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EXPLORING THE ANTECEDENTS OF SOCIAL NETWORK USAGE ON ACADEMIC PERFORMANCE–A COMBINED GP-TOPSIS APPROACH

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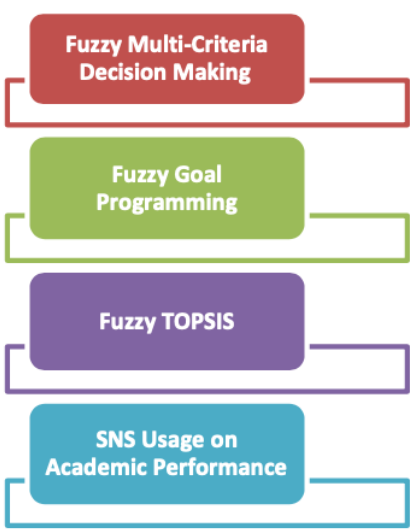
Arun Kumar Sangaiah[a*], Xiao-Zhi Gao[b], Ajith Abraham[c]

[a]School of Computing Science and Engineering, VIT University, Vellore, Tamil Nadu, India
[b]Department of Electrical Engineering and Automation, Aalto University, Aalto, Finland
[c]Machine Intelligence Research Labs, United States

*Corresponding author
arunkumarsangaiah@gmail.com

Graphical abstract



Abstract

The present study is focused with two objectives: (1) to explore the influence of big-five personality factors (extraversion, neuroticism, agreeableness, openness to experience, and conscientiousness) towards social network site (SNS) usage among Asian university students, and (2) to analyze the mediating roles of personality, cultural and technology factors, in the relationship between SNS usage on academic performance. Moreover, assessment framework for the integration of personality, cultural and technology factors for the effectiveness of SNS usage on academic performance has not been adequately presented in the available literature. For measuring the effects of SNS usage on academic performance, we have integrated Fuzzy Multi-Criteria Decision Making (FMCDM) Approaches: (a) Fuzzy Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) and (b) Goal Programming (GP) approach. Further, the hybridization of fuzzy TOPSIS and GP has addressed only in very few studies. Based on this context we have integrated fuzzy TOPSIS and GP approach for evaluating SNS usage on academic performance from the perspective of university students in India. The hybrid GP-TOPSIS methodology has been employed in a real case study among VIT university students in India. A numerical illustration for SNS usage on academic performance is also given to demonstrate the application of hybrid MCDM approach.

Keywords: Social Networking Sites (SNS), Academic Performance, Fuzzy Multi-Criteria Decision Making (FMCDM), Goal Programming (GP), Technique for Order Performance by Similarity to Ideal Solution (TOPSIS)

1.0 INTRODUCTION

In today's world, the rapid expansion of internet applications, Social Networking Sites (SNS) has been one of the worldwide used internet applications and plays a prominent role across the university students. SNS such as Face book and Twitter are gaining popularity and regularly used applications to get the information about other individuals and building relationship, in particular among Asian university students. In India, SNS sites are currently utilized by 120.5 million of users on (2014) the demand is estimated at 224.2 million of social network users in 2018, up from 63.1 million in 2012 (Statista, 2014). In addition, an earlier study reported that more than 80%

of university students have used Face book, which is a vital element in university social culture [2].

Recent studies [3, 4, 5, 6] have linked the relationship of the big-five personality factors with the usage of SNS. In addition, the significance of SNS usage on student academic performance has been investigated in a substantial measure forming part of available literature [7, 8, 9, 10, 11]. Moreover, a number of studies [12, 13, 14] have investigated the cultural difference and its motivations behind the usage of SNS. Subsequently, the earlier literature [16, 17] reveals that academic performance can be related to SNS usage and its effective, integrated use of ICTs. Consistent with the earlier literature, this research has integrated the SNS usage and student academic performance relationship in three contexts: *personality context* (big-five personality factors), *technology context* (ICT tools), and *cultural context* (personal importance of SNS and motives of SNS usage). However, the integration of personality, cultural and technology context factors affecting SNS usage has not been investigated adequately despite their importance in student academic performance. In addition, a comprehensive approach for considering personality, technology, and cultural factors for evaluating SNS usage on student academic performance has not been reported. Subsequently, fuzzy multi-criteria decision making for evaluating student academic performance perceived by SNS usage has not been adequately reported in the literature. As a result, to address this research gaps enthused us to propose a integrated approach based on fuzzy GP-TOPSIS presented in this paper.

To address these research gaps, an empirical study has been carried out in VIT University, India to evaluate SNS effectiveness from the perspective of student academic performance. The rest of this paper is organized as follows: Section 2 presents the literature reviews on SNS criteria and it measurements have been used in this study. Sections 3 and 4 present the theoretical foundations of GP-TOPSIS approach and assessment framework used in this research. Section 5 and 6 presents the empirical study results and a discussion of the study respectively. A conclusion of the study is presented finally to address the significance of GP-TOPSIS to address the SNS effectiveness.

2.0 EXPERIMENT LITERATURE OF PAST RESEARCH WORK

2.1 Personal Characteristics and SNS usage on Academic Performance

This section presents the earlier studies and develops an assessment methodology that is used in this research. Earlier research studies have addressed that the big-five personality factors are most significant characteristics of measuring SNS usage [3, 4, 5, 6]. Moreover, recent studies [7, 10, 11] have related the (extraversion, neuroticism, agreeableness, openness to experience, and conscientiousness) of SNS usage to academic performance.

Subsequently, recent studies [17, 18, 34, 35] have investigated the relationship between of big-five personality factors and SNS usage and find the greater impact on younger students than the older once. Thus, this study investigates the big-five personality factors among VIT university students. Consequently, the previous studies [9, 10, 19] have reported that personality factors such as neuroticism and conscientiousness are significant measurements for predicting academic performance. Moreover, the earlier studies [20, 21] indicated that openness to experience was a stronger predictor and consistently related to academic success. In addition, the recent study [6, 22, 23, 35] points out to extraversion and agreeableness an important factor to predict the SNS usage particularly in face book site. Consistent with earlier literature, this study has investigated personal characteristics from the perspective of SNS effectiveness on student academic performance through big-five indictors.

2.2 Technology Context and SNS usage on Academic Performance

Drawing upon the literature, [16, 24, 25] integrated use of ICTs specifically using in SNS increases the efficiency and productivity in academic settings. Currently, ICT provides a rich platform for teaching and learning. Recently, web 2.0 technologies having integrated the use of web-based tools, generally involving in SNS to enhance teaching and learning ability for students. Web 2.0 provides users with a personalized platform that relies mostly on asymmetric information exchange [24, 37]. Consequently, the earlier studies [16, 24] have explored the potential of Web 2.0 in SNS in formal learning context. In addition, previous studies [16, 24, 25] have attempted to prove the integrated the use of ICT in SNS and its positive outcome in educational settings.

Moreover, the research related to SNS and integrate the use of ICT tools that support SNS has been very limited in the literature. Thus, in technology context the focus of this study has investigating the SNS and integrates use of ICT towards academic performance.

Table 1 Summary of source of measurements and possible evaluation criteria's of SNS effectiveness on academic performance

Criteria and Sources of Measurement	Code	Description
Personality Context		
Extraversion	**C1**	Effectiveness of extraversion on SNS usage on academic performance
Neuroticism	**C2**	Effectiveness of neuroticism on SNS usage on academic performance
Conscientiousness	**C3**	Direct and positive effect of conscientiousness on SNS usage on academic performance
Agreeableness	**C4**	Positive effect and agreeableness on SNS usage on academic performance
Openness to experience	**C5**	Previous and openness to experience on SNS usage on academic performance
Technology Context		
ICT Tools	**C6**	Effectiveness of ICT tools usage of SNS on academic performance
Cultural Context		
Personal Importance of SNS	**C7**	Effectiveness of personal importance on SNS usage on academic performance
Motives of SNS Usage	**C8**	Direct positive effect and motives of SNS usage on academic performance

Table 2 Fuzzy linguistic terms and associate TFNs

Linguistic Variable	Corresponding TFN Multiplicative/Fuzzy	Crisp Value
Strongly agree	(3,4,5)/(0.9,1.0,1.0)	5/1.0
Agree	(2,3,4)/(0.7,0.9,1.0)	4/0.9
Neither Disagree Nor Agree	(1,2,3)/(0.3,0.5,0.7)	3/0.7
Disagree	(0,1,2)/(0.0,0.1,0.3)	2/0.3
Strongly Disagree	(0,0,1)/(0.0,0.0,0.1)	1/0.1

2.3 Culture and SNS usage on Academic Performance

The main objective of this study is to investigate the student perceptions of SNS usage impact on academic performance in India and China. Since the culture might vary between India and China, similarities and differences on SNS usage on academic performance is addressed in this study. In addition, VIT University has many of Chinese students. So we have collected data among Chinese and Indian students that and these used in this study. Similarly, many studies [11, 12, 13, 14] have investigated the cultural difference and the motivations behind the usage of SNS. Moreover, the recent study [11] has reported the cultural differences, usage of SNS, and its impact in academic-performance.

Similarly, the number of studies [12, 26] have investigated the culture aspects towards SNS usage of academic performance on the basis of personal importance of SNS and motives for SNS usage. Based on this context, the cultural aspects have been evaluated for SNS effectiveness on student academic performance addressed in this paper through two dimensions: personal importance of SNS and motives for SNS usage.

The panel of experts has validated the questionnaires and finalized these factors as evaluation criteria to assess KT effectiveness in GSD project under this study as shown in Table 1.

3.0 THEORETICAL FOUNDATIONS

In this study, the fuzzy TOSIS approach has been integrated with the Goal Programming approach for the evaluation of SNS usage effectiveness on students' academic performance from the perspective of personality, cultural and technology contexts under a fuzzy environment is proposed. The proposed GP-TOPSIS methodologies for SNS usage on academic performance evaluation framework consists of two parts. First, we have adopted the GP approach for determining the priority weights (relative importance) of the criteria according to the subjective preferences (fuzzy preference relation and multiplicative preference relation). Then we have applied TOPSIS to theoretical foundations of fuzzy TOPSIS and GP approaches have been illustrated in the following sections.

3.1 Fuzzy Goal Programming

The GP method suggested by [30, 31, 32] that is used for analyzing the data in this study, and its computational procedure summarized as follows:

Function GP ()
Input: number of criteria *n*, number of respondents *K*, fuzzy preference and multiplicative relational values
Output: priority weight *W*

1. **Begin**
2. Create a decision matrix for the important weights of SNS criteria on academic performance attributes.
3. Aggregate the minimum and maximum values of individuals with respect to the objective under each criterion.
4. Design the goals and fuzzy membership limits with respect to the problem objective under each criterion.
5. Obtain the degree of importance of each SNS factors based on two forms: fuzzy preference and multiplicative relational values.
6. Set up fuzzy preference and multiplicative relational matrix with corresponding data from respondents // *Refer Table-3*.
7. Aggregate the ranking of each alternatives with respect to the criteria // *Refer Table-4*.
8. Evaluate the weight by applying GP modelling
9. Set the maximum negative and positive tolerance values on the decision vector.// As per the reference [38]
10. For the same priority objectives, its importance, give the appropriate weight coefficient according to its importance // *Refer Table-5*.
11. Compute objectives according to the requirements of the decision-makers.
12. Formulate the Model (Fig.1) for the GP-TOPSIS MCDM problem.
13. Solve the Model (Fig.1) to get the satisfactory solution of the GP-TOPSIS problem.
14. **End function**

Goal programming has been a widely used methodology for handling multi-criteria decision making (MCDM) problems. Moreover, a number of studies [30, 31, 32, 33] have applied fuzzy GP approach to evaluate the relative importance of the criteria based on fuzzy preference relation and multiplicative preference relation along with achieved priority of group decision makers (DM). In this paper, GP approach has been used with respect to the earlier studies [30, 31, 32, 33]. GP is based on DMs' fuzzy preference relation; multiplicative preference relation on priority of the criteria has been used to evaluate the relative importance of the criteria of TOPSIS approach has been adopted in this study to evaluate rank and relative order of alternatives. Likewise this research focuses GP-TOSIS approach on designing hybrid methodology for the real data set obtained from VIT University, India for evaluating SNS usage on academic performance is presented.

3.2 Fuzzy TOPSIS

TOPSIS, one of the conventional MCDM methods, has been widely used to compute the relative importance of alternatives and solving practical decision making problems with its high computational efficiency and comprehensibility. Moreover, existing studies have adopted TOPSIS to solve MCDM problems [27, 28, 29, 30, 39, 40, 41]. Similarly, the basic idea of using TOPSIS in this paper is to compute the ideal solution (best values realistic of criteria) and negative ideal solution (worst values realistic of criteria) for ranking the SNS usage on academic performance factors perceived by university students. The TOPSIS approach operational procedure and its data analysis has been summarized as follows:

Step 1: Construct normalized decision matrix.

To transform the various attribute dimensions into non-dimensional attributes, which allows comparisons across the criteria. The normalized scores or data are as follows:

$$R_{ij} = \frac{x_{ij}}{\sum x_{ij}^2} \quad (1)$$

$$for\ i = 1 \cdots m; j = 1 \cdots n$$

Step 2: Construct the weighted normalized decision matrix.

Assume we have a set of weights for each criterion is $w_j, for i = 1 \cdots n.$ Multiply each column of the normalized decision matrix by its associated weight. Weights used in this step have been derived from fuzzy DEMATEL approach given in Eqn. (8). These weights will be applied on normalized decision matrix R.
An element of the new matrix is:

$$v_{ij=}w_{ij} \times r_{ij} \quad (2)$$

Here, weighted normalized decision matrix is represented asv_{ij} is calculated by multiplying weights (w_j) of the constructs with the normalized fuzzy decision matrix(r_{ij}).

Step 3: Compute the fuzzy positive ideal solution (FPIS) and fuzzy negative ideal solution (FNIS).

The FPIS and FNIS of the alternatives are computed as follows:

Ideal solution.

$$A^* = \{V_1, V_2 \cdots V_n\}\text{where} \quad (3)$$

$$s^* = \{\max(V_{ij})\}$$

Negative ideal solution.

$$A^{'} = \{V_1, V_2 \cdots V_n\}\text{where} \quad (4)$$

$$s^{'} = \{\min(V_{ij})^i\}$$

Where s^* represents the fuzzy positive ideal solution and $s^{'}$ represents the fuzzy negative ideal solution. It can be derived with the help of the A^* and $A^{'}$ fuzzy decision matrices.

Step 4: Calculate the separation measures for each alternative.

The separation from the ideal alternative is:

$$s_i^* = \left[\sum (s^* - s')\right] \quad (5)$$

Step 5: Compute the closeness coefficient (c_i) of each alternative.

The closeness coefficient c_i represents the distances to the fuzzy positive ideal solution (s^*) and the fuzzy negative ideal solution ($s^{'}$) simultaneously. The closeness coefficient (CC) of each alternative is calculated as:

$$c_i = \frac{s_i^{'}}{s^{'} + s^*} \quad (6)$$

Step 6: Rank the alternatives according to the Preference Ratio (K)

In this step, the different alternatives are ranked according to the closeness coefficient *(c_i) and preference ratio (PR)*. In this study, the overall preference over all the criteria and fuzzy distance has been computed via PR suggested by earlier studies [30,33]. The best alternative is closest to the FPIS and farthest from the FNIS

4.0 FRAMEWORK FOR EVALUATING SNS USAGE ON ACADEMIC PERFORMANCE IN FUZZY ENVIRONMENT

To the best of our knowledge, up to date research on evaluation of SNS usage on academic performance case study under fuzzy environment is very limited. Moreover, assessment framework for the integration of personality, cultural and technology factors for the effectiveness of SNS usage on academic performance has not been adequately presented in the available literature. Further, the hybridization of fuzzy TOPSIS and GP has addressed only in very few studies. Based on this context we have integrated fuzzy TOPSIS and GP approach for evaluating SNS usage on academic performance from the perspective of university [...] framework and computation procedure of hybridization of TOPSIS and GP approach under a fuzzy environment is depicted in Fig.1.

5.0 EMPIRICAL CASE FOR EVALUATING THE KT CRITERIA'S OF GSD TEAMS

The primary objective of this study is to investigate the influence of SNS usage effectiveness at individual, cultural and technology levels in academic performance research phenomenon of university students. To achieve this goal, an empirical study has been carried out in VIT University located in India. The university has more than 24000 students, 1400 faculty members, reputation (national and international standard certification) and over the years VIT has taken in many international students for various disciplines. The demographic details of the respondents of this study were undergraduate science, engineering students, and faculty members of VIT University. Moreover, group of 2 Indian and 2 Chinese students was selected and each students group consisting 20 DMs' preferences represented in the form matrix $S = \{S_1, S_2, S_3, S_4\}$as shown in Table 3(a)-3(d). Similarly, four faculty was selected each faculty group consists of 20 DMs' responses represented in the form of matrix $F = \{F_1, F_2, F_3, F_4\}$ as shown in Table 3(d)-3(h). Consequently, the empirical study has been tested among 40 DMs' (20 students and 20 faculties) of this organization to validate the effectiveness of SNS usage (see table-1) on academic performance.

Table 3 (a) Multiplicative preference relations: Student # 1 – Matrix-S_1

	C1	C2	C3	C4	C5	C6	C7	C8
C1	1	4	3	1/3	4	¼	5	5
C2	1/4	1	4	9	1/4	5	5	3
C3	1/3	1/4	1	1/8	1/8	2	1/4	1
C4	3	1/9	8	1	4	¼	5	1/5
C5	1/4	4	8	1/4	1	½	4	1/7
C6	4	1/5	1/2	4	2	1	1/5	3
C7	1/5	1/5	4	1/5	1/4	5	1	1/4
C8	1/5	1/3	1	5	7	1/3	4	1

Table 3(b) Multiplicative preference relations: Student # 2 – Matrix- S_2

	C1	C2	C3	C4	C5	C6	C7	C8
C1	1	2	1/5	1/3	4	1/6	5	8
C2	1/2	1	1/5	9	1/4	8	5	3
C3	5	5	1	1/8	4	2	1/4	1
C4	3	1/9	8	1	4	¼	5	1/5
C5	¼	4	1/4	1/4	1	¼	4	1/7
C6	6	1/8	1/2	4	2	1	1/5	3
C7	1/5	1/5	4	1/5	1/4	5	1	1/4
C8	1/8	1/3	1	5	7	1/3	4	1

Table 3(c) Multiplicative preference relations: Student # 3 – Matrix- S_3

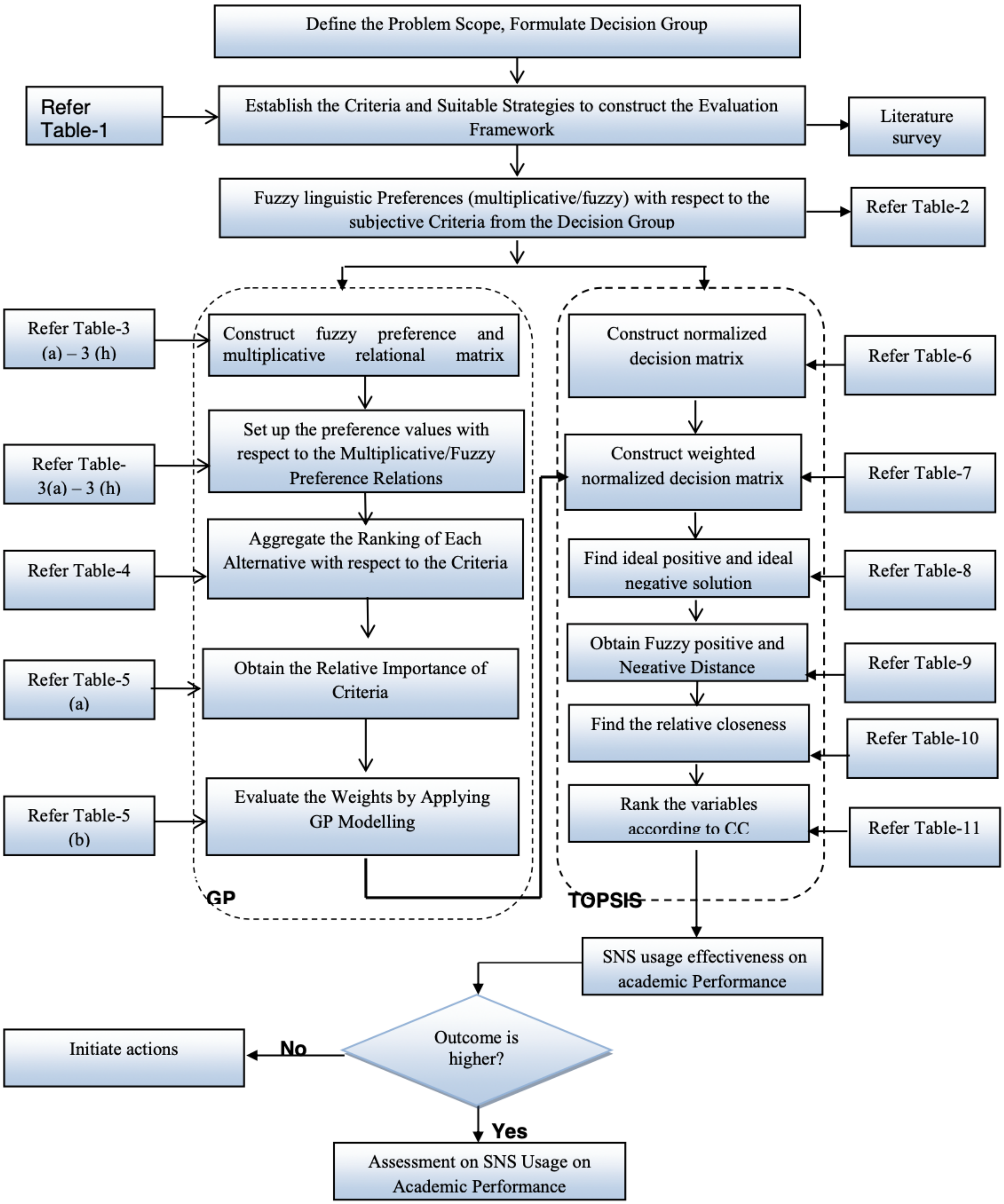
	C1	C2	C3	C4	C5	C6	C7	C8
C1	1	2	1/5	1/3	4	1/6	5	8
C2	1/2	1	1/5	9	1/4	8	5	3
C3	5	5	1	1/8	4	2	1/4	1
C4	3	1/9	8	1	4	¼	5	1/5
C5	1/4	4	1/4	1/4	1	1/2	4	1/7
C6	6	1/8	1/2	4	2	1	1/5	3
C7	1/5	1/5	4	1/5	1/4	5	1	¼
C8	1/8	1/3	1	5	7	1/3	4	1

Table 3(d) Multiplicative preference relations: Student # 4 – Matrix- S_4

	C1	C2	C3	C4	C5	C6	C7	C8
C1	1	2	1/5	1/3	4	1/6	5	8
C2	½	1	1/5	9	¼	8	5	3
C3	5	5	1	1/8	4	2	¼	1
C4	3	1/9	8	1	4	1/4	5	1/5
C5	¼	4	1/4	1/4	1	1/2	4	1/7
C6	6	1/8	1/2	4	2	1	1/5	3
C7	1/5	1/5	4	1/5	¼	5	1	¼
C8	1/8	1/3	1	5	7	1/3	4	1

Table 3(e) Fuzzy preference relations: Faculty # 1 – Matrix- F_1

	C1	C2	C3	C4	C5	C6	C7	C8
C1	0.5	0.4	0.2	0.9	0.7	0.2	0.1	0.1
C2	0.2	0.5	0.6	0.9	0.7	0.8	0.5	0.3
C3	0.3	0.1	0.5	0.8	0.5	0.6	0.4	0.1
C4	0.8	0.2	0.7	0.5	0.3	0.4	0.8	0.5
C5	0.2	0.1	0.2	0.6	0.5	0.2	0.4	0.7
C6	0.1	0.8	0.3	0.5	0.4	0.5	0.5	0.3
C7	0.9	0.7	0.6	0.2	0.4	0.3	0.5	0.4
C8	0.2	0.1	0.3	0.3	0.7	0.4	0.5	0.5


Define the Problem Scope, Formulate Decision Group
Refer Table-1
Establish the Criteria and Suitable Strategies to construct the Evaluation Framework
Literature survey
Fuzzy linguistic Preferences (multiplicative/fuzzy) with respect to the subjective Criteria from the Decision Group
Refer Table-2
Refer Table-3 (a) – 3 (h)
Construct fuzzy preference and multiplicative relational matrix
Refer Table-3(a) – 3 (h)
Set up the preference values with respect to the Multiplicative/Fuzzy Preference Relations
Refer Table-4
Aggregate the Ranking of Each Alternative with respect to the Criteria
Refer Table-5 (a)
Obtain the Relative Importance of Criteria
Refer Table-5 (b)
Evaluate the Weights by Applying GP Modelling
GP
Construct normalized decision matrix
Refer Table-6
Construct weighted normalized decision matrix
Refer Table-7
Find ideal positive and ideal negative solution
Refer Table-8
Obtain Fuzzy positive and Negative Distance
Refer Table-9
Find the relative closeness
Refer Table-10
Rank the variables according to CC
Refer Table-11
TOPSIS
SNS usage effectiveness on academic Performance
Initiate actions
No
Outcome is higher?
Yes
Assessment on SNS Usage on Academic Performance

The totality of 40 DMs' assessments with corresponding SNS criterion for all five alternatives has been shown in *Appendix-A*. According to earlier studies [30, 31, 32], we have followed fuzzy preference and multiplicative preference relations for DM's judgments over set of alternatives/criteria. In addition, uncertainty over set of DM's preferences has been effectively handled through GP approach. The hybrid fuzzy TOPSIS-GP approaches were applied in this case study, as illustrated in the following sections.

5.1 Goal Programming Application

The basic steps of Fuzzy-GP approach used in this study are as follows:

Step 1: Construct fuzzy preference and multiplicative relational matrix, determine the alternatives, and normalize the scores in order to find the best alternative as shown in Table-9.

Step 2: The subjective decisions of 40 DMs' (students and faculties) use the linguistic fuzzy preference relation and multiplicative relation of each SNS criterion

Step 3: The weighted performance interval-valued fuzzy decision matrix is constructed to aggregate the rating of each alternatives with respect to the SNS criterion as shown in Table 7.

Step 4: Obtain relative importance of the criteria and output of GP modeling as shown in Table-12.

5.2 Fuzzy TOPSIS Application

The basic steps of Fuzzy-TOPSIS approach used in this study are as follows:

Step 1: Construct fuzzy assessment decision matrix, determine the alternatives, and normalize the scores in order to find the best alternative as shown in Table-9.

Step 2: Input the weights which is obtained from the GP method to calculate the weighted normalized decision matrix as given in Table-10.

Step 3: The best evaluation and worst evaluation value with respect to each criterion is determined through FPIS and FNIS as shown in Table-11.

Step 4: Obtain relative closeness coefficient to the ideal solution and rank the alternatives as shown in Table-12.

6.0 RESULTS AND DISCUSSIONS

The integrated GP-TOPSIS methodology has been used for investigation of SNS usage on the academic performance of students from Asian countries and especially in VIT University, India. The data used in this University to explore the SNS usage on academic performance through survey questionnaires. The faculty and students given their subjective judgments based on multiplicative preference/fuzzy preference relations. Totally 40 (8 alternatives) DMs' samples are represented in this study to explore the SNS effectiveness criteria using linguistic assessments on fuzzy preference / multiplicative preference relation as shown in Table-2. The subjective preferences of DMs (students/faculty) are shown in Table-3. In addition, Table 3 depicts the aggregation of DMs ranking of each alternative with respect to criteria on Table-1 using fuzzy linguistic items as shown in Table-2. The totality of 40 DMs' assessments with corresponding SNS criterion for all alternatives has been shown in Appendix-A. Subsequently, the relative importance of the criteria and output of GP modeling has been represented in Table-5. The weights of GP modeling results address that personality context factors that is extraversion (C_1) and conscientiousness (C_3) values are more significant that those other evaluation factors. Similarly, the relative importance and fuzzy distance of the criteria values are closer that those all other values as shown in table-5 and table 11. Consequently, the GP modeling results have been applied in the TOPSIS method and their results are given in Table 6-11. Thereby, SNS usage on university students can facilitate the effectiveness of student learning performance in academic organizations.

Table 3(f) Fuzzy preference relations: Faculty # 2 – Matrix- F_2

	C1	C2	C3	C4	C5	C6	C7	C8
C1	0.5	0.8	0.4	0.1	0.7	0.2	0.1	0.1
C2	0.2	0.5	0.6	0.9	0.7	0.8	0.5	0.3
C3	0.7	0.8	0.5	0.9	0.5	0.6	0.5	0.1
C4	0.8	0.2	0.7	0.5	0.6	0.6	0.8	0.5
C5	0.2	0.2	0.2	0.6	0.5	0.2	0.4	0.7
C6	0.1	0.8	0.3	0.5	0.4	0.5	0.5	0.3
C7	0.7	0.7	0.9	0.2	0.7	0.3	0.5	0.4
C8	0.2	0.1	0.3	0.2	0.7	0.4	0.5	0.5

Table 3(g) Fuzzy preference relations: Faculty # 3 – Matrix- F_3

	C1	C2	C3	C4	C5	C6	C7	C8
C1	0.5	0.9	0.7	0.1	0.7	0.2	0.1	0.1
C2	0.2	0.5	0.7	0.9	0.7	0.8	0.5	0.3
C3	0.3	0.9	0.5	0.9	0.5	0.6	0.5	0.1
C4	0.1	0.2	0.7	0.5	0.6	0.6	0.8	0.5
C5	0.8	0.2	0.2	0.5	0.5	0.1	0.4	0.7
C6	0.9	0.8	0.3	0.5	0.4	0.5	0.5	0.3
C7	0.3	0.7	0.9	0.6	0.7	0.3	0.5	0.4
C8	0.2	0.1	0.3	0.2	0.7	0.4	0.5	0.5

Table 3(h) Fuzzy preference relations: Faculty # 4 – Matrix- F_4

	C1	C2	C3	C4	C5	C6	C7	C8
C1	0.5	0.8	0.6	0.1	0.5	0.2	0.2	0.1
C2	0.2	0.5	0.9	0.3	0.7	0.9	0.5	0.3
C3	0.3	0.8	0.5	0.8	0.5	0.7	0.5	0.2
C4	0.1	0.4	0.7	0.3	0.6	0.7	0.8	0.5
C5	0.8	0.6	0.2	0.6	0.5	0.2	0.4	0.8
C6	0.9	0.8	0.3	0.5	0.4	0.5	0.5	0.3
C7	0.3	0.7	0.9	0.6	0.7	0.3	0.5	0.4
C8	0.2	0.1	0.3	0.2	0.7	0.4	0.5	0.5

Table 4 Aggregation of ranking of each alternative with respect to criteria

	C1	C2	C3	C4	C5	C6	C7	C8
A1	(0.2,0.3,0.7,0.8)	(0.1,0.4,0.7,0.8)	(0.3,0.7,0.8,.9)	(0.1,0.3,0.7,0.5)	(0.5,0.6,0.8,1)	(0.4,0.5,0.8,1)	(0.3,0.7,0.8,1)	(0.2,0.5,0.8,1)
A2	(0.1,0.4,0.7,0.9)	(0.3,0.7,0.8,.9)	(0.2,0.5,0.8,1)	(0.1,0.5,0.8,0.9)	(0.2,0.5,0.8,1)	(0.2,0.3,0.7,0.8)	(0.5,0.6,0.8,1)	(0.2,0.3,0.7,0.9)
A3	(0.3,0.5,0.7,0.8)	(0.2,0.5,0.8,1)	(0.5,0.6,0.8,1)	(0.3,0.7,0.8,.9)	(0.2,0.3,0.7,0.8)	(0.1,0.5,0.8,0.9)	(0.2,0.3,0.5,0.9)	(0.5,0.6,0.8,1)
A4	(0.4,0.7,0.8,.9)	(0.5,0.6,0.8,1)	(0.2,0.6,0.7,0.8)	(0.2,0.6,0.7,0.8)	(0.5,0.6,0.8,1)	(0.3,0.6,0.8,1)	(0.2,0.5,0.8,1)	(0.5,0.6,0.8,1)
A5	(0.1,0.5,0.8,0.9)	(0.3,0.8,0.7,1)	(0.1,0.4,0.7,0.9)	(0.1,0.5,0.8,0.9)	(0.3,0.8,0.7,1)	(0.2,0.5,0.8,1)	(0.5,0.6,0.8,1)	(0.3,0.8,0.7,1)

Table 5 (a) Relative importance of the criteria. **(b)** The output of GP modeling

W1	W2	W3	W4	W5	W6	W7	W8
.024567	.011134	.043420	.00123	.01456	.01660	.01220	.00135

	C1	C2	C3	C4	C5	C6	C7	C8
C1	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0	0	0
C3	0	0	0	0	0.112267	0	0	0
C4	0.1212345	0	0	0	0	0	0.121245	0
C5	0	0	0	0.33224	0	0	0	0
C6	0	0.313123	0	0	0	0	0	0
C7	0	0	0	0	0	0	0	0
C8	0	0	0	0	0.11110	0	0	0

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
C1	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0	0.22222	0
C3	0	0.21342	0	0	0	0.33431	0	0
C4	0	0	0.22113	0	0	0	0	0
C5	0	0	0	0	0.11212	0	0	0
C6	0.214320	0	0	0	0	0	0	0
C7	0	0	0	0	0	0	0	0
C8	0	0	0	0	0	0	0	0.62145

Table 6 Normalized decision matrix

	C1	C2	C3	C4	C5	C6	C7	C8
A1	(0.2,0.3,0.7,0.8)	(0.12,0.43,0.76,0.88)	(0.3,0.7,0.8,.9)	(0.1,0.3,0.7,0.5)	(0.53,0.62,0.82,1)	(0.4,0.5,0.8,1)	(0.3,0.7,0.8,1)	(0.22,0.55,0.89,1)
A2	(0.1,0.4,0.7,0.9)	(0.32,0.76,0.89,.98)	(0.2,0.5,0.8,1)	(0.1,0.5,0.8,0.9)	(0.29,0.54,0.80,.14)	(0.2,0.3,0.7,0.8)	(0.5,0.6,0.8,1)	(0.23,0.34,0.76,0.98)
A3	(0.3,0.5,0.7,0.8)	(0.23,0.55,0.89,1)	(0.5,0.6,0.8,1)	(0.3,0.7,0.8,.9)	(0.25,0.36,0.78,0.89)	(0.1,0.5,0.8,0.9)	(0.2,0.3,0.5,0.9)	(0.55,0.67,0.88,1)
A4	(0.4,0.7,0.8,.9)	(0.55,0.62,0.84,11)	(0.2,0.6,0.7,0.8)	(0.2,0.6,0.7,0.8)	(0.53,0.67,0.89,1)	(0.3,0.6,0.8,1)	(0.2,0.5,0.8,1)	(0.54,0.65,0.86,.99)
A5	(0.1,0.5,0.8,0.9)	(0.33,0.87,0.75,1)	(0.1,0.4,0.7,0.9)	(0.1,0.5,0.8,0.9)	(0.32,0.87,0.76,1)	(0.2,0.5,0.8,1)	(0.5,0.6,0.8,1)	(0.33,0.86,0.75,1)

Table 7 Weighted normalized decision matrix

	C1	C2	C3	C4	C5	C6	C7	C8
A1	(0, 0.01, 0.012,0.014)	(0.45,0.052,0.076, 0.088)	(0.324,0.721,0.834,0.092)	(0.123,0.314,0.723,0.523)	(0.53,0.62,0.82,1)	(0.423,0.514,0.867,.0123)	(0.323,0.756,0.82,.0341)	(0.214,0.556,0.823,.021)
A2	(0,0.017,0.019,0.021)	(0.32,0.76,0.89,.98)	(0.314,0.456,0.823,.021)	(0.123,0.534,0.878,0.934)	(0.29,0.54,0.80,.14)	(0.323,0.723,0.856,.945)	(0.214,0.556,0.823,.021)	(0.23,0.34,0.76,0.98)
A3	(0,0.006,0.07,0.01)	(0.45,0.55,0.89,1)	(0.5,0.6,0.8,1)	(0.323,0.723,0.856,.945)	(0.25,0.36,0.78,0.89)	(0.514,0.556,0.823,.021)	(0.2,0.3,0.5,0.9)	(0.55,0.67,0.88,1)
A4	(0,0.012,0.017,0.019)	(0.03,0.037,0.4,0.052)	(0.2,0.6,0.7,0.8)	(0.2,0.6,0.7,0.8)	(0.45,0.55,0.89,1)	(0.323,0.634,0.823,1)	(0.323,0.756,0.82,.0341)	(0.814,0.556,0.823,.021)
A5	(0,0.012.0.017,0.019)	(0.03,0.037,0.75,0.052)	(0.1,0.4,0.7,0.9)	(0.1,0.5,0.8,0.9)	(0.32,0.87,0.76,1)	(0.2414,0.556,0.823,.021)	(0.523,0.614,0.867,.015)	(0.33,0.86,0.75,1)

Table 8 Fuzzy Positive Ideal Solution (FPIS) and Fuzzy Negative Ideal Solution (FNIS)

	C1	C2	C3	C4	C5	C6	C7	C8
FPIS	(0.323,0.723, 0.856,.945)	(0.123,0.345,0.453,0.123)	(0.214,0.556,0.823,.021)	(0.123,0.111,0.564,0.2)	0.523,0.614,0.867,.015)	(0.123,0.444,0.654,0.808)	(0.5,0.6,0.8,1)	(.0023,.0345,0.321,0.234)
FNIS	(0.0121,0.345,0.567,0.333)	(0.003,0.444,0.654,0.808)	(.0032,.0123,.0456,.0784)	(0.5,0.6,0.8,1)	(0.235,0.569,0.889,.011)	(0.523,0.626,0.856,.071)	(.0033,.0365,0.721,0.234)	(.0012,.0123,.0456,.0784)

Table 9 FPD and FND for each alternative

	Fuzzy positive distance		Fuzzy negative distance
A1	(0,0.0123,0.234,0.406,)	A1	(0,0.569,0.0889,0.011)
A2	(0,0.345,0.567,0.0333)	A2	(0,0.626,0.0856,0.071)
A3	(0,0.243,0.0145,0.0231)	A3	(0,0.0231,0.0221,0.123)
A4	(0,0.234,0.0455,0.667)	A4	(0,0.0334,0.0676,0.776)
A5	(0,0.232,0.0255,0.454)	A5	(0,0.0456,0.0556,0.799)

Table 10 Fuzzy closeness coefficients

A1	(0.0001,0.032,1.034,3123.563)
A2	(0.0001,0.432,0.334,3523.793)
A3	(0.0001,0.138,1.056,1127.528)
A4	(0.0001,0.052,0.044,4003.597)
A5	(0.0001,0.045,0.034,5123.452)

Table 11: Final ranking of each alternative using preference ratio

	1/K-value	K-value	Rank
A1	1.000	1.000	1
A2	0.756	1.321	3
A3	0.518	2.001	4
A4	0.978	1.767	2
A5	0.321	2.555	5

7.0 CONCLUSION

In this paper, a combined MCDM approach has been designed based on goal programming and fuzzy TOPSIS approach. Moreover, this integrated approach has been applied in VIT University students to explore the influence of the big-five personality factors, personal importance, and motives of SNS usage in cultural context and ICT tools on the performance of academic students. In addition, to demonstrate the applicability and capability of GP-TOPSIS approach, the framework has been tested based on the data collected from the VIT university students. Consequently, this study has presents two valuable contributions: (i) a comprehensive overview of the factors influencing SNS usage on academic performance (ii) GP-TOPSIS approach to find the relative importance of the criteria and to rank the criteria on the basis of fuzzy distance measurement and preference ratio. Moreover, the uncertainty, subjective vagueness within the DM's preferences and decision making process have been handled effectively through GP-TOPSIS. In this research work, we suggest a research methodology based on GP-TOPSIS which can effectively validate and rate the SNS evaluation criteria in the context of students' academic performance. Subsequently, the case study results indicate that personality, technology, and cultural context factors have a significant impact on the evaluation of the SNS effectiveness of student academic performance in the academic environment. The prototype of proposed approach (GP-TOPSIS) can be developed in the future it can be enhanced into a efficient tool to handle MCDM in a real time settings. Through MCDM approach we have revealed that SNS and its influential factors are the main contributors to enhance student learning performance in a academic settings.

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Appendix - A : Respondents ranking with respect to SNS criterion

	C1	C2	C3	C4	C5	C6	C7	C8
A1								
DM1	SA	A	U	SD	A	D	SD	D
DM2	A	SA	A	U	SA	A	A	A
DM3	SA	A	A	A	SD	D	D	A
DM4	SD	D	D	D	D	D	SA	SA
DM5	SA	SA	D	A	SD	SA	A	SD
DM6	A	D	SD	A	SD	SD	A	SA
DM7	SA	SD	SD	SA	D	SD	SD	SA
DM8	A	SD	SD	A	D	D	SA	SD
A2								
DM1	SD	D	D	SD	A	SD	SD	SD
DM2	SA	SA	SA	U	SA	SA	SA	A
DM3	SA	A	SA	A	SD	SD	SD	A
DM4	SD	D	D	D	D	SD	SA	SA
DM5	SA	SA	D	A	SD	SA	SA	SD
DM6	SA	D	SD	A	SD	SD	A	SA
DM7	SA	D	D	A	SD	SD	SD	SA
DM8	A	D	D	SA	SD	D	SA	SD
A3								
DM1	SA	A	U	SD	A	D	SD	D
DM2	A	SA	A	U	SA	A	A	A
DM3	SA	A	A	A	SD	D	D	A
DM4	SD	D	D	D	D	D	SA	SA
DM5	SA	SA	D	A	SD	SA	A	SD
DM6	A	D	SD	A	SD	SD	A	SA
DM7	SA	SD	SD	SA	D	SD	SD	SA
DM8	A	SD	SD	A	D	D	SA	SD
A4								
DM1	SD	D	D	SD	A	SD	SD	SD
DM2	SA	SA	SA	U	SA	SA	SA	A
DM3	SA	A	SA	A	SD	SD	SD	A
DM4	SD	D	D	D	D	SD	SA	SA
DM5	SA	SA	D	A	SD	SA	SA	SD
DM6	SA	D	SD	A	SD	SD	A	SA
DM7	SA	D	D	A	SD	SD	SD	SA
DM8	A	D	D	SA	SD	D	SA	SD
A5								
DM1	SA	A	U	SD	A	D	SD	D
DM2	A	SA	A	U	SA	A	A	A
DM3	SA	A	A	A	SD	D	D	A
DM4	SD	D	D	D	D	D	SA	SA
DM5	SA	SA	D	A	SD	SA	A	SD
DM6	A	D	SD	A	SD	SD	A	SA
DM7	SA	SD	SD	SA	D	SD	SD	SA
DM8	A	SD	SD	A	D	D	SA	SD

