexities of student learning happiness by employing a sophisticated analytical strategy. Specifically, it conducted a rigorous examination of the impact of SD and AC biases on the factor structure derived from an EFA of student learning happiness measures. The EFA incorporated an unbalanced design with specific negatively worded statement items and SD items. This approach aligned with the six dimensions identified by Laosum (2023) and offered additional insights, highlighting the divergent areas of student experiences based on their responses to these items.

- The preliminary steps in this phase involved assessing the data's suitability for factor analysis, the determinant of the dispersion matrix was notably low, at 0.000, suggesting the data was highly suitable for factoring. Bartlett's test of sphericity yielded a statistic of 6423.800 (df = 703, $P < 0.01$), indicating a significant correlation between variables and their suitability for structure detection. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.894, classified as good. These metrics confirmed a solid foundation for EFA, aiming to investigate the underlying dimensions of students' learning happiness. In our analysis of the 39-item happiness scale, we also checked for multicollinearity using the Variance Inflation Factor (VIF) and tolerance values. The VIF values ranged from 1.856 to 2.114, with a mean of 2.089, indicating low multicollinearity as all values were below the threshold of 5. Additionally, tolerance values ranged from 0.4731 to 0.5388, with a mean of 0.4790, all above the 0.2 threshold. According to Kyriazos (2018), these results confirm the absence of significant multicollinearity and support the robustness and validity of our factor analysis findings.

- The EFA, focusing on students' learning happiness as a single content factor, indicates AC's nuanced impact on item loadings. Items designed to measure SD were excluded from the factor analysis. Controlling for AC significantly increased the loadings for negatively worded statements, suggesting that initial responses were influenced by a tendency towards agreement regardless of content. For example, items expressing academic discontent, items q3, q12, q17, q23, and q28, showed an increase in positive loadings after AC control, affirming their inverse relationship with academic satisfaction. Positive statements reflecting academic satisfaction and overall contentment with the educational support system, such as satisfaction with learning resources, academic services, interpersonal relations in the learning environment, curriculum management, and self-perceptions, maintained strong positive loadings after AC control. Specifically, items q1, q2, q4, q5, q11, q13 to q16, q18 to q22, q24 to q27, and q30 to q34 showed robust positive loadings, indicating lesser influence from response bias and accuracy in measuring the intended construct. This phase of the analysis emphasises the importance of accounting for AC to ensure the integrity and accuracy of the measured constructs, especially within the educational context.

- Controlling for SD in the factor analysis of students' learning happiness is crucial. The factor loadings of SD on the content items should be less significant than those on the designated SD items, with a cut-off value of 0.30 for substantial factor loadings. The SD items, q35, q36, q38, and q39, have loadings of -0.651, -0.656, -0.852, and -0.714, respectively. These high negative loadings exceed the cut-off, confirming their strong association with the SD factor. In contrast, content items q1, q2, and q4, have loadings of 0.022, 0.102, and 0.158, respectively, suggesting minimal influence of SD. This indicates that the responses to these content items reflect genuine feelings about their learning experiences rather than a desire to present themselves favorably. The negatively worded items, q3, q12, q17, and q23, when controlled for SD, have loadings of -0.016, 0.048, 0.080, and 0.043, respectively, aligning more closely with the content factor and away from SD bias. None of the content items surpasses the cut-off post-SD control, indicating a relatively unbiased measurement of learning happiness and underscoring the effectiveness of controlling for SD in the assessment.

- When controlling for both SD and AC biases, the analysis reveals critical insights into measuring students' learning happiness. The SD items, q35, q36, q38, and q39, have loadings of -0.651, -0.656, -0.852, and -0.714, respectively, indicating their primary role in capturing SD biases and showing zero loadings on both the AC and content factors. Conversely, the content items generally display low loadings on the content factor after controlling for biases. For instance, items q1, q4, and q11, which initially had higher loadings (0.581, 0.544, and 0.559, respectively), show reduced values, reflecting a more accurate measurement of learning happiness. Negatively worded items, including q3, q12, q17, q23, and q28, now demonstrate high positive loadings on the content factor (0.434, 0.663, 0.634, 0.706, and 0.655, respectively), indicating a strong alignment with learning happiness. Items that initially showed negative loadings, such as q6, q7, q8, q9, and q10 (-0.721, -0.756, -0.792, -0.792, and -0.531, respectively), shift significantly after bias control, indicating their genuine inverse relationship with learning happiness. Some content items still exhibit high loadings on the AC factor but lower on the content factor, such as q2 and q5 (0.618 on AC, 0.082 on content for q2; 0.532 on AC, 0.202 on content for q5), suggesting a continued but reduced influence of AC bias. Overall, the simultaneous control of SD and AC biases significantly enhances the validity and reliability of the measurement, providing a more accurate reflection of students' genuine feelings about their learning experiences, illustrated in Table 2.

Table 2. Loading matrix obtained with and without controlling response bias

Item	With bias	Controlled AC		Controlled SD		Controlled AC and SD		
	Content factor	AC	Content factor	SD	Content factor	SD	AC	Content factor
q35 (SD)				**-0.651**	0.000	**-0.651**	0.000	0.000
q36 (SD)				**-0.656**	0.000	**-0.656**	0.000	0.000
q38 (SD)				**-0.852**	0.000	**-0.852**	0.000	0.000
q39 (SD)				**-0.714**	0.000	**-0.714**	0.000	0.000
q1	**0.583**	**0.579**	0.188	0.022	**0.604**	0.022	**0.581**	0.185
q2	**0.591**	**0.621**	0.104	0.102	**0.589**	0.102	**0.618**	0.082
q3(-)	0.163	-0.016	**0.430**	0.067	0.160	0.067	-0.018	**0.434**
q4	**0.536**	**0.549**	0.120	0.158	**0.530**	0.158	**0.544**	0.082
q5	**0.505**	**0.536**	0.076	0.207	**0.489**	0.207	**0.532**	0.020
q6	-0.294	0.028	**-0.689**	0.049	**-0.316**	0.049	0.026	**-0.721**
q7	**-0.345**	0.016	**-0.769**	-0.144	**-0.340**	-0.144	0.020	**-0.756**
q8	**-0.356**	-0.006	**-0.742**	-0.040	**-0.373**	-0.040	-0.006	**-0.754**
q9	**-0.393**	-0.033	**-0.819**	-0.207	**-0.385**	-0.207	-0.027	**-0.792**
q10	-0.298	-0.014	**-0.589**	-0.298	-0.269	-0.298	-0.006	**-0.531**
q11	**0.527**	**0.559**	0.111	-0.001	**0.545**	-0.001	**0.559**	0.117
q12(-)	**0.335**	0.048	**0.696**	0.203	**0.322**	0.203	0.042	**0.663**
q13	**0.623**	**0.627**	0.177	-0.016	**0.640**	-0.016	**0.626**	0.189
q14	**0.588**	**0.575**	0.196	-0.031	**0.614**	-0.031	**0.576**	0.215
q15	**0.581**	**0.585**	0.160	0.050	**0.594**	0.050	**0.582**	0.152
q16	**0.591**	**0.584**	0.178	0.242	**0.579**	0.242	**0.575**	0.119
q17(-)	**0.367**	0.080	**0.695**	**0.312**	**0.341**	**0.312**	0.072	**0.634**
q18	**0.636**	**0.638**	0.171	0.089	**0.637**	0.089	**0.637**	0.158
q19	**0.592**	**0.614**	0.118	0.143	**0.595**	0.143	**0.611**	0.079
q20	**0.624**	**0.629**	0.156	0.123	**0.628**	0.123	**0.627**	0.129
q21	**0.746**	**0.730**	0.190	0.086	**0.746**	0.086	**0.730**	0.172
q22	**0.725**	**0.708**	0.228	0.100	**0.729**	0.100	**0.706**	0.220
q23(-)	**0.324**	0.097	**0.557**	0.043	**0.331**	0.043	0.096	**0.566**
q24	**0.699**	**0.691**	0.221	0.104	**0.706**	0.104	**0.691**	0.207
q25	**0.436**	**0.440**	0.131	-0.184	**0.481**	-0.184	**0.447**	0.188
q26	**0.616**	**0.607**	0.180	0.111	**0.620**	0.111	**0.607**	0.166
q27	**0.649**	**0.651**	0.189	-0.054	**0.683**	-0.054	**0.655**	0.223
q28(-)	**0.463**	0.162	**0.721**	0.261	**0.448**	0.261	0.155	**0.679**
q29	0.172	0.275	-0.115	-0.110	0.196	-0.110	0.278	-0.083
q30	**0.545**	**0.528**	0.219	-0.013	**0.568**	-0.013	**0.529**	0.240
q31	**0.590**	**0.588**	0.202	0.013	**0.612**	0.013	**0.591**	0.220
q32	**0.549**	**0.525**	0.226	-0.025	**0.569**	-0.025	**0.524**	0.251
q33	**0.605**	**0.667**	0.067	0.088	**0.613**	0.088	**0.663**	0.050
q34	**0.399**	**0.408**	0.116	-0.179	**0.437**	-0.179	**0.413**	0.173

The insights gleaned from EFA, which involved controlling for biases, notably SD, suggest a diminished effect of SD on measurement outcomes when data is collected via an online form. This phenomenon can be attributed primarily to the anonymity and privacy inherent in digital data collection methods. Buchanan and Smith (1999) and Joinson (2001) demonstrated that the perceived anonymity provided by online platforms encourages respondents to offer more truthful responses, as the lack of physical presence and direct scrutiny diminishes the pressure to conform to socially desirable norms. Furthermore, Krumpal (2013) emphasises the role of perceived confidentiality in reducing SD bias, especially in surveys covering sensitive topics, suggesting that the digital format's ability to assure respondents of their privacy and anonymity significantly contributes to the accuracy and reliability of self-reported data. Collectively, these findings underline the advantages of online survey methodologies in mitigating response biases, reinforcing the importance of thoughtful survey design to maximise data quality (Buchanan & Smith, 1999; Joinson, 2001; Krumpal, 2013).

After controlling for SD and AC, the analysis suggests significant influences of these biases on the measurement of content factors related to learning happiness among students. For example, the SD items q35, q36, q38, and q39, have loadings of -0.651, -0.656, -0.852, and -0.714, respectively. In contrast, content items such as q1, q4, and q11, which initially had higher loadings (0.581, 0.544, and 0.559, respectively), show reduced values post-adjustment, reflecting a more accurate measurement of learning happiness. Negatively worded items, q3, q12, q17, q23, and q28, demonstrate high positive loadings on the content factor (0.434, 0.663, 0.634, 0.706, and 0.655, respectively) after controlling for biases, indicating a strong alignment with learning happiness. Items initially showing negative loadings, such as q6, q7, q8, q9, and q10 (-0.721, -0.756, -0.792, -0.792, and -0.531, respectively), shift significantly, indicating their genuine inverse relationship with learning happiness. Some content items still exhibit high loadings on the AC factor but lower on the content factor, such as q2 and q5 (0.618 on AC, 0.082 on content for q2; 0.532 on AC, 0.202 on content for q5), suggesting a continued but reduced influence of AC bias. Given these findings, a strong recommendation emerges for using factor scores instead of raw scores in future analyses, as factor scores account for the underlying structure and relationships among items, effectively incorporating the variance shared among items that tap into the same construct. Utilising factor scores allows for a more accurate and nuanced understanding of students' learning happiness, as these scores better represent the latent constructs free from distortions introduced by systematic biases. This approach enhances the validity of the research findings and provides a solid foundation for developing targeted interventions and support mechanisms to improve student's learning experiences and overall satisfaction.

5. Conclusion

This study rigorously controlled for AC and SD biases within EFA, revealing a nuanced factor structure and offering valuable insights into student learning happiness (Ferrando et al., 2009). Disentangling the complex interplay of biases, we deepened our understanding of how students navigate their educational environments based on genuine experiences and societal expectations (Crowne & Marlowe, 1960; Podsakoff et al., 2003). These findings inform targeted interventions and policies, aiding stakeholders in crafting strategies that address diverse aspects of student learning happiness, such as designing curricula that challenge students and establishing support systems to mitigate SD bias (Fredrickson, 2001; Helliwell et al., 2020; Lyubomirsky et al., 2005). However, the study has limitations. The focus on a single institution, STOU, limits the generalisability of the findings to other contexts. Recruiting participants through provincial student clubs may not represent the entire undergraduate population and could introduce selection bias, as these students might differ from those not involved in such clubs. Geographic and cultural differences among these clubs also influence responses and engagement levels (Gunawardena & McIsaac, 2004; Moroz & Moroz, 2022). Future research should include additional constructs related to happiness using standardised instruments to provide evidence of concurrent validity. Incorporating a broader range of constructs, such as academic engagement, satisfaction with learning resources, and emotional well-being, would enhance understanding and strengthen the generalisability of our findings (Fredrickson, 2001; Lyubomirsky et al., 2005). Comprehensive sampling methods, such as stratified random sampling, would ensure proportional representation of all significant subgroups (Comrey & Lee, 1992; Tabachnick & Fidell, 2013). Overall, this study advances the field methodologically and highlights the importance of addressing the multifaceted nature of student experiences to supportive learning environments. Applying these findings is essential to enrich the educational journey for students in diverse learning contexts (Deci et al., 1991; Helliwell et al., 2020).

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