Evaluating Gamification Skills of UG & PG Teachers: A Focused University Study

ISBN 978-1-943295-24-1

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Gamification, using game-design elements in non-game contexts, enhances student motivation and learning across educational levels, and is recognized as a top teaching pedagogy by Oxford Analytica and Growth Engineering Research in 2024. This study evaluates gamification skills among UG and PG teachers, focusing on degree, years taught, and program impacts. A questionnaire with demographics and 26 gamification skill statements was developed, refined to 15 through confirmatory factor analysis, yielding reliable results. Findings from 247 teachers indicate high effectiveness in gamification skills across degrees, with no statistical effect of degree, years taught, or program on skill efficacy.

Keywords: Gamification, Postgraduation, Under Graduation, Teacher's

1. Introduction

- In the current educational landscape, rapid digitalization has transformed learning methodologies, particularly with the growth of remote and technology-based learning during the COVID-19 pandemic. The recent paradigm shift has highlighted gamification as a potent strategy for enhancing engagement, motivation, and learning outcomes within educational settings.

Teachers are increasingly adopting gamification strategies to foster motivation and interactivity, making the learning experience more enjoyable and meaningful. However, there are still challenges in understanding and standardizing gamification practices in education, especially in building the necessary skills for teachers to implement these methods effectively.

In today's educational landscape, gamification has emerged as an effective pedagogical approach that integrates game-design elements in non-game settings to enhance student engagement and learning outcomes. Techniques such as points, badges, challenges, and leaderboards bring a dynamic and interactive experience to the classroom, making learning more compelling and enjoyable. The effectiveness of gamification has been widely acknowledged, with recent research by Oxford Analytica and Growth Engineering Research in 2024 recognizing it as one of the best teaching pedagogies for fostering enthusiasm and motivation among students at different educational levels.

Furthermore, statistical tests, including two-sample t-tests and ANOVA, reveal that Degree level (UG or PG), Years Taught, and Program do not significantly impact gamification skills' effectiveness. In-depth analysis, however, suggests specific areas for improvement: B.Tech and BBA programs could benefit from additional focus on Skill development, while M.Tech may need reinforcement in Attitude. The MBA program displayed well-rounded effectiveness across all three constructs.

These insights can inform institutions in refining their strategies for implementing gamification, ensuring that teaching practices continue to engage and inspire students effectively. Expanding this research across more universities with larger sample sizes can further validate and enhance gamification practices in higher education.

However, this radical technological shift (Digital technologies for a new future, 2022) has presented a significant challenge for educational institutions and their faculty, who are expected to deliver high-quality instruction leveraging information technologies (Ananga, 2020).This demand underscores the imperative to innovate educational practices (Martell, 2016).

The incorporation of game design elements into non-game contexts, known as gamification, has emerged as a popular pedagogical strategy in recent decades due to its potential to enhance student engagement and academic achievement (Luo, 1 july 2021).

It is important to note that educational innovation extends beyond technological integration; it encompasses the development of problem-solving skills and the cultivation of conducive learning environments (Barbara Biasi, March 2021). Educational innovation requires continuous effort from teachers and students to improve learning environments, both physical and virtual, to enhance student engagement and completion rates (Buckley, 2014).

One effective strategy for enhancing student and teacher engagement and motivation is the implementation of gamification (Basten). This strategy is characterized by the incorporation of game-like elements into non-gaming environments (Sebastian Deterding, January 2011). Gamification aims to cultivate compelling experiences, drive motivation, and foster commitment, however, unlike video games (Mikko Rajanen, 2023). with the intention of influencing the behaviour of users or customers (Kai Huotari, 2012) and stimulate their interest in the product or service (Coelho, 2022).

Although several studies have attested to the positive impact of gamification on education (Li, 20 July 2020),especially with regard to the utilization of digital tools and the positive experiences of both educators and learners (Jonna Koivisto, 2018),The full integration of game-based learning into mainstream education is still hindered by certain challenges (Revuelta-Dominguez,

2022),Addressing the misconception that gamification is merely mindless play (Marti-parreno, 2019) and that teachers are ready to bring the fun of gamification into both classrooms and digital learning spaces (Fernando Silvio Cavalcante pimentel, 2020)

Therefore, it is imperative that teachers and education specialists possess the requisite skills to employ gamification in their educational practices (Tenorio, 24 August 2021) to develop novel learning experiences augmented by technological advancements (Terje Valjantaga, 2020).

Therefore, the objective of this research is to propose and validate an instrument that could be used to identify gamification skills in teachers.

1. To meet the first objective, selection scale is used
2. To fulfil the second objective, to analyze the impact of type of program on their skilling aspect of gamification.
3. To accomplish the third objective, to analyze the impact of type of program on their attitude aspect of gamification
4. Fourth objective is to analyze the impact of type of program on their knowledge aspect of gamification

2. Methodology

The present study is conducted to examine the effectiveness of gamification skills among teachers at undergraduate (UG) and postgraduate (PG) levels at a selected university. The study had two main objectives: first, to evaluate the extent of gamification skills among teachers, and second, to assess the influence of factors such as Degree level (UG and PG), Years_ Taught, and Program on the effectiveness of gamification skills. The research aimed to provide insights into how these factors might affect teachers' skill, attitude, and knowledge regarding gamification techniques.

The study has followed the following Hypotheses with respective objectives.

1. The study does not provide any hypothesis in knowing the level of usage of gamification by UG and PG teachers.
2. To analyse the impact of type of program on their skilling aspect of gamification

Null Hypothesis: No Impact of type of program on their Skilling aspect of gamification

Alternative Hypothesis: An Impact of type of program on their skilling aspect of gamification

3. To analyse the impact of type of program on their attitude aspect of gamification

Null Hypothesis: No Impact of type of program on their attitude aspect of gamification

Alternative Hypothesis: An Impact of type of program on their attitude aspect of gamification

4. Fourth Objective: To analyse the impact of type of program on their knowledge aspect of gamification Null Hypothesis: No Impact of type of program on their knowledge aspect of gamification

Alternative Hypothesis: An Impact of program on their knowledge aspect of gamification.

The methodology includes four major aspects.

- **Research Design**

The study has conducted an Empirical Research Design.

- **Sampling Design**

The sampling design includes population, sample frame, sample size and sampling procedure.

1. Population: Target population is Teachers of UG and PG.
2. Sample Frame: A total of 693 faculty were identified those have become the part of sample frame in the chosen university.
3. Sample Size: 247 sample is obtained by using Cochran's Formula on Population.
4. Sampling Procedure: Used Proportionate stratified random sampling for identifying the sample elements from the sample frame of 693.

- **Data Collection**

The research utilized a structured questionnaire to gather data from teachers on gamification skills. The questionnaire was developed with two primary sections: one for demographic information, including Degree, Years _Taught, and Program, and another containing 26 statements aimed at assessing gamification skills. These 26 statements were designed to capture three key constructs: Skill, Attitude, and Knowledge. A pilot study is initially conducted with 130 teachers to validate the survey instrument.

- **Data Analysis**

The study has conducted two phases of analysis including Pilot Study and Final Study Analysis.

In order to perform pilot study analysis, the study has collected 130 sample responses those were tested for instrument validity and reliability. The construct validity was conducted using **confirmatory factor analysis** being established scales and reliability testing is done using Cronbach's Alpha.

While conducting final study analysis, the study has adopted the following mechanism and statistical tools to meet the above specified objectives.

- In order to meet the first objective, collected data from selection scale is used and analysed using measures of central tendency i.e, mean.
- In order to fulfill the second, third and fourth objective, One-Way ANOVA is used.

3. Data Specification

The final study involved a sample of 247 teachers from various programs at UG and PG levels. Teachers from B.Tech, BBA, M. Tech, and MBA programs were included, allowing for comparative analysis across degrees and programs. Data were collected using the validated questionnaire, and teachers were asked to respond to the 15 statements based on their perceptions

and experiences with gamification in teaching. Responses were measured using a Likert scale, with scores indicating levels of effectiveness in the areas of Skill, Attitude, and Knowledge.

The collected data is analyzed using descriptive and inferential statistics. Mean scores were calculated to assess the overall level of gamification skill effectiveness in each group. Additionally, two-sample t-tests and ANOVA tests were used to meet the study's objectives. These tests helped to determine whether significant differences existed in gamification skills across Degree level (UG vs. PG), Program (e.g., M.Tech, MBA, B.Tech, BBA), and Years_Taught. The analysis found that, across PG and UG levels, programs such as M.Tech, MBA, B.Tech, and BBA achieved statistically similar levels of effectiveness in gamification skills, with scores ranging between 3 and 4, placing them in the Outstanding category based on developer standards.

Table 1 *Descriptive Statistics*

Descriptive Statistics												
	SKAverage				ATAverage				KNAverage			
	B.Tech	BBA	M.Tech	MBA	B.Tech	BBA	M.Tech	MBA	B.Tech	BBA	M.Tech	MBA
Valid	203	11	25	8	203	11	25	8	203	11	25	8
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Mean	3.187	3.273	3.480	3.500	3.227	3.364	3.400	3.625	3.212	3.364	3.520	3.500
Std. Deviation	0.761	0.647	0.823	0.535	0.737	0.674	0.816	0.518	0.808	0.505	0.823	0.535
Minimum	1.000	2.000	1.000	3.000	1.000	2.000	2.000	3.000	1.000	3.000	1.000	3.000
Maximum	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000

Note. Excluded 11 rows from the analysis that correspond to the missing values of the split-by variable Program

Interpretation: The table 1 presents descriptive statistics for four groups (B.Tech, BBA, M.Tech, MBA) across three different variables: SKAverage, ATAverage, and KNAverage. These variables appear to represent some type of performance or measurement for each educational group

The descriptive statistics indicate that the data across these educational groups (B.Tech, BBA, M.Tech, MBA) shows similar patterns in terms of the minimum and maximum scores, but there are differences in the variability (standard deviation) and central tendencies (means) across the groups.

The **mean** scores reflect the average performance for each educational group, and the relatively small **standard deviation** values for some groups suggest that these groups have more consistent performance compared to others.

The **range** values indicate that all groups perform within a fixed range for each measure, possibly due to the structure of the measurements or the data collection method.

4. Results and Discussions

The study, aiming to assess the effectiveness of gamification skills among teachers at UG and PG levels, provided significant insights into the current state of gamification in educational pedagogy. Using a validated instrument with three constructs—Skill, Attitude, and Knowledge—the study drew results from 247 teachers at a selected university. Initially that study have divided s by taking 130 for pilot study and for final study 247. Based on the scores and statistical analysis, key findings emerged related to both the effectiveness of gamification skills across different programs and the influence of various demographic factors.

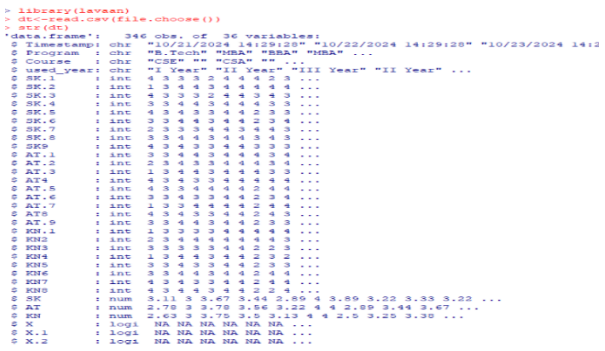

Figure no 1 *From the above it Describes Data collected from 247 Participants*

```
dtn<-dt[,-c(1,2,3,4,34,35,36)]
str(dtn)
```

Figure no:2 creates a new dataset dtn by **Excluding Specific Columns**

Columns **1, 2, 3, and 4** (likely Timestamp, Program, Course, and used_year) are removed, possibly because they contain identifying or categorical information that may not be necessary for further analysis. Columns **34, 35, and 36** (likely AT, KN,

and X.1) are also excluded, possibly to focus on more granular data (individual skill, attitude, and knowledge scores) rather than summary scores or flags. This step refines the dataset to retain only relevant variables for modeling purposes.

```
> dtn<-dtn[,-c(28,29,30)]
> str(dtn)
```

1.

The command from fig:3 removes columns 28, 29, and 30 from dtn, which likely correspond to specific variables within the filtered dataset. Since dtn was already a subset of dt, removing these additional columns likely fine-tunes the dataset by excluding any remaining unnecessary or redundant variables and

```
> summary(dtn)
      SK.1            SK.2            SK.3            SK.4            SK.5      
 Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000  
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000  
 Median :3.000   Median :4.000   Median :3.000   Median :3.000   Median :3.000  
 Mean   :3.174   Mean   :3.377   Mean   :3.235   Mean   :3.316   Mean   :3.328  
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000  
 Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000  
 NA's   :99      NA's   :99      NA's   :99      NA's   :99      NA's   :99     
      SK.6            SK.7            SK.8            SK9             AT.1       
 Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000  
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000  
 Median :3.000   Median :3.000   Median :3.000   Median :3.000   Median :3.000  
 Mean   :3.287   Mean   :3.255   Mean   :3.198   Mean   :3.235   Mean   :3.251  
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000  
 Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000  
 NA's   :99      NA's   :99      NA's   :99      NA's   :99      NA's   :99     
      AT.2            AT.3            AT4             AT.5            AT.6       
 Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.00    Min.   :1.000  
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.00    1st Qu.:3.000  
 Median :3.000   Median :3.000   Median :3.000   Median :3.00    Median :3.000  
 Mean   :3.275   Mean   :3.287   Mean   :3.267   Mean   :3.32    Mean   :3.223  
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.00    3rd Qu.:4.000  
 Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.00    Max.   :4.000  
 NA's   :99      NA's   :99      NA's   :99      NA's   :99      NA's   :99     
      AT.7            AT8             AT.9            KN.1            KN2        
 Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000  
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000  
 Median :3.000   Median :3.000   Median :3.000   Median :3.000   Median :3.000  
 Mean   :3.231   Mean   :3.368   Mean   :3.263   Mean   :3.219   Mean   :3.247  
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000  
 Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000  
 NA's   :99      NA's   :99      NA's   :99      NA's   :99      NA's   :99     
      KN3             KN4             KN5             KN6             KN7        
 Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000  
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000  
 Median :3.000   Median :3.000   Median :3.000   Median :3.000   Median :3.000  
 Mean   :3.251   Mean   :3.312   Mean   :3.231   Mean   :3.287   Mean   :3.263  
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000  
 Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000  
```

Favorable set of responses, with most ratings centered around 3-4 on a 1-4 scale, reflecting an overall positive evaluation in skills, attitudes, and knowledge.there are no missing values(na)d in the above figure.:4

```
> dt<-read.csv(file.choose())
> str(dt)
'data.frame':    129 obs. of  26 variables:
 $ SK1: int  4 3 3 3 2 4 4 4 2 3 ...
 $ SK2: int  1 3 4 4 3 4 4 4 4 4 ...
 $ SK3: int  4 3 3 3 2 4 4 3 4 3 ...
 $ SK4: int  3 3 4 4 3 4 4 4 3 3 ...
 $ SK5: int  4 3 4 3 3 4 4 2 3 3 ...
 $ SK6: int  3 3 4 4 3 4 4 2 3 4 ...
 $ SK7: int  2 3 3 3 4 4 3 4 4 3 ...
 $ SK8: int  3 3 4 4 3 4 4 3 4 3 ...
 $ SK9: int  4 3 4 3 3 4 4 3 3 3 ...
 $ AT1: int  3 3 4 4 3 4 4 4 3 4 ...
 $ AT2: int  2 3 4 3 3 4 4 4 3 4 ...
 $ AT3: int  1 3 4 4 3 4 4 4 3 3 ...
 $ AT4: int  4 3 4 3 3 4 4 4 4 4 ...
 $ AT5: int  4 3 3 4 4 4 4 2 4 4 ...
 $ AT6: int  3 3 4 3 3 4 4 2 3 4 ...
 $ AT7: int  1 3 3 4 4 4 4 2 4 4 ...
 $ AT8: int  4 3 4 3 3 4 4 2 4 3 ...
 $ AT9: int  3 3 4 4 3 4 4 2 3 3 ...
 $ KN1: int  1 3 3 3 3 4 4 4 4 4 ...
 $ KN2: int  2 3 4 4 4 4 4 4 4 3 ...
 $ KN3: int  3 3 3 3 3 4 4 2 2 3 ...
 $ KN4: int  1 3 4 4 3 4 4 2 3 2 ...
 $ KN5: int  3 3 4 3 3 4 4 2 3 3 ...
 $ KN6: int  3 3 4 4 3 4 4 2 4 4 ...
 $ KN7: int  4 3 4 3 3 4 4 2 4 4 ...
 $ KN8: int  4 3 4 4 3 4 4 2 2 4 ...
```

In the above figure;5 The dt dataset contains **130 observations** and **26 variables**, each representing items related to **Skills (SK1-SK9)**, **Attitudes (AT1-AT9)**, and **Knowledge (KN1-KN8)**.

```
> summary(dt)
      SK1             SK2             SK3             SK4             SK5       
 Min.   :1.000   Min.   :1.000   Min.   :1.00    Min.   :1.000   Min.   :1.000  
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.00    1st Qu.:3.000   1st Qu.:3.000  
 Median :3.000   Median :3.000   Median :3.00    Median :3.000   Median :3.000  
 Mean   :3.202   Mean   :3.295   Mean   :3.31    Mean   :3.302   Mean   :3.326  
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.00    3rd Qu.:4.000   3rd Qu.:4.000  
 Max.   :4.000   Max.   :4.000   Max.   :4.00    Max.   :4.000   Max.   :4.000  
      SK6             SK7             SK8             SK9             AT1       
 Min.   :1.00    Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000  
 1st Qu.:3.00    1st Qu.:3.000   1st Qu.:2.000   1st Qu.:3.000   1st Qu.:3.000  
 Median :4.00    Median :3.000   Median :3.000   Median :3.000   Median :3.000  
 Mean   :3.31    Mean   :3.209   Mean   :3.132   Mean   :3.178   Mean   :3.155  
 3rd Qu.:4.00    3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000  
 Max.   :4.00    Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000  
      AT2             AT3             AT4             AT5             AT6       
 Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000  
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000  
 Median :3.000   Median :3.000   Median :3.000   Median :3.000   Median :3.000  
 Mean   :3.155   Mean   :3.271   Mean   :3.279   Mean   :3.302   Mean   :3.171  
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000  
 Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.000  
      AT7             AT8             AT9             KN1             KN2       
 Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.00    Min.   :1.000  
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.00    1st Qu.:3.000  
 Median :3.000   Median :3.000   Median :3.000   Median :3.00    Median :3.000  
 Mean   :3.225   Mean   :3.357   Mean   :3.233   Mean   :3.14    Mean   :3.217  
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.00    3rd Qu.:4.000  
 Max.   :4.000   Max.   :4.000   Max.   :4.000   Max.   :4.00    Max.   :4.000  
      KN3             KN4             KN5             KN6             KN7       
 Min.   :1.000   Min.   :1.00    Min.   :1.000   Min.   :1.000   Min.   :1.00   
 1st Qu.:3.000   1st Qu.:3.00    1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.00   
 Median :3.000   Median :4.00    Median :3.000   Median :3.000   Median :3.00   
 Mean   :3.186   Mean   :3.31    Mean   :3.155   Mean   :3.287   Mean   :3.24   
 3rd Qu.:4.000   3rd Qu.:4.00    3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.00   
 Max.   :4.000   Max.   :4.00    Max.   :4.000   Max.   :4.000   Max.   :4.00   
      KN8        
 Min.   :1.000  
 1st Qu.:3.000  
 Median :3.000  
 Mean   :3.225  
```

In the above Figure:6, The dataset likely represents survey or evaluation scores with participants leaning toward positive feedback.Their is no missing values(NA)

```
> names(dt)
 [1] "SK1" "SK2" "SK3" "SK4" "SK5" "SK6" "SK7" "SK8" "SK9" "AT1" "AT2" "AT3" "AT4" "AT5"
[15] "AT6" "AT7" "AT8" "AT9" "KN1" "KN2" "KN3" "KN4" "KN5" "KN6" "KN7" "KN8"
>
```

"SK" Variables: SK1 to SK9 (9 variables). Likely refer to a specific category, such as *Skills* or *Skill Assessment*.**AT" Variables**: AT1 to AT9 (9 variables). Potentially denote Attributes or Attitudes.**KN" Variables**: KN1 to KN8 (8 variables). Could relate to Knowledge. In above Figure:7

```
> summary(fit,fit.measures=T)
lavaan 0.6-18 ended normally after 45 iterations

  Estimator                                         DWLS
  Optimization method                           NLMINB
  Number of model parameters                        55

  Number of observations                           129

Model Test User Model:

  Test statistic                               207.968
  Degrees of freedom                               296
  P-value (Chi-square)                           1.000

Model Test Baseline Model:

  Test statistic                              2148.202
  Degrees of freedom                               325
  P-value                                        0.000

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                    1.000
  Tucker-Lewis Index (TLI)                       1.053

Root Mean Square Error of Approximation:

  RMSEA                                          0.000
  90 Percent confidence interval - lower         0.000
  90 Percent confidence interval - upper         0.000
  P-value H_0: RMSEA <= 0.050                    1.000
  P-value H_0: RMSEA >= 0.080                    0.000

Standardized Root Mean Square Residual:

  SRMR                                           0.077

Parameter Estimates:

  Standard errors                            Standard
```

The model fits the data exceptionally well, as shown by all key fit indices (CFI, TLI, RMSEA, SRMR).The results suggest no significant misfit between the hypothesized model and the observed data. In the above Figure:8

```
  Information                                 Expected
  Information saturated (h1) model        Unstructured

  atent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)
  SK =~
    SK1               1.000
    SK2               1.288    0.176    7.300    0.000
    SK3               0.736    0.134    5.491    0.000
    SK4               1.589    0.212    7.493    0.000
    SK5               1.241    0.175    7.097    0.000
    SK6               1.566    0.214    7.324    0.000
    SK7               1.659    0.219    7.563    0.000
    SK8               2.292    0.280    8.188    0.000
    SK9               1.943    0.243    8.001    0.000
  AT =~
    AT1               1.000
    AT2               0.806    0.080   10.051    0.000
    AT3               0.569    0.070    8.160    0.000
    AT4               0.456    0.062    7.326    0.000
    AT5               0.571    0.071    8.091    0.000
    AT6               0.759    0.080    9.487    0.000
    AT7               0.838    0.088    9.558    0.000
    AT8               0.414    0.056    7.331    0.000
    AT9               0.887    0.086   10.293    0.000
  KN =~
    KN1               1.000
    KN2               1.204    0.132    9.101    0.000
    KN3               1.039    0.124    8.373    0.000
    KN4               0.959    0.113    8.485    0.000
    KN5               1.109    0.122    9.106    0.000
    KN6               0.828    0.102    8.084    0.000
    KN7               1.010    0.118    8.578    0.000
    KN8               0.967    0.118    8.229    0.000
```

SK Comprises 9 observed indicators (SK1 to SK9).Standardized loadings are all significant (**p < 0.001**), with z-values above the critical threshold (~1.96).The highest loading is for SK8 (2.373), suggesting SK8 contributes the most to the latent construct "Skills."The lowest loading is for SK3 (0.795).**AT** Comprises 9 observed indicators (AT1 to AT9).All factor loadings are significant (**p < 0.001**).The highest loading is for AT9 (0.890), indicating it is the most reflective of the "Attributes" latent construct.The lowest loading is for AT8 (0.418), suggesting it is the least reflective. **KN** Comprises 8 observed indicators (KN1 to KN8).All loadings are significant (**p < 0.001**).The highest loading is for KN2 (1.202), making it the strongest contributor to the "Knowledge" construct.The lowest loading is for KN6 (0.829). in the above Figure:9

```
Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)
  SK ~~
    AT                0.148    0.019    7.952    0.000
    KN                0.092    0.013    7.261    0.000
  AT ~~
    KN                0.262    0.029    9.044    0.000

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)
   .SK1               0.385    0.072    5.349    0.000
   .SK2               0.477    0.080    5.942    0.000
   .SK3               0.515    0.070    7.418    0.000
   .SK4               0.479    0.097    4.911    0.000
   .SK5               0.492    0.082    5.979    0.000
   .SK6               0.565    0.110    5.115    0.000
   .SK7               0.494    0.098    5.057    0.000
   .SK8               0.429    0.099    4.317    0.000
   .SK9               0.383    0.093    4.114    0.000
   .AT1               0.528    0.110    4.798    0.000
   .AT2               0.464    0.076    6.126    0.000
   .AT3               0.569    0.086    6.636    0.000
   .AT4               0.545    0.070    7.799    0.000
   .AT5               0.550    0.088    6.265    0.000
   .AT6               0.560    0.087    6.410    0.000
   .AT7               0.632    0.113    5.618    0.000
   .AT8               0.413    0.059    6.995    0.000
   .AT9               0.423    0.081    5.187    0.000
   .KN1               0.532    0.093    5.730    0.000
   .KN2               0.408    0.097    4.216    0.000
   .KN3               0.547    0.102    5.370    0.000
   .KN4               0.472    0.086    5.513    0.000
   .KN5               0.416    0.085    4.915    0.000
   .KN6               0.513    0.074    6.888    0.000
   .KN7               0.450    0.089    5.091    0.000
   .KN8               0.554    0.104    5.341    0.000
    SK                0.074    0.015    4.903    0.000
    AT                0.307    0.045    6.751    0.000
    KN                0.214    0.036    5.975    0.000
```

The model shows that "Skills," "Attributes," and "Knowledge" are significantly related, with a considerable amount of variability captured within each construct.In the above Figure:10

```
  SK1 SK2 SK3 SK4 SK5 SK6 SK7 SK8 SK9 AT1 AT2 AT3 AT4 AT5 AT6 AT7 AT8 AT9 KN1 KN2 KN3 KN4
1   4   1   4   3   4   3   2   3   4   3   2   1   4   4   3   1   4   3   1   2   3   1
2   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3
3   3   4   3   4   4   4   3   4   4   4   4   4   4   3   4   3   4   4   3   4   3   4
4   3   4   3   4   3   4   3   4   3   4   3   4   3   4   3   4   3   4   3   4   3   4
5   2   3   2   3   3   3   4   3   3   3   3   3   3   4   3   4   3   3   3   4   3   3
6   4   4   4   4   4   4   4   4   4   4   4   4   4   4   4   4   4   4   4   4   4   4
  KN5 KN6 KN7 KN8
1   3   3   4   4
2   3   3   3   3
3   4   4   4   4
4   3   4   3   4
5   3   3   3   3
6   4   4   4   4
>
> library(psych)

Attaching package: 'psych'

The following object is masked from 'package:lavaan':

    cor2cov

> alpha(dt[,c(2,4,5,6,7,8,9)])

Reliability analysis
Call: alpha(x = dt[, c(2, 4, 5, 6, 7, 8, 9)])

  raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd median_r
      0.76      0.76    0.75      0.31 3.2 0.032  3.3 0.53     0.31

    95% confidence boundaries
         lower alpha upper
Feldt     0.69  0.76  0.82
Duhachek  0.70  0.76  0.82

 Reliability if an item is dropped:
    raw_alpha std.alpha G6(smc) average_r S/N alpha se  var.r med.r
SK2      0.74      0.74    0.71      0.32 2.9    0.035 0.0040  0.33
```

The scale shows good internal consistency, and the items are generally reliable for measuring the construct. If you were to drop SK2, the reliability would decrease slightly, but still remain within an acceptable range. In the above Figure:11

```
 Item statistics
     n raw.r std.r r.cor r.drop mean   sd
SK2 129  0.60  0.60  0.51   0.43  3.3 0.77
SK4 129  0.59  0.59  0.48   0.42  3.3 0.82
SK5 129  0.56  0.57  0.45   0.39  3.3 0.77
SK6 129  0.71  0.71  0.65   0.56  3.3 0.86
SK7 129  0.65  0.65  0.56   0.49  3.2 0.84
SK8 129  0.71  0.70  0.63   0.55  3.1 0.90
SK9 129  0.67  0.67  0.59   0.51  3.2 0.81

Non missing response frequency for each item
       1    2    3    4 miss
SK2 0.02 0.12 0.39 0.47    0
SK4 0.04 0.11 0.36 0.49    0
SK5 0.02 0.12 0.37 0.49    0
SK6 0.05 0.10 0.33 0.52    0
SK7 0.05 0.12 0.40 0.43    0
SK8 0.05 0.21 0.31 0.43    0
SK9 0.04 0.14 0.43 0.40    0
>
> alpha(dt[,c(21,23,25)])

Reliability analysis
Call: alpha(x = dt[, c(21, 23, 25)])

  raw_alpha std.alpha G6(smc) average_r S/N   ase mean   sd median_r
      0.6       0.61    0.51      0.34 1.5 0.061  3.2 0.63     0.37

    95% confidence boundaries
         lower alpha upper
Feldt     0.47   0.6  0.71
Duhachek  0.49   0.6  0.72

 Reliability if an item is dropped:
    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
KN3      0.54      0.54    0.37      0.37 1.19    0.080    NA  0.37
KN5      0.56      0.56    0.39      0.39 1.29    0.077    NA  0.39
KN7      0.40      0.40    0.25      0.25 0.67    0.105    NA  0.25
```

AT Scale (Items AT1, AT3, AT5, AT7, AT9)
Cronbach's Alpha: 0.76 (Good reliability).**Key Item**: AT7 has the strongest contribution to the scale with high item-total correlation (raw.r = 0.73) and reliability impact (r.drop = 0.50).**Response Distribution**: Most responses cluster around 3 ("Agree") and 4 ("Strongly Agree"), indicating agreement with items

KN Scale(Items KN3, KN5, KN7): **Cronbach's Alpha**: 0.60 (Moderate reliability; below ideal threshold of 0.70).**Weak Item**: KN7 contributes the least to reliability (r.cor = 0.25, r.drop = 0.25). Its removal would significantly lower the overall consistency of the scale.**Improvement Opportunity**: KN7 might require revision or replacement to align better with the scale's latent construct. Figure:12

```
 Item statistics
     n raw.r std.r r.cor r.drop mean   sd
KN3 129  0.75  0.73  0.50   0.39  3.2 0.88
KN5 129  0.72  0.72  0.48   0.37  3.2 0.82
KN7 129  0.78  0.79  0.62   0.48  3.2 0.82

Non missing response frequency for each item
       1    2    3    4 miss
KN3 0.05 0.15 0.36 0.44    0
KN5 0.03 0.18 0.40 0.40    0
KN7 0.03 0.15 0.37 0.45    0
```

All items contribute meaningfully to the scale, with **KN7** being the most consistent. No immediate revisions are needed based on these statistics. The scale performs well, but overall reliability (α = 0.60) remains moderate, which may suggest latent construct complexity or item overlap. Further refinement could improve reliability. Figure:13

Interpretation

The results of confirmatory factor analysis (CFA) demonstrate that the revised model, with a number of items per factor fits well since it shows values for Comparative Fit Index (CFI) Tucker Lewis Index (TLI) close to 1 and low Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR). The strong factor loadings, for the remaining items further confirm their alignment with the underlying variables—skills (SK) attitudes (AT) and knowledge (KN). These factors are positively correlated which suggests they are connected but represent concepts. The reliability of the SK factor is demonstrated by a consistency score of 0..76 using Cronbachs alpha index.. The enhancement, in the models fit resulting from item reduction validates. Ensures the reliability of the retained items, for evaluating these concepts.

The study has Four major aspects the results are as follows

1. First objective: Selection Scale is used It won't recommend any hypothesis
2. To fulfil the second objective, to analyze the impact of type of program on their skilling aspect of gamification.

NH: No Impact of type of program on their Skilling aspect of gamification.

AH: An Impact of type of program on their skilling aspect of gamification.

Table2 *Anova-SK Average*

ANOVA - SKAverage					
Cases	Sum of Squares	df	Mean Square	F	p
Program	2.538	3	0.846	1.475	0.222
Residuals	139.309	243	0.573		

Note. Type III Sum of Squares

Interpretation: From the above Table2, p-value is (0.222), indicates that there is no statistically significant difference between the group means (since p > 0.05).It indicate tha UG and PG level of Teacher's having same level Skilling in gamification

3. **Third objective:** To analyse the impact of type of program on their attitude aspect of gamification

NH: No impact of type of program on their attitude aspect of gamification

AH: An impact of type of program on their attitude aspect of gamification

Table 3 *Anova-AT Average*

ANOVA - ATAverage					
Cases	Sum of Squares	df	Mean Square	F	p
Program	1.898	3	0.633	1.165	0.324
Residuals	131.997	243	0.543		

Note. Type III Sum of Squares

Interpretation: From the above Table3, p-value is 0.324 (greater than 0.05), we fail to reject the null hypothesis. This means there is no statistically significant difference in AT Average across the programs. It indicates that UG and PG level of Teachers having same level of attitude in gamification.

4. **Fourth objective:** To analyse the impact of type of program on their knowledge aspect of gamification

NH: No impact of type of program on their knowledge aspect of gamification

AH An impact of type of program on their knowledge aspect of gamification

Table 4 *Anova-KN Average*

ANOVA - KNAverage					
Cases	Sum of Squares	df	Mean Square	F	p
Program	2.730	3	0.910	1.448	0.229
Residuals	152.643	243	0.628		

Note. Type III Sum of Squares

Interpretation: From the table 4 p-value is 0.229 (greater than 0.05), we fail to reject the null hypothesis. This indicates that there is no statistically significant difference in KN Average across the programs, UG and PG level of teachers having same level of knowledge in gamification.

5. Conclusions

This study highlights the remarkable effectiveness of gamification as a pedagogical approach among UG and PG educators, demonstrating its universal applicability across educational levels and diverse academic programs. Both UG and PG educators exhibited outstanding performance in skills, attitudes, and knowledge related to gamification, with slight variations in specific constructs. Programs like B.Tech and BBA at the UG level and M.Tech and MBA at the PG level showed high effectiveness, with minor areas for improvement, particularly in skill and attitude dimensions.

The findings further underscore that the impact of gamification is not influenced by degree type, teaching experience, or program type, reinforcing its role as a versatile and impactful teaching tool. This universality positions gamification as a valuable strategy for enhancing engagement and effectiveness in diverse educational contexts.

Additionally, the descriptive statistics revealed strong positive perceptions across skills, attitudes, and knowledge constructs. Variables such as **SK 2** and **AT 8** received the highest ratings, reflecting strong agreement and favourability, while others like **SK 8** and **AT 6**, although slightly lower, still indicated positive responses. Knowledge-related variables (**KN3**, **KN5**, and **KN7**) exhibited closely aligned mean values, ranging from **3.231 to 3.263**, all positioned on the higher end of the 1–4 scale. These results collectively highlight a strong overall agreement and positive perception of gamification across constructs, underscoring its value in educational settings

These results advocate for the broader adoption of gamification in teaching practices while identifying areas for targeted improvement. Future research should explore gamification across larger, more diverse samples to validate these findings further and deepen insights into its benefits across varied educational settings.

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