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Article

Evaluating Arab generation Z's acceptance of biometric attendance control technology in educational systems

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Abstract: There is insufficient consideration of Generation Z's cultural and generational needs in the implementation of biometric attendance systems in Arabic educational settings. This study delves into Generation Z's discipline, exploring their perspectives on attendance systems and aligning commitment with their interests. The primary aim is to gauge biometric systems' impact on productivity. Google Form questionnaires collected data from young employees, ages 25 to 35, who belong to Generation Z's working in the higher education system. Structural equation modeling and descriptive analysis assessed the data. While biometric systems enhance discipline, they may dampen morale. Implementing systems fairly and maintaining flexibility is vital. The study underscores the importance of evaluating employees based on achievements. It sheds light on biometric systems' role in attendance management and organizational performance, aiding HR practices. The results showed no significant effect of Employee Management Practices (EMP) on organization performance through Biometric Attendance Technology (BAT) ($B = 0.049$, $t = 1.330$, $p = 0.184$). Nor significant effects of Organizational Performance Metrics (OPM) ($B = 0.019$, $t = 0.608$, $p = 0.543$). Technological Infrastructure (TI) ($B = 0.019$, $t = 0.2461$, $p = 0.645$), or Satisfaction and Engagement (ESE) ($B = 0.057$, $t = 1.381$, $p = 0.167$) on organization performance through Biometric Attendance Technology. The mediator impact was also found to be not significant ($P > 0.05$). Therefore, both direct and specific indirect effects were not significant. Indicating that Biometric Attendance Technology does not mediate the relationship between these variables and organizational performance.

Keywords: biometric technology; generation Z's; organizational performance; technology management; educational systems

1. Introduction

The exploration of generational disparities in technology acceptance, conflicts, intellectual growth, and human necessities has gained prominence in social sciences (Al-Shamsi and Shannaq, 2023; Granić and Marangunić, 2019; Shannaq et al., 2023a).

These discussions infiltrate various societal domains, fueling interest in understanding each generation's unique traits and thought processes. This comprehension aids in addressing generational concerns, fostering their contributions across sectors. Organizations increasingly prioritize understanding new generations, notably Generation Z, vital for Vision 2020—2040's success in particular (Al-Shamsi et al., 2023; Oman Vision, 2040; Shannaq et al., 2023b; UNESCO, 2023) Sultanate of Oman. Commitment and discipline are pivotal, especially with biometric attendance systems' prevalence and punctuality's emphasis. This study delves into Generation Z's discipline, examining their perspectives on attendance systems and strategies to align commitment with their interests. It underscores the importance of evaluating employees, particularly faculty members, based on achievements rather than attendance metrics for accurate competence assessment. When comparing discipline

and commitment across generations, it's crucial to trace their evolution. (Dixit, 2022) Millennials Generation, born from the early 1982s to the mid-1994s, remain active in today's workforce. Raised with a strong emphasis on discipline, they associated commitment with reputation, influenced by economic booms, notably in Arab countries. For Millennials Generation, adherence to discipline overshadowed productivity, with punctuality deemed more vital than job performance. In contrast, Generation Z, the current workforce, values flexibility over strict discipline, shaped by technological innovation and social media's influence. This shift has created tension between the generations, as leaders from Millennials Generation uphold traditional systems like biometric attendance without considering Generation Z's needs (Racolța-Paina and Irini, 2021; Wandhe, 2024).

1.1. Millennials and Generation Z

Numerous research back up Generation Z's propensity for flexibility over Millennials. Twenge (2018) for example, points out that Gen Z appreciates remote work and flexible work settings more than Millennials since they were raised in a digital age. Mo (2022) and Nguyen (2024) note that Millennials, on the other hand, place a higher value on stability and work-life balance. This difference may be seen in how Gen Z behaves at work: according to Perszon (2024), Asril and Perdhana (2024) study, Gen Z frequently looks for gig economy and freelancing possibilities, whereas Millennials typically follow traditional career trajectories. The aforementioned research highlights the distinct Gen Z tendency towards adaptability and digital integration.

Studies highlighting the differences in experiences and ideals between Arabic Millennials and Generation Z provide credence to the idea that they vary from each other in terms of adaptability. Gentina and Parry (2020), Al-Mutairi (2019), for instance, discovered that Arabic Gen Z places a higher priority on remote learning opportunities and flexible work conditions than Millennials since they were raised during the digital revolution. Daquila (2024) points out that, in contrast, Arabic Millennials place a higher value on established career pathways and job stability since they experienced economic uncertainty throughout their formative years. This may be seen in how Gen Z behaves in the workplace; they prefer to desire secure, long-term employment, whereas Millennials are more interested in gig economy jobs and digital entrepreneurship. These studies demonstrate how Arabic Gen Z is the only generation that is shifting toward adaptability and digital integration (Shannaq et al., 2019; Shannaq, 2019; Shannaq, 2020).

To reconcile these differences, organizations must develop inclusive systems that accommodate both generations, fostering environments where discipline and creativity coexist. The purpose of the study is to better understand the distinct habits and preferences of Generation Z, especially their propensity for flexibility, in order to develop professional and educational initiatives. The impetus comes from the necessity of adjusting to rapidly changing technology trends as well as the unique digital upbringing of Generation Z, which greatly affects their interactions and expectations.

In conclusion, this research elucidates biometric attendance systems' role in

attendance management and organizational performance, offering valuable HR insights across sectors.

1.2. Identifying gaps in existing research

There is an increasing desire in using biometric attendance systems into educational settings, according to recent study on Arabic Generation Z's acceptance of them. Studies draw attention to advantages such increased efficiency and precision, but they frequently ignore generational and cultural variations in technology adoption. Significant deficiencies encompass inadequate attention to the distinct requirements and inclinations of Generation Z inside the Arabic milieu, as well as the influence of biometric mechanisms on their involvement and contentment. Our publication fills in these gaps by offering policymakers and educators new views by thoroughly analyzing the distinct viewpoints of Generation Z and suggesting customized tactics for greater alignment with their digital aspirations.

The structure of the paper is as follows: In Section 1, the report is presented together with some background information on Generation Z and Millennials. The conceptual framework, research questions, objectives, hypotheses, data collecting, and data cleaning procedures are all covered in depth in Section 2 along with the materials and methodologies. Model evaluation, validity, reliability, discriminant validity, direct hypothesis testing, and mediation analysis are all covered in Section 3's data analysis and outcomes. Section 5 concludes with recommendations and a discussion of the results in Section 4. At the end is a list of references.

2. Materials and methods

This research developed a conceptual model, depicted in **Figure 1**, which is further elaborated to provide a detailed understanding of each stage. The study examines the relationships between Employee Management Practices (EMP), Organizational Performance Metrics (OPM), Technological Infrastructure (TI), and Employee Satisfaction and Engagement (ESE). It measures their impact on organizational performance effectiveness, with Biometric Attendance Technology (BAT) acting as a mediator between EMP, OPM, TI, and ESE. The analysis is conducted using partial least squares structural equation modeling (PLS-SEM) within a descriptive analytical framework.

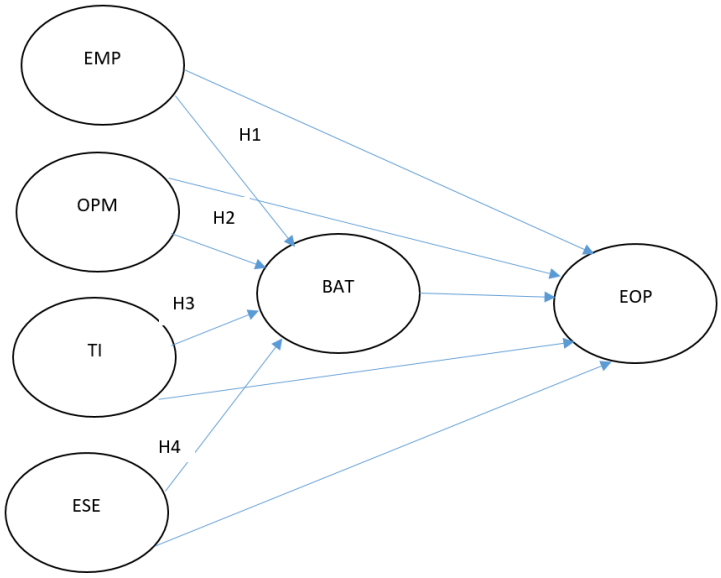

Figure 1. Conceptual framework.

The proposed research model on a thorough analysis of the body of current literature with regard to the research procedures and the development of the conceptual framework. Studies like (Hair et al., 2019), which shed light on the connections between (ESE), (OPM), (TI), and (EMP), have identified specific factors that influence others.

Drawing from the proposed conceptual model, the following research questions, objectives, and hypotheses have been developed:

Research Questions:

- In the context of technology management, how are staff management procedures affected by the use of biometric attendance technology?
- In technology-driven sectors, what effect does biometric attendance technology have on organizational performance?

Objectives

- To look at how staff management methods in technology management are affected by biometric attendance technology.
- To investigate how organizational success in technology-driven sectors is related to the use of biometric attendance technologies.

Hypotheses

- Hypothesis 1 (H1): In the context of Employee Management Practices (EMP), the use of biometric attendance technology has a favorable impact on organizational performance.
- Hypothesis 2 (H2): In the context of. Organizational Performance Metrics (OPM), the use of biometric attendance technology has a favorable impact on organizational performance.
- Hypothesis 3 (H3): In the context of Technological Infrastructure (TI), the use of biometric attendance technology has a favorable impact on organizational performance.
- Hypothesis 4 (H4): In the context of Employee Satisfaction and Engagement (ESE), the use of biometric attendance technology has a favorable impact on

organizational performance.

For those interested, the survey structure, including variables, indicators available in Survey (2024). **Table 1** offers an example of the survey's format and structure.

Table 1. The questionnaire structure.

Demographic **Specialization major**	**University higher degree**	**Age**	**Experience year in academic teaching**
Independent Variables (IV)			
EMP	OPM	TI	ESE
Mediator			
Biometric Attendance Technology (BAT)			
Dependent Variable (DV)			
Organizational Performance (EOP)			

where:

EMP: Employee Management Practices.

OPM: Organizational Performance Metrics.

TI: Technological Infrastructure.

ESE: Employee Satisfaction and Engagement.

The survey consisted of four components. The first component collected demographic data about participants, including specialization major, university higher degree, age, and years of experience in academic teaching. The second section represented the independent variables: (EMP), (OPM), (TI), and (ESE), each with five questions (indicators). The third section focused on the mediator, (BAT), and the final section covered the dependent variable, (EOP) with five indicators. The structure of the survey is detailed in **Table 1**, showing the arrangement of these components.

2.1. Data collection and sampling process

The collected dataset comprises 30 attributes and 331 instances without the demographic data. The sampling frame, using a non-probability design due to time and email constraints. Convenience sampling targeted instructors with relevant information. After reviewing relevant literature and defining research goals, we created a questionnaire with four independent and one dependent variable and one mediator. The questions underwent expert review to ensure clarity. The e-questionnaire was distributed via Google Drive to faculty members where the Biometric Attendance technology is applied in their workplace. Out of 566 contacted participants, 331 responses were received by 3 June 2024 (Hair et al., 2021; Hair and Page et al., 2019; Hair and Risher et al., 2019). This sample size was deemed suitable for analysis based on prior studies.

2.2. Data cleaning process

After retrieving the data in CSV format from Google Form, we began the data cleaning process in SPSS. Initially, we checked the dataset's minimum and maximum values, ensuring accuracy on the five-point Likert scale (1 to 5). We then addressed missing data from mandatory form fields and conducted outlier detection, finding none.

Finally, we evaluated anomalous responses using standard deviation (SD). The SD-Min = 0.430 and SD-Max = 1.676, Descriptive statistics presented in **Table 2**, indicating suitability for analysis based on prior studies (Hair et al., 2021; Hair and Page et al., 2019; Hair and Risher et al., 2019). The recommended threshold for the standard deviation (STDEV) is above 0.25.

Table 2. Descriptive statistics.

Variable	Mean	Median	Scale min	Scale max	Standard deviation	Excess kurtosis	Skewness
1. EMP	3.48	4.2	1	5	1.485	−1.184	−0.936
2. EMP	3.601	4.2	1	5	1.207	−0.932	−0.679
3. EMP	3.665	4.2	1	5	1.127	−0.336	−0.57
4. EMP	3.669	4	1	5	1.127	−0.439	−0.518
5. EMP	3.681	4.2	1	5	1.114	−0.43	−0.531
6. OPM	3.187	4	1	5	1.592	−1.104	−0.957
7. OPM	3.254	4.2	1	5	1.285	−1.029	−0.937
8. OPM	3.334	4	1	5	1.148	−0.65	−0.699
9. OPM	3.384	4.2	1	5	1.124	−0.554	−0.604
10. OPM	3.31	4	1	5	1.152	−0.58	−0.624
11. TI	3.178	4	1	5	1.531	−1.425	−0.843
12. TI	3.378	4	1	5	1.152	−1.013	−0.867
13. TI	3.348	4	1	5	1.172	−0.687	−0.711
14. TI	3.313	4	1	5	1.102	−0.601	−0.687
15. TI	3.408	4	1	5	1.128	−0.594	−0.587
16. ESE	3.242	4	1	5	1.172	−0.537	−0.493
17. ESE	3.106	4	1	5	1.528	−1.554	−0.23

3. Data analysis and results

3.1. Model of assessment: Measurement model

3.1.1. Validity and reliability

Reliability and validity underwent assessment via 'Cronbach's Alpha' and 'Composite Reliability (CR)'. Initially, items with factor loadings under 0.700 were purged from the dataset. The constructs "30. Dv_EOP = 0.550, 8.OPM = 0.429 .21. MV_BAT = 0.601" have been removed because the factor loading was under 0.7, depicted in **Figures 2** and **3**, **Tables 3** and **4**. Other indicators with values less than 0.7, such as 24. MV_BAT = 0.698, 8. OPM = 0.670, 18. ESE = 0.677, and 19. ESE = 0.683, were not removed because they do not affect the Average Variance Extracted (AVE) as shown in **Table 3**. Consequently, Cronbach's Alpha and Composite Reliability (CR) have been established.

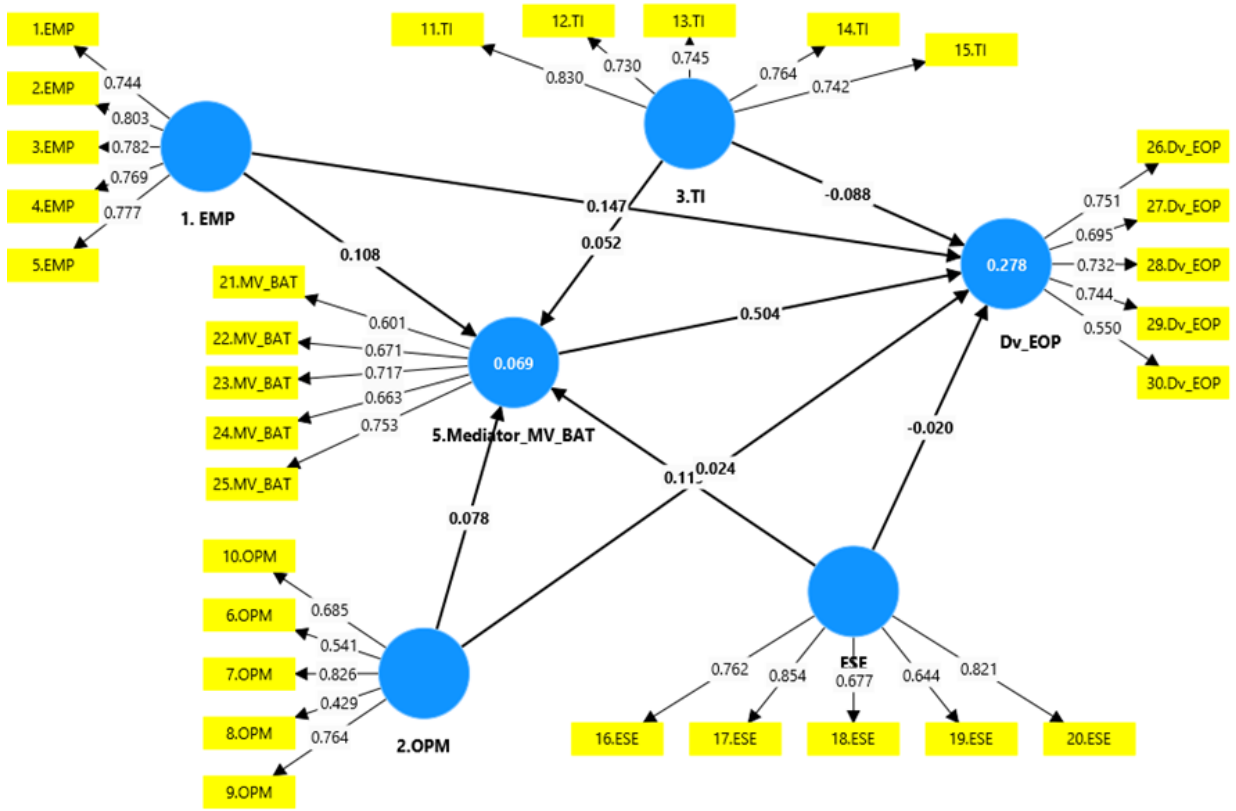

Figure 2. First conceptual model with all variables and indicators.

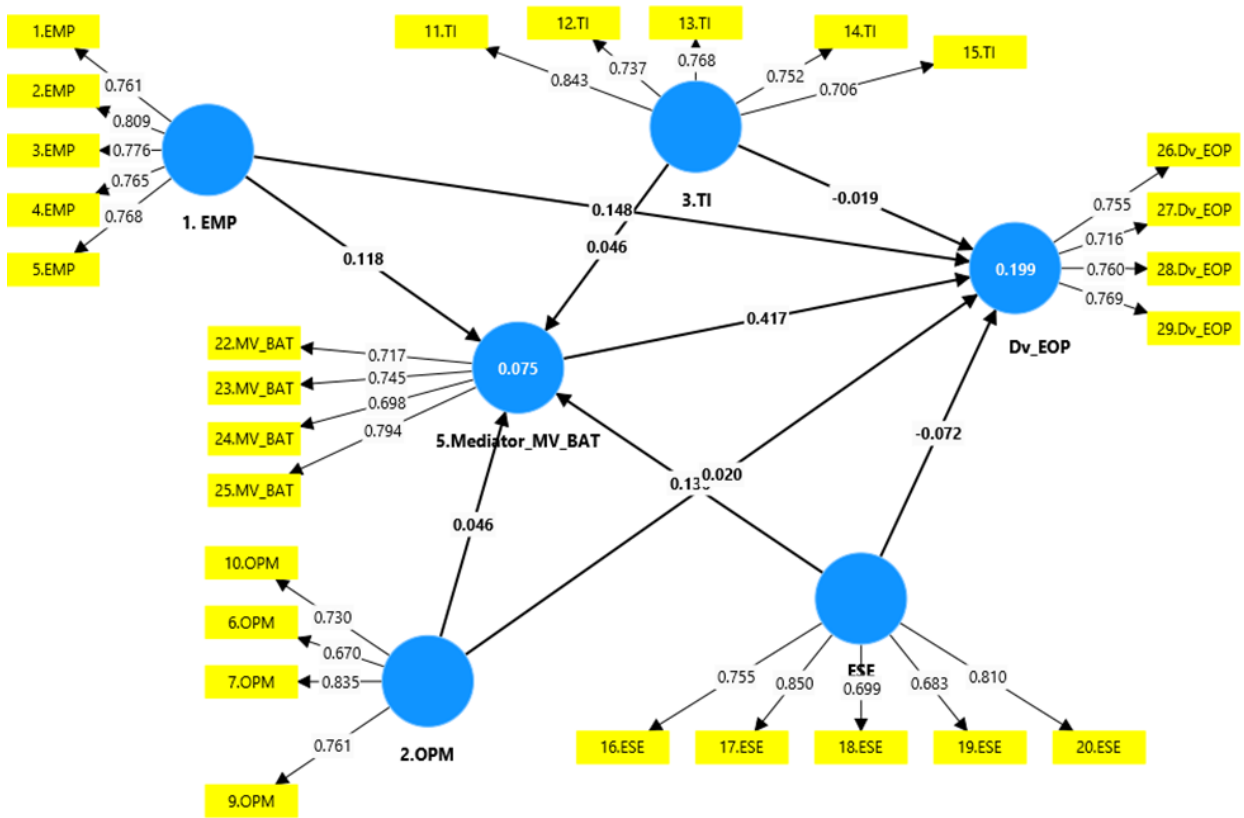

Figure 3. Final conceptual model after removing (30. Dv_EOP = 0.550, 8. OPM = 0.429, 21. MV_BAT = 0.601) indicators.

Table 3. Average variance extracted (AVE) results for the first conceptual model.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
1. EMP	0.837	0.859	0.883	0.601
2. OPM	0.815	0.274	0.791	0.443
3. TI	0.824	0.858	0.874	0.582
5. Mediator_MV_BAT	0.713	0.713	0.813	0.466
Dv_EOP	0.734	0.747	0.825	0.488
ESE	0.828	0.879	0.868	0.571

Table 4. Average variance extracted (AVE) results for final conceptual model.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
1. EMP	0.837	0.861	0.883	0.602
2.OPM	0.77	0.802	0.838	0.565
3. TI	0.824	0.882	0.874	0.582
5. Mediator_MV_BAT	0.723	0.727	0.828	0.546
Dv_EOP	0.742	0.747	0.837	0.563
ESE	0.828	0.885	0.873	0.581

This determination followed extensive tests, encompassing AVE and HTMT. Remaining items' reliability and validity, with their factor loadings, are shown in **Table 5**. All alpha values and CRs exceeded the recommended threshold of 0.700, indicating robust reliability. Convergent validity was confirmed by AVE and CR values, each equal to or greater than 0.500 and 0.700, respectively. Discriminant validity was evidenced through cross-loadings, where factor loadings surpassed cross-loadings for all items, signifying distinctiveness. Moreover, 'multicollinearity' was gauged with VIF values below 5 for each indicator, indicating no' multicollinearity' issues. **Table 6** portrayed cross-factor loadings of all items, consistently favoring factor loadings over cross-loadings, reinforcing discriminant validity.

Table 5. Item loadings, reliability and validity.

	Factor Loading	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Employee Management Practices (EMP)		**0.837**	**0.861**	**0.883**	**0.602**
1. EMP ← 1. EMP	0.761				
2. EMP ← 1. EMP	0.809				
3. EMP ← 1. EMP	0.776				
4. EMP ← 1. EMP	0.765				
5. EMP ← 1. EMP	0.768				
Organizational Performance Metrics (OPM)		**0.770**	**0.802**	**0.838**	**0.565**
6. OPM ← 2. OPM	0.670				
7. OPM ← 2. OPM	0.835				
9. OPM ← 2. OPM	0.761				
10. OPM ← 2. OPM	0.730				

Table 5. (*Continued*).

	Factor Loading	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Technological Infrastructure (TI)		**0.824**	**0.882**	**0.874**	**0.582**
11. TI ← 3. TI	0.843				
12. TI ← 3. TI	0.737				
13. TI ← 3. TI	0.768				
14. TI ← 3. TI	0.752				
15. TI ← 3. TI	0.706				
Employee Satisfaction and Engagement (ESE)		**0.828**	**0.885**	**0.873**	**0.581**
16. ESE ← ESE	0.755				
17. ESE ← ESE	0.850				
18. ESE ← ESE	0.699				
19. ESE ← ESE	0.683				
20. ESE ← ESE	0.810				
Biometric Attendance Technology (BAT)		**0.723**	**0.727**	**0.828**	**0.546**
22. MV_BAT ← 5. Mediator_MV_BAT	0.717				
23. MV_BAT ← 5. Mediator_MV_BAT	0.745				
24. MV_BAT ← 5. Mediator_MV_BAT	0.698				
25. MV_BAT ← 5. Mediator_MV_BAT	0.794				
Effective Organizational Performance (EOP)		**0.742**	**0.747**	**0.837**	**0.563**
26. Dv_EOP ← Dv_EOP	0.755				
27. Dv_EOP ← Dv_EOP	0.716				
28. Dv_EOP ← Dv_EOP	0.760				
29. Dv_EOP ← Dv_EOP	0.769				

Table 6. 'Heterotrait-monotrait ratio (HTMT)'—Matrix.

	1. EMP	2. OPM	3. TI	5. Mediator_MV_BAT	Dv_EOP	ESE
1. EMP						
2. OPM	0.080					
3. TI	0.765	0.086				
5. Mediator_MV_BAT	0.291	0.078	0.276			
Dv_EOP	0.227	0.087	0.146	0.582		
ESE	0.773	0.071	0.891	0.292	0.144	

3.1.2. Discriminant validity

Further confirmation of discriminant validity was achieved through the criteria proposed by 'Fornell and Larcker' and the 'Heterotrait-Monotrait method (HTMT)', with detailed results provided in **Table 6**. In **Table 6** 'Discriminant validity' is presented using the criterion by 'fornell and Larcker and Heterotrait-Monotrait method (HTMT)'. To evaluate the discriminant validity of the Fornell-Larcker criteria, which is shown in **Table 7**, a comparison is made between the square root of the AVE and the correlations between the latent variables.

Table 7. 'Fornell-Larcker' criterion.

	1. EMP	2. OPM	3. TI	5. Mediator_MV_BAT	Dv_EOP	ESE
1. EMP	0.776					
2. OPM	0.042	0.751				
3. TI	0.646	0.019	0.763			
5. Mediator_MV_BAT	0.237	0.058	0.224	0.739		
Dv_EOP	0.189	0.047	0.117	0.431	0.750	
ESE	0.641	0.045	0.740	0.248	0.113	0.762

The HTMT criteria is what we advise when evaluating discriminant validity. Discriminant validity between two reflectively assessed constructs has been proven if the HTMT value is less than 0.90 (Hair et al., 2021; Hair and Risher et al., 2019).

3.2. Model of assessment: Structural model

The next step in our study was to evaluate the structural models in order to look into the theories that we had put forward.

3.2.1. Direct hypothesis testing

A two-tailed test with a 95% significance level and a t-value threshold of −1.96 was selected, influenced by the findings presented in (Hair et al., 2021; Hair and Page et al., 2019). **Table 8** indicates that none of the independent variables have a direct significant impact on the dependent variable (EOP), except for the mediator variable (MV_BAT). The Biometric Attendance Technology (BAT) shows a significant impact on EOP ($B = 0.417$, $t = 8.103$, $p = 0.000$).

Table 8. Path coefficients, STDEV, *T* values, *p* values.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	*T* statistics (|O/STDEV|)	*P* values
1. EMP → 5. Mediator_MV_BAT	0.118	0.118	0.084	1.406	0.160
1. EMP → Dv_EOP	0.148	0.147	0.076	1.938	0.053
2. OPM → 5. Mediator_MV_BAT	0.046	0.055	0.074	0.623	0.533
2. OPM → Dv_EOP	0.020	0.012	0.081	0.250	0.803
3. TI → 5. Mediator_MV_BAT	0.046	0.060	0.097	0.473	0.636
3. TI → Dv_EOP	−0.019	−0.017	0.079	0.237	0.813
5. Mediator_MV_BAT → Dv_EOP	0.417	0.425	0.051	8.103	0.000
ESE → 5. Mediator_MV_BAT	0.136	0.137	0.094	1.445	0.148
ESE → Dv_EOP	−0.072	−0.071	0.080	0.892	0.372

3.2.2. Mediation analysis results

Figure 4 demonstrating the 'Bootstrapping' implementation for Mediation analysis.

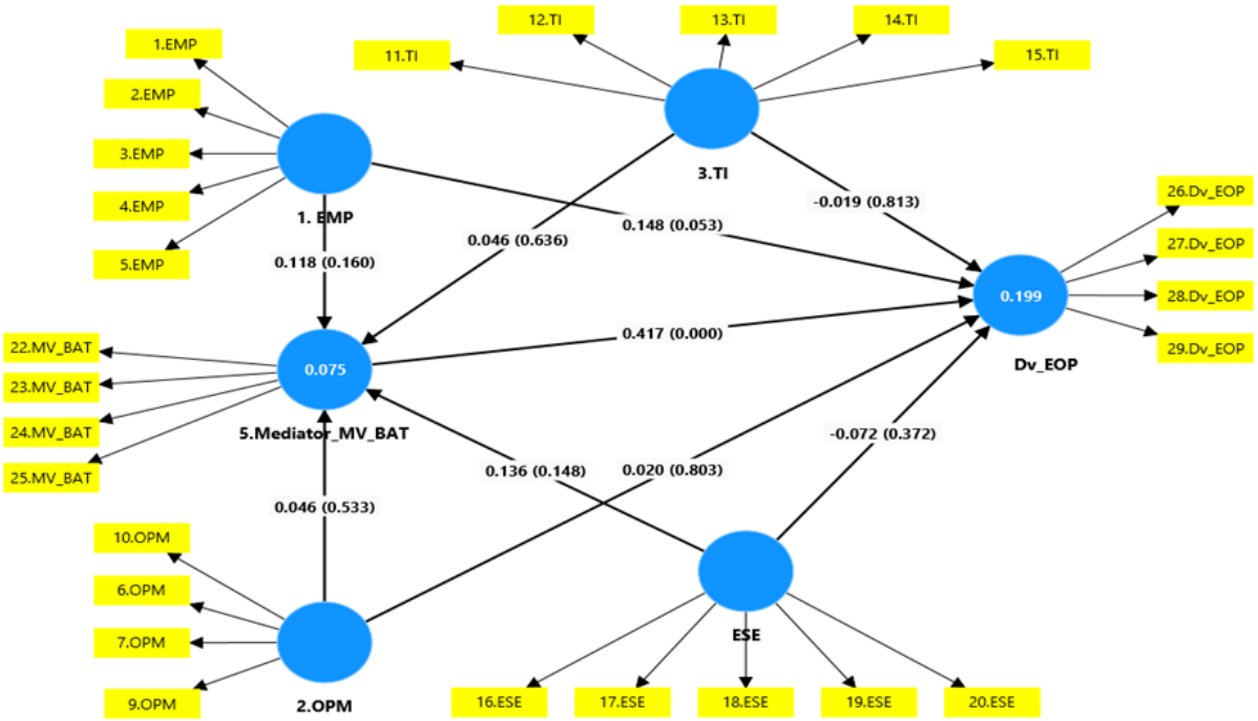

Figure 4. Bootstrapping implementation for Mediation analysis.

Table 9 summarizes the results and presents the total effect, direct effect, and specific indirect effect, which are used to test the four hypotheses proposed in this study.

Table 9. Result summary.

Total effect		**Direct Effect**		**Specific indirect effect**							
B	***P***	***B***		**Hypothesis**	***B***	***t***	**UL**	**LL**	***P***	**Results**	
0.197	0.009	0.148	0.053	H1 EMP → 5. Mediator_MV_BAT → Dv_EOP	0.049	1.330	-0.018	0.127	0.184	No mediation effect	H1: Rejected
0.040	0.665	0.020	0.803	H2 OPM → 5. Mediator_MV_BAT → Dv_EOP	0.019	0.608	0.001	0.096	0.543	No mediation effect	H2: Rejected
0.001	0.995	-0.019	0.813	H3 TI → 5. .Mediator_MV_BAT → Dv_EOP	0.019	0.2461	-0.065	0.098	0.645	No mediation effect	H3: Rejected
-0.015	0.866	-0.072	0.372	H4 ESE → 5. Mediator_MV_BAT → Dv_EOP	0.057	1.381	-0.023	0.140	0.167	Partial Mediation	H4: Rejected

Table 9 presents and explains the obtained results, as outlined in the following steps:

Step 1:

H1 seeks to assess the mediating role of Employee Management Practices (EMP) in the relationship between Biometric Attendance Technology and Effective

Organizational performance (EOP).

H2 seeks to assess the mediating role of Organizational Performance Metrics (OPM) in the relationship between Biometric Attendance Technology and Effective Organizational performance (EOP).

H3 seeks to assess the mediating role of Technological Infrastructure (TI) in the relationship between Biometric Attendance Technology and Effective Organizational performance (EOP).

H4 seeks to assess the mediating role of Employee Satisfaction and Engagement (ESE) in the relationship between Biometric Attendance Technology and Effective Organizational performance (EOP).

Step 2:

The results indicated by H1 revealed no significant effect of Employee Management Practices (EMP) on organization performance through Biometric Attendance Technology ($B = 0.049$, $t = 1.330$, $p = 0.184$)

The results indicated by H2 revealed no significant effect of Organizational Performance Metrics (OPM) on organization performance through Biometric Attendance Technology ($B = 0.019$, $t = 0.608$, $p = 0.543$)

The results indicated by H3 revealed no significant effect of Technological Infrastructure (TI) on organization performance through Biometric Attendance Technology ($B = 0.019$, $t = 0.2461$, $p = 0.645$)

The results indicated by H4 revealed no significant effect of Satisfaction and Engagement (ESE) on organization performance through Biometric Attendance Technology ($B = 0.057$, $t = 1.381$, $p = 0.167$)

Step 3:

The path analysis demonstrated in **Figure 4** showed that in absent of the mediator between all independent variables with no significant impact of Biometric Attendance Technology on organization performance, the mediator impact was found not significant ($P > 0.05$).

Step 4:

Considering the direct and indirect effects, it's evident that both the direct and specific indirect effects were not found to be significant. This indicates that Biometric Attendance Technology does not mediate the relationship between Employee Management Practices (EMP), Organizational Performance Metrics (OPM), Technological Infrastructure (TI), Employee Satisfaction and Engagement (ESE), and organizational performance.

4. Discussion and recommendations

4.1. Exploring the shift from millennials to Gen Z

There have been many transitions of generations through time. Each generation that followed the next one had beliefs of their own. These beliefs and the time spent in different periods of time through their lives have shaped them to what they are right now. In the 21st century, there could be no generation other than the Millennials to be the generation that changed the most, with the rise of technology, start-up companies, and the fast pace of life. Growing up with it, however, had its own effects as well. Either connected to the internet or their phones constantly created side effects besides

the beneficial sides of it. Yet, as time passed, the new generation that is ready to follow the footsteps of the Millennials has appeared. Gen Z represents those who have been born in and grown up with further digitalization and have been influenced by the economic crisis globally.

Society and experts believed that the teacher was the main person affected by the changes brought about by the digital revolution. These were the pioneer Millennials, who were expected to experience everything in a borderless world with constantly evolving technologies, and who started to resemble each other in the middle of the economic crisis and began to realize the problems arising from this resemblance. The effects of increasing inequality, fake news, and the transformative change in traditional roles—especially in heterosexual relationships—affected them very intensely, and along with this, they were defined in the eyes of society as a generation that does not pursue traditional goals, that has difficulty in communicating face-to-face, that is weak due to online identity, and that has mental problems. However, when we look at the real differences as a result of the rapid development of technology and economy, these problems started to develop in the digital world, resulting in the discomfort of the pioneers of digitalization, the Millennials.

4.2. Definition and characteristics of millennials

Although the exact beginning and end dates of the millennial generation are hard to pinpoint, typically, they are considered to be those who were born between 1980 and the middle of the 1990s. This generation has lived through a number of life-altering world events which have played a significant part in shaping their worldview. During their formative years, the likes of the Columbine massacre, 9/11, and the subsequent War on Terror would have had a direct impact on the way they lived, learned, and experienced life. Their parents would have been the generation that potentially faced the increased loneliness, social mistrust, economic divide, and religious inclination that technological advancement has been reported to cause, and it is with this backdrop that millennials would have grown up, possibly seeing and experiencing these challenges at close quarters. It is, therefore, not surprising that millennials are considered to be more open to change and have different outlooks and tastes when compared to previous generations. As a result of the world they grew up in, millennials appear to place more value on experiences and fulfillment as opposed to material goods, even choosing homes which are closer to where they work and where leisure activities take place rather than buying homes which are larger in size.

In fact, research has shown that millennials have reached the age of thirty with fewer possessions than previous generations held at the same point in the life cycle. These changing trends, coupled with higher property costs, have contributed to the decline of home ownership within the millennial generation and the consequently lower property appreciation rates. Societal backlash against this grouping has been reported, with criticism including ‘special treatment’ in terms of mortgage rates and better job offers despite having grown up in a more prosperous time than previous generations. Due to the need to work extra hours to regain economic stability, millennials have been defined as ‘workaholic’ in nature with rushed meal schedules and little time for themselves, and have even been recognized as the burnout

generation. The majority of publicized studies, statistics, and trends, in fact, indicate that the troll definition of a millennial is negative and reflects shortcomings in the way they have grown and developed, and the values that they have embraced.

4.3. Definition and characteristics of Gen Z

Gen Z is the generation born between 1995 and 2012/2017. It is also called the internet and/or 'iGeneration' because of their digital skills. Moreover, they share a high-tech lifestyle, hyper-cognitive, value flexibility, and a personalized environment. They have been influenced by the Great Recession and the increasing cyberspace threats. They are also aware of other expressed societal concerns and are motivated by making a tangible change, even at a local level. However, they are also seen as overly protected, over-parented, or even fickle.

In comparison to Millennials, Gen Z shares technological literacy and reliance. However, they lack the traits of entitlement or individual irresponsibility. There are multiple lists of traits of Gen Z, even not unique or directly applicable to every representative. The most crucial points could be summarized as the entrepreneurial and pragmatic generation, the true digital natives, character-focused, practical and straightforward, anxious but safe. They read from their birth or even earlier. They face growing concerns about their privacy and security vulnerabilities. They are socially aware and feel moral obligations to do something good, but are also able to consider online and social media perpetually constructed environments.

4.4. Gulf Millennial and Gen Z

In AGSIW (2024), Millennial Gulf highlights the endeavors of young people in the Gulf Arab nations in culture, politics, technology, and entrepreneurship. It aims to amplify youth voices and enhance comprehension of their aspirations and issues. The study in (Racolța-Paina and Irini, 2021) investigated that Generation Z's arrival in the workforce brings about a noteworthy shift in organizational dynamics. This study examines organizational readiness to handle the challenges presented by Gen Z. Interviews with Romanian HR professionals suggest organizations are prepared to embrace these changes by understanding and utilizing Gen Z's unique traits (Suale et al., 2023). Workforce Management has evolved with technology, particularly through the automation of employee time and attendance. Biometric Time and Attendance Management System (BTAMS) is a crucial tool in managing workforce, with Managerial Commitment (MC) playing a vital role in its success. A study with 226 respondents found that BTAMS positively impacts workplace attendance and loafing, but has no significant effect on employee compensation. Additionally, MC moderates the relationship between BTAMS and attendance (Rashid Al-Shamsi and Shannaq, 2024; Sadriwala et al., 2024; Shannaq and Al Shamsi, 2024; Shannaq et al., 2024a; Shannaq et al., 2024b). These studies analyze consumer behavior in Oman and Bahrain's e-commerce sectors, focusing on sustainable strategies for enhancing business technology. Findings show a substantial revenue increase in Bahrain, with a projected annual growth rate of 8.09%, and a dominance of beverage and fashion products in Bahrain. The findings suggest the need for effective market penetration strategies (Frigillana et al., 2023). This research paper examines the effectiveness and

efficiency of a biometric attendance system at 'Don Honorio' Ventura State University. The system was found to be highly effective and efficient, with a 92% consensus rating. The system's accessibility and privacy measures received positive scores of 80% and 82% respectively. However, an outlier score of 1 from a participant prompted further investigation (Garg et al., 2018). This paper explores the use of fingerprint biometric identification systems in university attendance monitoring software. The biometric method, which involves verifying an individual's identity by analyzing human body features, has numerous benefits, including reducing absenteeism and improving workforce efficiency. The study uses qualitative research methodology and explores the integration of biometrics with conventional workforce attendance monitoring systems. Results show that biometric identifiers are effective and economical for employee attendance monitoring software, but further research is needed to determine the best approach for improving business performance (Shannaq, 2024a). The study presents a systematic model for transforming formative assessment in Oman's educational systems, specifically for students from Arabic cultural backgrounds. The model, based on a case study at the University of Buraimi, aims to overcome challenges like cultural hesitancy and low classroom participation. The model, utilizing the Moodle Learning System, has shown significant success in improving academic performance (Hoo and Ibrahim, 2019). Biometric recognition technology has expanded its applications in various domains, including personal authentication. Currently, attendance-tracking systems based on biometric recognition are underutilized in education sectors. Conventional methods are time-consuming and can lead to fraud. Advancements in biometric recognition have led to more advanced systems. This literature survey provides an overview of hardware components used in biometric-based attendance systems, emphasizing microcontroller platforms, biometric sensors, communication channels, and database storage (Shannaq, 2024b). The research paper discusses the role of search engines in the digital economy, highlighting the importance of query formulation in information retrieval. It introduces the Interactive Digital Associative Tool (IDAT), which enhances human memory and conceptual thinking, leading to improved query formulation and increased profitability and productivity. More information about technology, such as mobile and e-learning, including its effects and impact on the new generation, has been investigated in greater detail in (Shakir et al., 2024; Shannaq, 2024c).

This paper reviews the relationship between HR technology and employee engagement, highlighting its role in streamlining processes, enhancing communication, and empowering employees (Opeyemi, 2023). It uses Technological Acceptance Theory to understand employee acceptance. However, the lack of qualitative insights and a longitudinal approach limits the understanding of the long-term effects of HR technology on engagement and performance (Ardebili et al., 2023). This paper examines cloud infrastructures for employee attendance management, focusing on three groups. Results show that cloud infrastructure significantly improves attendance systems management. The study also highlights the importance of radio frequency identification authentication protocol for protecting privacy and enhancing workplace efficiency and safety (Espegren and Hugosson, 2023). This paper explores human resource analytics (HRA) from a practice-based perspective, analyzing 100 academic and practitioner-oriented publications. The authors identify main practices, their

enactment, and three topics in the HRA-as-practice network: HRA technology, outcomes, and hindrances and facilitators. The findings offer HR function and professionals a foundation to evaluate HRA as a contextual activity that can generate business value and increase HR impact. The paper also provides a novel theoretical contribution by conceptualizing HRA-as-practice and compiling related topics (Zhang and Jin, 2023). This study examines the impact of digital transformation on sustainable corporate development in Chinese A-share listed companies from 2010 to 2020. Results show that digital transformation significantly enhances sustainable development, with empowered management and educated employees being essential human resources. Internal controls also play a positive moderating role. The study highlights the importance of digital transformation in promoting corporate sustainability, providing insights for management and policymakers. The investigation of the current literature delves into the effects of technology on workforce management, with a lack focus on the Gulf Arab states, and examines the significance of Managerial Commitment (MC) in ensuring its triumph. Many studies cover the usage of fingerprint biometric identity systems, biometric attendance systems, and search engines' place in the digital economy. It also covers the use of search engines in the digital economy, the efficacy of biometric attendance systems, and the integration of biometrics with conventional attendance tracking systems. The importance of HR technology in employee engagement is also covered in the literature, with an emphasis on how it can empower workers and streamline procedures.

4.5. Summary

However, none of the literature has studied biometric attendance technology in education systems, considering the new generation Z. We believe that this work is a valuable contribution to the path of new technology as accepted by the new generation in particular from Arabic culture perspectives.

Generation Z, a digitally savvy generation, values freedom, independence, and continuous learning. They prioritize personal and professional development, leveraging technology to streamline workplace processes. Remote work appeals to Generation Z, driven by the global shift towards remote work culture, especially following the COVID-19 pandemic. Entrepreneurs of Generation Z believe in their ability to achieve success quickly and view traditional employment as a stepping stone. To enhance Generation Z's commitment to attendance and departure, organizations must adapt to post-COVID-19 changes by implementing flexible practices such as flexible hours, mobile applications, remote work policies, clear goal setting, and idea acceptance. By balancing Generation Z's needs and organizational requirements, organizations can empower them to innovate and succeed while achieving organizational strategies. This highlights the challenges posed by traditional attendance systems for Generation Z.

5. Conclusion

With an emphasis on Generation Z in particular, this study looks at how biometric attendance systems manage attendance and how they affect organizational performance. It offers insightful information on HR management techniques in a

variety of industries, highlighting the necessity of adjusting to the new generation's work preferences and digital requirements.

Our results emphasize a number of important points:

Effect on Generation Z: According to the study, present attendance systems especially those based on fingerprints might not fully meet the requirements and expectations of Arabic-speaking staff members from Generation Z. Their dedication and job happiness may be impacted by this imbalance.

Workplace Adjustment: Our suggestion is that companies should design workspaces that accommodate younger workers' digital inclinations. This entails changing attendance control procedures to allow for remote work and flexible work schedules, which can alleviate commuting-related issues and improve general wellbeing.

Finding a Balance between Performance and Punctuality: Research shows that strict attendance regulations that only take punctuality into account may ignore important factors like productivity and performance. It is advised to take a more balanced stance that takes cultural differences and employee well-being into account.

Cultural Sensitivity: Negative effects on communication and work behaviors may arise from the implementation of attendance systems that fail to take employee interests and cultural subtleties into consideration. Incorporating cultural sensitivity into the design and execution of these systems is crucial to guarantee their efficacy and alignment with business objectives.

As a result, our research suggests that existing attendance control procedures be reevaluated in order to better meet the demands of Generation Z and promote an inclusive and flexible work environment. This method improves employee happiness and corporate performance overall while also addressing the shortcomings of current methods.

6. Advantages, drawbacks, and prospects for further research advantages

This study has a number of noteworthy advantages. It begins by providing a thorough examination of biometric attendance systems, particularly in relation to Arabic Generation Z, a group that has received little attention. Strong data collecting techniques and a sizable sample size are used in the study, which improves the validity and dependability of the conclusions. The study also incorporates a thorough analysis of cultural elements that affect technology adoption, which deepens our knowledge of the implications of biometric systems in educational environments.

6.1. Limitation

Notwithstanding these advantages, the study has some drawbacks. The fact that the study was restricted to a few Arab educational institutions may have an impact on how broadly the results may be applied to other areas or educational settings. Furthermore, the use of self-reported data raises the possibility of response biases, which might affect how accurate the results are. Furthermore, a more thorough understanding may benefit from an examination of the long-term impacts of biometric attendance systems on user behavior and institutional performance, which is not done

in this study.

6.2. Future paths for research

- In order to overcome these constraints and enhance the current investigation, future studies might concentrate on other domains: Greater Geographic Coverage: Including institutions from more areas in the research can yield a more thorough picture of biometric system adoption in diverse cultural situations.
- Longitudinal Studies: Long-term research can be used to evaluate the long-term effects of biometric attendance systems on user behavior and institutional results.
- Comparative Studies: Analyzing the efficacy of biometric systems against other attendance technologies, including mobile apps, might provide valuable information about alternate strategies and their possible benefits.
- Examining Other Variables: To offer a more comprehensive picture of the elements involved, future study should look into additional variables including organizational culture and technological literacy that influence technology uptake.

In addition to addressing the shortcomings of the current study, these paths will further our understanding of biometric attendance systems and how to integrate them into learning settings.

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