Nudged to Class: Exploring Online Reminders through a Quasi-Experiment

Fathin Fakhriah Abdul Aziz

Faculty of Technology and Applied Sciences, Open University Malaysia, Malaysia

ABSTRACT

This study examines the effectiveness of digital nudges, specifically through WhatsApp reminders, in enhancing student attendance in e-tutorial sessions within an Open Distance Learning (ODL) environment. Using a quasi-experimental design, we compared attendance rates between a treatment group receiving WhatsApp reminders and a control group with no additional prompts. Results indicated a significant increase in attendance for the nudged group, with an average attendance of 3.63 sessions compared to 1.39 sessions in the control group. Statistical analysis confirmed the effectiveness of the nudges ($t(77) = 3.56$, $p < 0.001$), with an effect size of Cohen's $d = 0.81$, and a chi-square test demonstrated a strong association between receiving digital nudges and improved attendance ($\chi^2 = 11.48$, $p < 0.001$). These findings suggest that accessible digital nudges, such as WhatsApp reminders, can effectively enhance attendance in online learning contexts. Implications for scaling digital nudging strategies across educational settings are discussed, highlighting potential applications in broader fields of digital engagement. Future research could explore personalisation of nudges and other delivery platforms to maximize impact.

Keywords: digital nudge, educational technology, Open Distance Learning, online learning, e-tutorial, attendance

INTRODUCTION

The shift to online education, accelerated by the COVID-19 pandemic, has introduced significant challenges in maintaining student attendance, particularly within ODL environments. In traditional classrooms, physical presence often correlates closely with engagement and academic success; however, virtual learning contexts lack the immediate social accountability found in face-to-face settings, contributing to increased absenteeism (García-Morales et al., 2021). Addressing this challenge, digital nudges subtle prompts delivered through digital channels have emerged as a promising approach to influence student behaviour positively, including improving attendance (Thaler & Sunstein, 2008). WhatsApp, given its widespread usage and accessibility, offers an especially practical channel for delivering these nudges to encourage greater student participation in online tutorials.

Previous research in both physical and virtual learning contexts underscores the importance of regular attendance for academic success, as it supports comprehension, engagement, and retention (Credé, Roch, & Kieszczynka, 2010). However, online learning often sees higher absenteeism due to the flexible and sometimes isolating nature of the environment (Stone & Springer, 2019). Digital nudges have been shown to improve engagement across various domains through methods like email and SMS reminders, but there remains a notable gap in research regarding the effectiveness of WhatsApp-based nudges specifically for attendance in online classes (York & Loeb, 2020).

Most studies in educational settings have focused on nudges aimed at general engagement metrics, such as assignment completion and course participation, rather than specifically targeting attendance (Damgaard & Nielsen, 2018). This study seeks to address that gap by examining how WhatsApp reminders influence attendance in e-tutorial sessions, providing insights into a focused aspect of student engagement. We hypothesize that students receiving regular WhatsApp reminders will exhibit higher attendance rates than those without such nudges.

This research has practical implications for educational institutions seeking cost-effective and scalable solutions to enhance attendance in online courses. By demonstrating the effectiveness of WhatsApp reminders, this study contributes to the development of digital intervention strategies that can be readily implemented across various online learning platforms, offering potential benefits for both student engagement and academic outcomes.

LITERATURE REVIEW

Digital nudging, rooted in behavioural economics, has emerged as a valuable tool for enhancing student engagement in education. Inspired by Thaler and Sunstein's (2008) work on non-coercive guidance, digital nudges use design elements and timely prompts to influence behaviours subtly, promoting student persistence and participation without limiting choice (Vese, 2022). This review examines the theoretical foundations, applications, ethical considerations, and empirical support for digital nudging in education, highlighting its growing relevance in online learning contexts.

Digital nudging, rooted in behavioural economics, is a concept popularized by Thaler and Sunstein in their seminal work "Nudge" (2008), which explores how subtle interventions can guide individuals towards better decision-making without restricting their freedom of choice. This approach leverages the understanding that humans often deviate from rational decision-making due to cognitive biases, and thus, can be gently steered by "choice architects" through well-designed environments and cues (Vese, 2022). In educational settings, digital nudging has been increasingly applied to enhance student engagement and persistence. For instance, at the University of Canterbury, an Early Alert System was implemented to send automated nudges to students at risk of disengagement, resulting in increased re-engagement with learning materials and sustained benefits across courses (Bostock, 2023). Similarly, a study utilizing the Fogg Behaviour Model attempted to tailor nudges based on students' motivation and perceived ability, although it found that motivation was a more significant factor in responsiveness than perceived ability (Plak et al., 2022). The integration of nudge theory with learning analytics, termed "nudge analytics," has also been explored to strategically encourage student engagement in online courses, highlighting the importance of timing and content in the nudging process (Brown et al., 2022). Despite the potential of digital nudges to influence positive behaviours such as attendance, the implementation in educational contexts remains sparse, necessitating a focus on long-term effects and the underlying processes of nudges for successful application (Weijers et al., 2021). Overall, digital nudging in education aims to subtly influence student behaviour, promoting engagement and attendance through carefully crafted interventions that respect individual autonomy.

Digital nudging refers to the use of subtle interventions within digital environments to influence user behaviour without restricting their freedom of choice. These nudges leverage interface design elements to guide users towards desired actions, such as asking questions in online classrooms or re-engaging with educational content (Weijers et al., 2023) (Valta et al., 2022). The effectiveness of digital nudges lies in their ability to subtly alter decision-making processes, often through timely prompts or reminders, as demonstrated by the Early Alert System at the University of Canterbury, which successfully increased student engagement and persistence by sending automated messages to at-risk students (Bostock, 2023). Despite their potential, digital nudges face challenges due to their opacity and the dominant role of private intermediaries in their implementation, which can raise ethical concerns (Tor, 2023). Transactional Distance Theory (TDT), proposed by Moore in 1993, provides a framework for understanding how digital nudges can reduce psychological distance in remote learning environments. By decreasing the perceived gap between students and instructors, digital nudges can enhance engagement and participation, as seen in studies where nudges were tailored to students' motivation and perceived ability levels (Plak et al., 2022). However, the effectiveness of these nudges can vary, with some studies showing limited impact on engagement or academic performance, suggesting that the design and targeting of nudges are crucial for maximizing their benefits (Weijers et al., 2023) (Plak et al., 2022). Overall, digital nudging represents a promising tool for promoting desired behaviours in educational settings, provided that ethical considerations and individual differences are carefully managed.

Digital nudges have been shown to positively impact student engagement, attendance, and academic performance across various platforms, including SMS and email. For instance, a study on mastery-based assignments in undergraduate STEM courses demonstrated that email-based nudges could improve assignment scores by an average of 3%, with the most significant benefits observed among students with lower prior

academic performance (Matz et al., 2024). This suggests that digital nudges can be particularly effective when tailored to individual student needs and delivered through familiar communication channels. A systematic review further supports the effectiveness of nudges in educational settings, highlighting the importance of techniques such as making information visible and providing reminders to influence learning behaviours (Lim & Lee, 2022). WhatsApp, in particular, offers unique advantages for delivering nudges in online learning environments due to its accessibility and widespread familiarity among students. During the COVID-19 pandemic, WhatsApp was effectively used to facilitate student engagement and support at a rural university, helping students feel a sense of belonging and reducing dropout rates (Rabotapi & Matope, 2024). This platform's low-cost communication features, such as affordable data bundles and group creation, make it an ideal tool for integrating nudges into students' daily communication routines, thereby enhancing their academic success. Additionally, data-informed nudges, which leverage insights from learning analytics, have been shown to improve student satisfaction and academic outcomes by subtly influencing students' learning behaviours (Blumenstein et al., 2018). These findings collectively underscore the potential of digital nudges, particularly through platforms like WhatsApp, to enhance student engagement and performance in diverse educational contexts.

Digital nudging, while a powerful tool for influencing behaviour, raises significant ethical concerns, particularly regarding manipulation and autonomy. The potential for manipulation arises when digital nudges exploit cognitive biases without the user's awareness, leading to decisions that may not align with their true preferences or intentions (Leimstädtner et al., 2023). This is particularly concerning in educational settings, where the autonomy of learners is paramount. The ethical implications of digital nudging are further complicated by the fact that transparency does not necessarily mitigate feelings of manipulation; individuals may still feel coerced even when they are aware of the nudge (Gerver et al., 2024). To address these concerns, responsible design principles have been proposed, emphasizing transparency and reflection to ensure that nudges align with users' intentions and promote informed decision-making (Leimstädtner et al., 2023). In educational contexts, this could involve designing nudges that encourage students to reflect on their learning goals and choices, thereby enhancing their autonomy rather than undermining it. Additionally, the concept of consent is crucial; allowing individuals to opt-in to being nudged can preserve autonomy and reduce negative feelings associated with manipulation (Gerver et al., 2024). Furthermore, the ethical design of digital nudges should consider the broader implications of autonomy and justice, particularly in personalized learning environments where the balance between guidance and freedom is delicate (Ryu, 2024). By integrating these ethical considerations, digital nudges can be implemented in educational settings in a manner that respects and enhances learner autonomy, ultimately contributing to a more ethical and effective educational experience.

Research on the use of nudges to improve attendance has shown varied results across different contexts and methodologies. For instance, a study in rural India demonstrated that using WhatsApp and other mobile technologies significantly reduced absenteeism among teachers and students, highlighting the potential of simple, accessible technologies to enhance educational outcomes in areas with poor internet connectivity (Nedungadi et al., 2018). In contrast, a study involving Venezuelan migrants in Colombia found that informational videos sent via WhatsApp actually decreased program take-up rates, primarily because recipients did not watch the videos due to factors like age, busyness, and limited internet access (Moya et al., 2023) (Rozo et al., 2024). This suggests that the effectiveness of nudges can be highly context-dependent. Other research has explored nudges in educational settings, such as email-based nudges in undergraduate courses, which were associated with improved assignment scores, particularly benefiting students with lower prior academic performance (Matz et al., 2024). Additionally, nudges aimed at reducing procrastination in higher education showed that while mere exposure to nudges did not significantly impact outcomes, active engagement with the nudges led to reduced procrastination and increased class attendance (Blondeel et al., 2023). Despite these insights, there is a notable gap in research specifically examining the use of WhatsApp for improving online class attendance, particularly in ODL contexts. Given the increasing reliance on digital platforms for education, especially in ODL settings, investigating the potential of WhatsApp as a tool for enhancing attendance could provide valuable insights and practical applications for educators and policymakers. This study is necessary to address this gap and explore how WhatsApp can be effectively utilized to support student engagement and attendance in online learning environments.

Existing studies on nudging strategies in educational settings face several limitations, such as sample size, lack

of random assignment, and limited generalizability, particularly in the context of ODL. For instance, while Matz et al. demonstrated the effectiveness of personalized nudges in improving mastery-based assessment scores in a large sample of undergraduate students, the study was confined to a single university, which may limit its generalizability to other educational contexts or ODL environments (Matz et al., 2024). Similarly, Arslan and Finn's research on reducing cognitively disengaged responses through nudges in low-stakes assessments involved a relatively small sample of eighth-graders, which may not reflect broader educational settings or age groups (Arslan & Finn, 2023). Furthermore, Cardenas Canto et al. highlighted the role of personality in nudge effectiveness, suggesting that individual differences significantly impact how students respond to nudges, yet this study was limited to healthcare education, indicating a need for broader application across various disciplines (Canto et al., 2024). Future research should explore personalized nudging strategies that consider individual differences, such as personality traits, and examine the effects of timing and context in diverse educational settings, including ODL. Additionally, integrating data-driven approaches, as suggested by Sadeghian and Otarkhani, could enhance the personalization and effectiveness of nudges by leveraging AI and big data analytics to tailor interventions more precisely (Sadeghian & Otarkhani, 2023). Finally, Wang et al. propose that future studies should focus on developing individual-based nudging mechanisms to sustain engagement, which could be particularly beneficial in ODL environments where student motivation and engagement are critical challenges (Wang et al., 2022).

Digital nudging shows promise for boosting engagement and attendance in online education. Studies support its potential to address issues like psychological distance and accountability. However, ethical concerns about autonomy and transparency must be managed for respectful use. Tailoring nudges to individual needs and contexts will be key to maximizing their effectiveness. With careful design, digital nudging can foster a more engaging and supportive digital learning environment.

METHODOLOGY

This study used a quasi-experimental design to investigate the impact of digital nudges on student attendance within an ODL environment at Open University Malaysia (OUM). Specifically, the study examined whether WhatsApp reminders could encourage students enrolled in an online course to attend e-tutorial sessions more consistently. By comparing attendance rates between a group that received digital nudges and a control group that did not, the research aimed to offer insights into digital nudging as a strategy to enhance engagement in online education.

WhatsApp was selected as the nudging platform due to its widespread adoption, ease of use, and familiarity among students, particularly in mobile-first educational environments. As a platform that allows direct and immediate communication, WhatsApp enables the delivery of timely reminders that can seamlessly integrate into students' daily routines without the need for additional logins or external platforms. Additionally, WhatsApp is accessible even with low-cost data plans, making it a practical tool for students in regions where internet connectivity may be limited or costly. These factors align with the study's goal of implementing a scalable, low-cost digital intervention that could be feasibly adopted across diverse educational settings.

A quasi-experimental design was chosen as it is well-suited to real-world educational settings where random assignment is often unfeasible. The intervention involved sending a WhatsApp reminder to students in the treatment group on the day of each e-tutorial session. These reminders provided timely prompts aimed at encouraging attendance. This design enabled a controlled comparison of attendance rates, with students in the treatment group receiving additional nudges through WhatsApp, while those in the control group relied only on standard notifications from OUM's learning management system, my INSPIRE.

While the quasi-experimental design was well-suited for examining the effects of WhatsApp nudges on attendance in a real-world educational setting, it does have certain limitations. The lack of random assignment means that potential selection biases may influence the outcomes, as differences in baseline motivation or engagement levels between the treatment and control groups could affect attendance independently of the nudging intervention. Additionally, without random assignment, establishing causality is more challenging, as other uncontrolled factors may contribute to variations in attendance rates. However, by carefully selecting a control group that received similar course information through standard notifications, the study aimed to mitigate

these limitations and enhance the validity of the findings. Future studies using randomized controlled trials would further strengthen evidence for causal effects of digital nudges on attendance.

The participants included undergraduate students enrolled in CDCT2203: Introduction to Information Technology and Environment, a general studies course required for all diploma programmes at OUM. In total, 79 students participated, with 35 in the treatment group receiving the Digital Nudges (DN) and 44 in the control group who did not. As this course is open to all diploma students, it offered a diverse, representative sample of the OUM student population, which supported the study's goal of examining digital nudges' potential effect on attendance in an ODL setting.

The intervention consisted of a single WhatsApp reminder sent to the treatment group on each e-tutorial session day. The messages were designed to be clear and encouraging, highlighting the benefits of attending. Reminders were sent once per session day to provide a minimal yet timely prompt. Students in the control group received only the standard course notifications available through my INSPIRE, OUM's LMS. This setup provided a straightforward structure to evaluate attendance differences between students who received reminders and those who did not.

Attendance data were collected over an eight-week period covering eight e-tutorial sessions. Each session was conducted through Google Meet, with attendance tracked automatically using Google Meet's attendance features. Attendance tracking occurred passively, with no additional steps required from students. A data clean-up process was performed to address any inconsistencies, such as duplicate entries or inaccurate timestamps, ensuring that the final dataset accurately represented student attendance and provided a reliable foundation for analysis.

To assess the impact of the intervention, attendance rates between the treatment and control groups were analysed using independent t-tests and chi-square tests. The t-tests measured mean differences in attendance rates between groups, while chi-square tests evaluated the association between digital nudging and attendance. Both tests were conducted at a significance level of $p < 0.05$ to confirm that any observed differences were statistically significant. This analytical approach provided a rigorous assessment of digital nudging's impact on attendance in an ODL setting.

In summary, this methodology facilitated a systematic comparison of attendance patterns between students who received digital nudges and those who did not. By implementing a focused intervention and ensuring accurate attendance tracking, this study provides a reliable approach to exploring how digital nudges may help address engagement challenges in virtual education settings. The results contribute meaningful insights into the effectiveness of digital reminders as a simple strategy for encouraging attendance in online learning environments.

RESULTS AND DISCUSSION

The study's findings reveal the effect of digital nudges on student attendance within an ODL environment. By comparing attendance rates between a treatment group that received WhatsApp reminders and a control group that did not, this analysis demonstrates how simple, timely digital interventions can positively influence engagement in online tutorials. Statistical tests and visual analyses provide insights into attendance patterns, the significance of differences between groups, and correlations in attendance behaviour across sessions. These findings underscore the potential of digital nudges as a strategy for enhancing participation in remote educational settings, where maintaining student accountability and attendance can be challenging.

The data analysis reveals a significant impact of WhatsApp nudges on student attendance, as illustrated in Figure 1. The treatment group consistently attended more sessions compared to the control group, indicating that digital nudges can effectively sustain engagement within an ODL environment. This consistent difference in attendance supports the hypothesis that digital nudges help mitigate absenteeism in online settings, where the lack of in-person accountability often leads to lower attendance. Furthermore, Figure 2, which tracks p-values for attendance across multiple sessions, shows statistically significant attendance improvements in the treatment group for specific tutorial dates. This variation suggests that the timing of nudges may play a crucial role in their

effectiveness, aligning with findings from prior studies on behavioural nudging that highlight the importance of contextual factors, such as timing, in influencing behaviour (Weinmann et al., 2016). By examining these attendance patterns across sessions, the analysis emphasizes not only the overall effectiveness of WhatsApp nudges but also underscores the potential of strategic timing to enhance their impact.
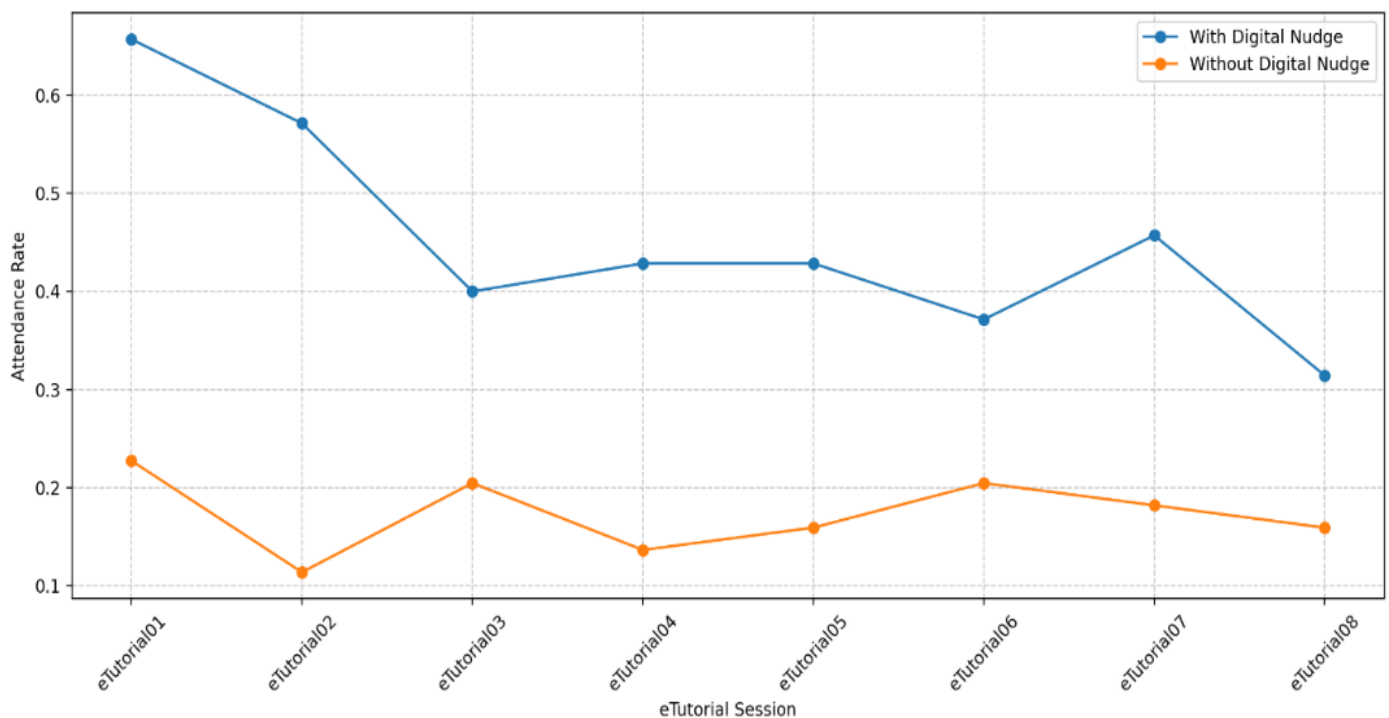

Figure 1: Comparison of Attendance Rates Across Eight E-Tutorial Sessions for The Treatment and Control Groups

To further evaluate the intervention's impact, an independent t-test confirmed a statistically significant difference in attendance rates between the two groups, with a t-value of t (77) = 3.56 and p < 0.001. The effect size (Cohen's d = 0.81) indicates a meaningful impact of digital nudges on attendance. Additionally, a chi-square test supported the association between receiving WhatsApp reminders and improved attendance (χ^2 = 11.48, p < 0.001), reinforcing the hypothesis that digital nudges can positively influence attendance in online education settings, aligning with findings from prior studies on behavioural nudging (Sunstein, 2014).

The Chi-square analysis in Table 1, reveals compelling evidence for the positive impact of digital nudges on student attendance across multiple sessions. The most striking effects were observed in the early sessions, particularly on eTutorial1 (χ^2 = 14.81, p < 0.001) and eTutorial2 (χ^2 = 18.89, p < 0.0001), showing highly significant differences between the nudged and non-nudged groups. These extremely low p-values (p < 0.001) provide strong statistical evidence rejecting the null hypothesis of no difference between groups. Looking at the observed frequencies, we can see that in the eTutorial1 session, 23 students attended in the digital nudge group compared to only 10 in the non-nudge group. Similarly, on eTutorial2, the digital nudge group had 20 attendees versus just 5 in the non-nudge group. This pattern continues throughout most sessions, though with varying degrees of significance:

eTutorial4: χ^2 = 8.53, p < 0.01

eTutorial5: χ^2 = 7.05, p < 0.01

eTutorial7: χ^2 = 6.99, p < 0.01

While some sessions (eTutorial3, eTutorial6, and eTutorial8) showed marginally significant or non-significant differences (p > 0.05), the overall trend demonstrates that digital nudges consistently produced higher attendance rates than expected by chance. The expected frequencies calculated from the Chi-square analysis show that the

actual attendance in the nudged group regularly exceeded statistical expectations, while the non-nudged group typically fell below expected attendance levels. This pattern of results strongly suggests that digital nudging is an effective intervention for improving student attendance, with particularly strong effects in the early parts of the term. The statistical evidence indicates that this is not merely due to chance but represents a genuine positive impact of the digital nudging strategy on student behaviour.

Table 1: Chi-square Test Results

	Chi-square Statistic	P-value	Observed Frequencies	Expected Frequencies
eTutorial1	14.80985	0.000119	[[23 12] [10 34]]	[[14.62025316 20.37974684] [18.37974684 25.62025316]]
eTutorial2	18.88647	1.39E-05	[[20 15] [5 39]]	[[11.07594937 23.92405063] [13.92405063 30.07594937]]
eTutorial3	3.608473	0.057486	[[14 21] [9 35]]	[[10.18987342 24.81012658] [12.81012658 31.18987342]]
eTutorial4	8.528725	0.003496	[[15 20] [6 38]]	[[9.30379747 25.69620253] [11.69620253 32.30379747]]
eTutorial5	7.04539	0.007947	[[15 20] [7 37]]	[[9.74683544 25.25316456] [12.25316456 31.74683544]]
eTutorial6	2.701936	0.100226	[[13 22] [9 35]]	[[9.74683544 25.25316456] [12.25316456 31.74683544]]
eTutorial7	6.986572	0.008212	[[16 19] [8 36]]	[[10.63291139 24.36708861] [13.36708861 30.63291139]]
eTutorial8	2.6687	0.10234	[[11 24] [7 37]]	[[7.97468354 27.02531646] [10.02531646 33.97468354]]

Figure 2: P-values of Chi-Square Tests Over Time provides further insights by illustrating the statistical significance of attendance variations across different sessions. Five specific sessions (eTutorial01, eTutorial02, eTutorial04, eTutorial05, and eTutorial07) show p-values below the 0.05 threshold, indicating significant differences in attendance between groups on these dates. This suggests that digital nudges may have a varying impact depending on session timing and content, highlighting the contextual sensitivity of digital nudging as observed in other studies (Weinmann et al., 2016).
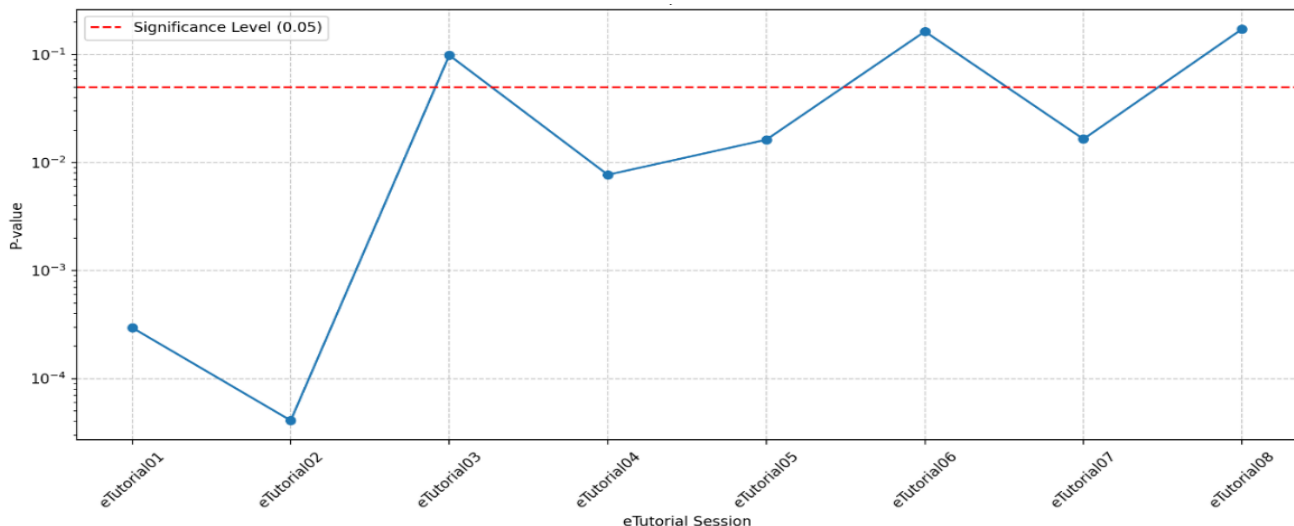

Figure 2: P-values of Chi-Square Tests Over Time

These findings align with previous studies demonstrating the effectiveness of digital nudges in educational settings. For instance, research by Patel et al. (2016) found that SMS-based nudges significantly improved attendance in primary school settings, while Damgaard and Nielsen (2018) showed similar positive effects on student engagement through digital reminders in higher education. The observed consistency in attendance improvements within our study's treatment group supports these prior results, reinforcing the value of timely digital prompts for enhancing engagement. However, unlike studies focused on general engagement metrics, such as assignment completion (York & Loeb, 2020), this research emphasizes attendance as a specific outcome, addressing a gap in digital nudging literature within ODL. By situating these findings within the broader context of digital nudging research, this study contributes unique insights into how simple, accessible platforms like WhatsApp can be tailored to address attendance challenges specifically.

The Correlation Heatmap of Attendance Patterns in Figure 3 reveals additional details about attendance behaviours within the treatment group. Figure 3 illustrates the correlation between attendance across multiple sessions for the treatment group. Positive correlations on certain dates suggest that students who attended one session were more likely to attend subsequent sessions, indicating a potential habit-forming effect driven by consistent WhatsApp reminders. This aligns with behavioural theories suggesting that repetitive cues can reinforce desirable actions over time.

However, lower or negative correlations on some dates may reflect competing demands or fluctuations in students' motivation. Positive correlations on certain dates indicate that students who attended one session were likely to attend subsequent sessions, suggesting a cumulative or habit-forming effect from regular digital nudges. This finding aligns with theories linking repetitive cues to habit formation, supporting the view that consistent reminders can reinforce attendance behaviours over time (Damgaard & Nielsen, 2018). Lower or negative correlations on some dates could indicate competing demands or variations in motivation, which may have impacted students' ability or desire to attend.
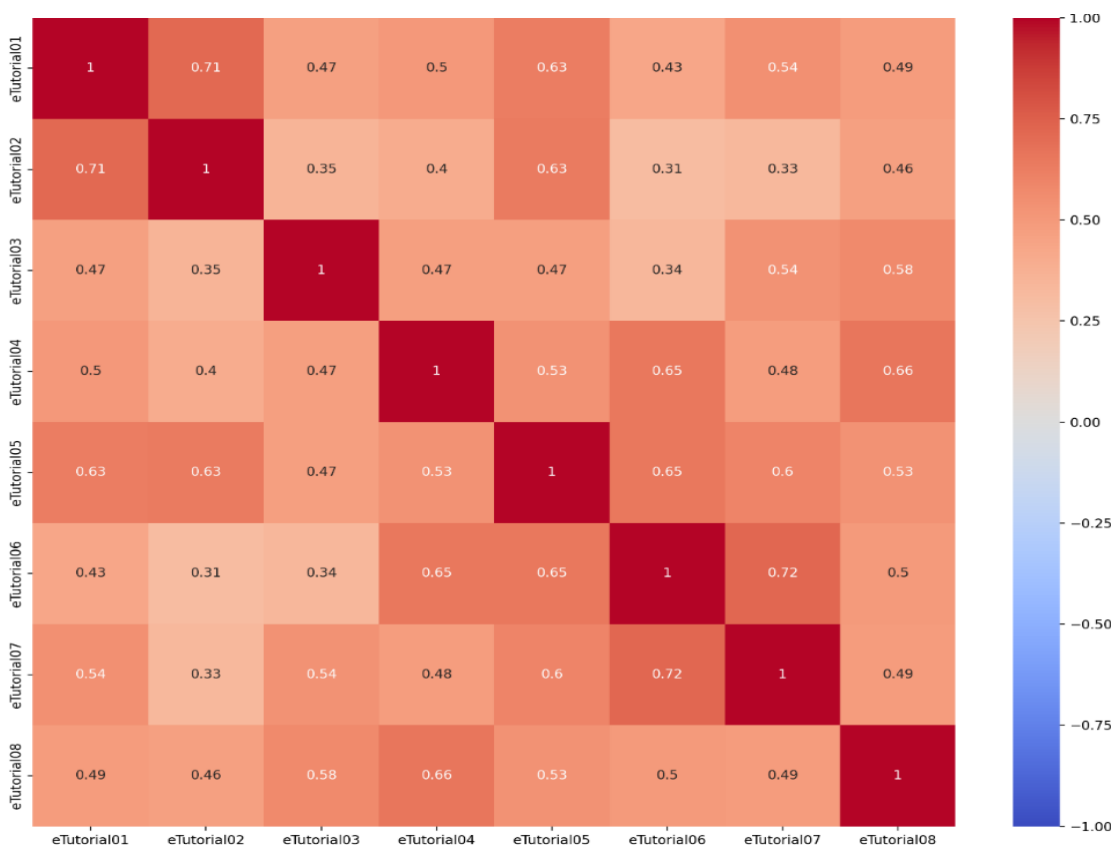

Figure 3: Correlation Heatmap of Attendance Patterns

The Attendance Rates and Difference Over Time chart in Figure 4 offers a side-by-side comparison of attendance rates, highlighting the persistent gap between the treatment and control groups. On most dates, the treatment group maintained consistently higher attendance rates, reinforcing the hypothesis that digital nudges help sustain

attendance across multiple sessions. This pattern suggests that digital nudges can effectively reinforce engagement even in an asynchronous and self-paced ODL setting (Sunstein, 2014).
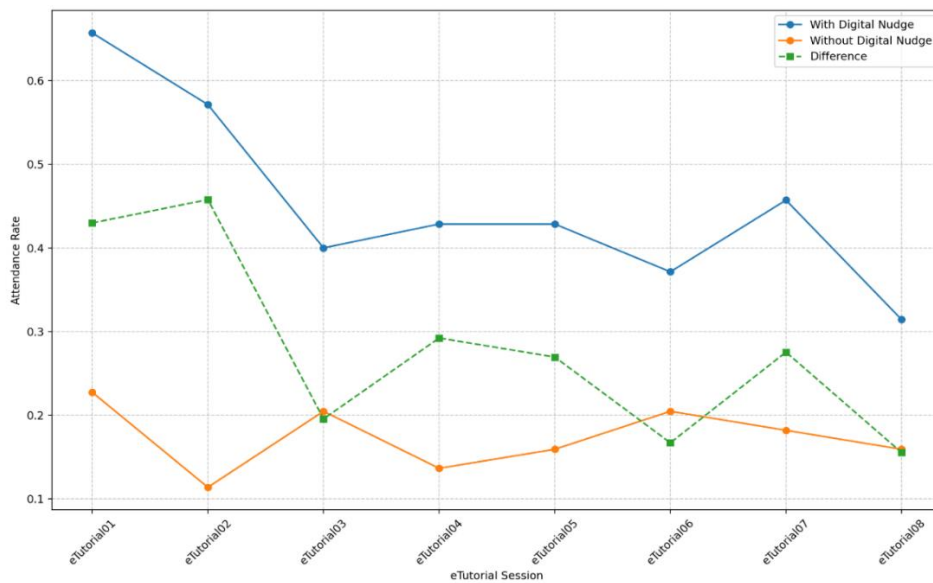

Figure 4: Attendance Rates and Difference Over Time

These results underscore WhatsApp reminders' potential to enhance attendance in ODL environments. The attendance increases observed in the treatment group suggest that digital nudges, when delivered through commonly used platforms like WhatsApp, can bridge engagement gaps in online learning, where the lack of physical presence may reduce students' accountability (Stone & Springer, 2019). This supports Transactional Distance Theory (Moore, 1993), which posits that reducing psychological distance through structured communication can strengthen students' sense of connection to their coursework.

However, the variability in effectiveness across sessions indicates that while digital nudges generally improve attendance, their impact may be influenced by external factors such as timing, session relevance, and personal commitments. Understanding these dynamics could inform the design of more targeted nudging strategies to maximise engagement in different educational contexts.

Future Research Directions

The findings of this study highlight several areas for future exploration, both to address limitations and to advance the understanding of digital nudging:

1. **Personalisation of Nudges:**

As the results demonstrate variability in student responsiveness, future studies should explore how personalised nudges tailored based on individual characteristics such as engagement levels or motivational profiles could optimize effectiveness. Leveraging AI and learning analytics may facilitate the customization of nudging strategies.

2. **Alternative Platforms and Channels:**

While WhatsApp proved effective, exploring alternative platforms such as email, SMS, or social media could offer insights into the most suitable communication methods for diverse student groups or settings.

3. **Long-Term Impacts:**

The habit-forming potential of nudges, suggested by positive correlations in attendance patterns, warrants further investigation. Longitudinal research could assess whether consistent nudges lead to sustainable behavioural changes or if their effects diminish over time.

4. Exploration of Ethical Concerns:

Ethical considerations, including transparency and autonomy, remain critical. Future research should evaluate student perceptions of nudges, ensuring these interventions are viewed as supportive rather than intrusive.

5. Broader Educational Settings:

The scalability of nudging strategies across various educational contexts, such as K-12 education or professional training, should be examined to establish their broader applicability and effectiveness.

Future research could refine digital nudges by personalizing interventions based on individual needs, exploring alternative platforms like email or social media, and investigating their long-term effects on habit formation and sustained engagement. Addressing ethical concerns, such as transparency and autonomy, would ensure nudges are supportive rather than intrusive. Expanding applications to diverse educational settings, including K-12 and professional training, could enhance scalability and validate their effectiveness, making digital nudges a more versatile tool for improving engagement and outcomes in various learning environments.

The quasi-experimental design used in this study enhances the practical implications of these findings, showing that interventions like WhatsApp reminders can be integrated with minimal disruption to existing educational practices. These insights underscore the feasibility and scalability of digital nudges as an effective tool for educators and institutions addressing attendance challenges in online education, particularly in ODL settings. Future research might explore ways to personalise digital nudges based on session content or individual preferences, potentially enhancing the effectiveness of these strategies in fostering sustained engagement.

CONCLUSION

This study demonstrates that digital nudges, specifically WhatsApp reminders, significantly improve student attendance in an ODL environment. Students who received regular WhatsApp reminders consistently attended more e-tutorial sessions than those who did not, suggesting that simple, accessible digital interventions can play an impactful role in enhancing engagement in virtual classrooms. By reducing the psychological distance between students and their coursework, these reminders foster a sense of accountability and connection, supporting the principles of Transactional Distance Theory (Moore, 1993).

The results underscore the potential for digital nudges to address attendance challenges in online education. However, the variability in effectiveness across sessions highlights the importance of timing and context in designing effective digital nudging strategies. Future research should consider these dynamics more closely, exploring how factors such as timing, personalisation, and message frequency may optimise nudging effects in diverse educational settings.

As a scalable and low-cost tool, WhatsApp-based nudging holds promise for broader applications within digital education. By leveraging platforms that are widely accessible and familiar to students, educational institutions can adopt nudging strategies with minimal disruption to existing practices. Future studies might investigate ways to personalize nudges based on individual student characteristics, course requirements, or session content to enhance engagement even further. Overall, this study provides a foundation for using digital nudges in ODL and similar contexts, offering practical insights for institutions aiming to enhance student participation and engagement through innovative, digital means.

REFERENCES

1. Arslan, B. and Finn, B. (2023). The effects of personalized nudges on cognitively disengaged student behaviour in low-stakes assessments. Journal of Intelligence, 11(11), 204.
2. Blondeel, E., Everaert, P., & Opdecam, E. (2023). A little push in the back: nudging students to improve procrastination, class attendance and preparation. Studies in Higher Education, 49(11), 2016-2035.
3. Blumenstein, M., Liu, D. Y. T., Richards, D., Leichtweis, S., & Stephens, J. W. W. (2018). Data-informed nudges for student engagement and success. Learning Analytics in the Classroom, 185-207.

4. Brown, A., Lawrence, J., Basson, M., Axelsen, M., Redmond, P., Turner, J., … & Galligan, L. (2022). The creation of a nudging protocol to support online student engagement in higher education. Active Learning in Higher Education, 24(3), 257-271.

5. Cardenas Canto, P., Dimitrova, V., Sherman, S., & Flint, S. W. (2024). Does personality matter: examining the value of personality insights for personalized nudges that encourage the selection of learning resources. Frontiers in Artificial Intelligence, 7.

6. Credé, M., Roch, S. G., & Kieszczynka, U. M. (2010). Class Attendance in College: A Meta-Analytic Review of the Relationship of Class Attendance with Grades and Student Characteristics. Review of Educational Research, 80(2), 272–295.

7. Damgaard, M. T., & Nielsen, H. S. (2018). Nudging in Education. Economics of Education Review, 64, 313–342.

8. García-Morales, V. J., Garrido-Moreno, A., & Martín-Rojas, R. (2021). The Transformation of Higher Education after the COVID Disruption: Emerging Challenges in an Online Learning Scenario. Frontiers in Psychology, 12, 616059.

9. Gerver, M., Banerjee, S., & John, P. (2024). Nudging against consent is effective but lowers welfare. Scientific Reports, 14(1).

10. Kay, E. and Bostock, P. (2023). The power of the nudge: technology driving persistence. Student Success, 14(2), 8-18.

11. Kay, E. and Bostock, P. (2023). The power of the nudge: technology driving persistence. Student Success, 14(2), 8-18.

12. Leimstädtner, D., Sörries, P., & Müller-Birn, C. (2023). Investigating responsible nudge design for informed decision-making enabling transparent and reflective decision-making. Mensch Und Computer 2023, 220-236.

13. Leimstädtner, D., Sörries, P., & Müller-Birn, C. (2023). Investigating responsible nudge design for informed decision-making enabling transparent and reflective decision-making. Mensch Und Computer 2023, 220-236.

14. Lim, K. K. and Lee, C. S. (2022). Nudging learning behaviour: a systematic review. Proceedings of the Association for Information Science and Technology, 59(1), 744-746.

15. Matz, R. L., Mills, M., Derry, H. A., Hayward, B. T., & Hayward, C. (2024). Viewing tailored nudges is correlated with improved mastery-based assessment scores. British Journal of Educational Technology, 55(5), 1841-1859.

16. d, C. (2024). Viewing tailored nudges is correlated with improved mastery-based assessment scores. British Journal of Educational Technology, 55(5), 1841-1859.

17. Matz, R. L., Mills, M., Derry, H. A., Hayward, B. T., & Hayward, C. (2024). Viewing tailored nudges is correlated with improved mastery-based assessment scores. British Journal of Educational Technology, 55(5), 1841-1859.

18. Moore, M. G. (1993). Theory of transactional distance. In Theoretical Principles of Distance Education (pp. 22-38). Routledge.

19. Moya, A., Rozo, S. V., & Urbina, M. J. (2023). The fine line between nudging and nagging: increasing take-up rates through social media platforms.

20. Nedungadi, P., Mulki, K., & Raman, R. (2017). Improving educational outcomes & reducing absenteeism at remote villages with mobile technology and WhatsApp: findings from rural India. Education and Information Technologies, 23(1), 113-127.

21. Patel, R., Cortes, R. D., Wu, K., & Minges, E. (2016). Improving Attendance in Primary Schools: The Role of Text Messaging. Journal of Educational Psychology, 108(5), 677-691.

22. Plak, S., Klaveren, C. v., & Cornelisz, I. (2022). Raising student engagement using digital nudges tailored to students' motivation and perceived ability levels. British Journal of Educational Technology, 54(2), 554-580.

23. Plak, S., Klaveren, C. v., & Cornelisz, I. (2022). Raising student engagement using digital nudges tailored to students' motivation and perceived ability levels. British Journal of Educational Technology, 54(2), 554-580.

24. Rabotapi, T. and Matope, S. (2024). Whatsapp as a tool to facilitate continued adjustment of first time entering students into university during covid–19 lockdown restrictions. Electronic Journal of E-Learning, 22(8), 01-11.

25. Ruochun, W., Abusafia, A., Lakhdari, A., & Bouguettaya, A. (2022). The nudging effect on tracking activity. Proceedings of the 2022 ACM International Joint Conference on Pervasive and Ubiquitous Computing.

26. Ryu, J. (2024). Digital nudge and normality of decision making in digital healthcare. Research Institute for Life and Culture So gang University, 72, 1-17.

27. Sadeghian, A. H. and Otarkhani, A. (2023). Data-driven digital nudging: a systematic literature review and future agenda. Behaviour &Amp; Information Technology, 1-29.

28. Stone, C., & Springer, M. (2019). Interactivity, Connectedness and 'Teacher-Presence': Engaging and Retaining Students Online. Australasian Journal of Educational Technology, 35(1), 75-88.

29. Sunstein, C. R. (2014). Why Nudge? The Politics of Libertarian Paternalism. Yale University Press.

30. Thaler, R. H., & Sunstein, C. R. (2008). Nudge: Improving Decisions About Health, Wealth, and Happiness. Penguin Books.

31. Tor, A. (2023). Digital nudges: contours and challenges. Economic Analysis of Law in European Legal Scholarship, 3-18.

32. Valta, M., Menzel, J., Maier, C., Pflügner, K., Meier, M., & Weitzel, T. (2022). Digital nudging. Proceedings of the Conference on Computers and People Research, 1-10.

33. Vese, D. (2022). Nudge: the final edition edited by richard h thaler and cass r sunstein, London: allen lane, penguin, 2021, edition final, xiv + 366 pp. European Journal of Risk Regulation, 13(2), 350-355.

34. Weijers, R. J., de Koning, B. B., Scholten, E., Wong, L., & Paas, F. (2024). "Feel free to ask": nudging to promote asking questions in the online classroom. The Internet and Higher Education, 60, 100931.

35. Weijers, R., Koning, B. B. d., & Paas, F. (2020). Nudging in education: from theory towards guidelines for successful implementation. European Journal of Psychology of Education, 36(3), 883-902.

36. Weinmann, M., Schneider, C., & vom Brocke, J. (2016). Digital Nudging. Business & Information Systems Engineering, 58(6), 433-436.

37. York, B. N., & Loeb, S. (2020). One Step at a Time: The Effects of an Early Literacy Text Messaging Program for Parents of Preschoolers. Journal of Human Resources, 55(3), 734-764.