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Exploring Gender Gaps in Smartphone Usage-Ownership Patterns Among Science Teachers: A Case Study of Zimbabwe

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Abstract

Using Zimbabwe as an LMIC case and guided by the Adaptive Structuration Theory for Individuals, the study was carried out to determine the gender gap in smartphone usage-ownership patterns for science teachers in LMICs. A descriptive survey design was used in this study. Data was collected using an online questionnaire which was completed by 179 science teachers. Findings from the study show that the average gender gap in smartphone ownership by science teachers in Zimbabwe is 5% and the average gender gap in smartphone use is 29%. Smartphone use for leisure purposes has the highest gender gap while access to social media is the lowest. The use of smartphones as instructional interface devices is still very low and the corresponding 27% gender gap is too high compared to the gap in ownership. The findings revealed that male science teachers dominate in both smartphone ownership and use in LMICs where Zimbabwe is used as a case. The study recommends that LMICs' science curricula should be tailored in compliance with Industry 4.0 dictates as a way of closing the gender gap in smartphone use and ownership.

Keywords: gender gap, digital divide, cyber-physical system, smartphone, digital instruction, interface device, lower middle income.

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1. Introduction

Smartphones have emerged as the predominant technology especially in Lower-Middle-Income Countries (LMICs) with ownership of the devices having increased significantly over the past decade (Olson et al., 2022). Statistics of ownership of such devices is however skewed along gender lines, with women being 8% less likely to own mobile devices compared to man as per 2020 global statistics(Rowntree & Shanahan, 2020).Such skewed statistics have worsened the digital divide, a social parameter linked to variation in the amount of information between those individuals with access to the information society and information and communication technologies (ICTs) and those who do not (Afzal et al., 2023). Advances are nonetheless being made to normalize the ownership statistics, mainly through accelerating affordability of the devices (Karisson et al., 2017), so that everyone can experience the same technological benefits of the devices irrespective of such differences as gender. Generally, societal norms and values that favor male dominance are known to compound high costs of ICT devices thereby exacerbating gender inequalities in accessing the devices (Karisson et al., 2017). The inequalities are in turn known to have significant political and economic consequences (Fröhlich, 2019). If not tamed, especially in Lower-Middle-Income Countries (LMICs) like Zimbabwe, the inequalities may further widen the already large gender gap that currently stands at 71% for political empowerment and 47% for economic empowerment (World Economic Forum, 2021). Gender gap refers to the difference between women and men as reflected in their attainments or attitudes (Harris, 2017). A narrow gender gap is known to favor economic growth, with high-female-share industries known to grow relatively faster in countries with narrow gender gaps (Bertay et al., 2021). Therefore, any measure that works to close the gender gap is useful (Karisson et al., 2017) for both political and economic empowerment, economic growth is considered in this study.

Closing the gender gap in education, particularly science education, is crucial for economic growth since inequality in education directly affects economic growth by lowering the average level of human capital for the industry (Klasen, 2002). In doing so, there is a need to ensure that curricula conform to dictates of Industry 4.0. Vandenberg (2020) defined as a new way of describing the blurring of boundaries between the physical, digital, and biological worlds. Industry 4.0 includes cyber-physical systems, automation, and the internet of things (IoT) that enable the creation of smart factory environments that might have a massive impact on industrial efficiency and productivity (Rojas & Ruiz Garcia, 2020). In science education,

smartphones align with Industry 4.0 as cyber-physical educational systems that offer convenience, creativity and instant access to vast resources that can transform learning (Dias & Victor, 2017; Manyeredzi, 2021).

Despite their benefits as cyber-physical educational systems, smartphones in LMICs show an 8% gender gap in use and ownership (Fitzgerald et al., 2019; Smith, 2008) thereby reinforcing economic gender inequality. In low- and middle-income countries (LMICs) such as Zimbabwe, structural challenges including economic instability, low teacher salaries and inconsistent Information and Communication Technology (ICT) infrastructure affect the adoption and effective use of these technologies. Zimbabwe's economic conditions have led to disparities in smartphone ownership among teachers, as purchasing power varies significantly across different qualification levels. Additionally, limited government funding for ICT in education further exacerbates these disparities, mirroring challenges faced by other African nations.

Across the continent, several studies have highlighted barriers to ICT adoption in education. Kassa et al. (2014) examined Ethiopian ICT challenges, identifying cost, lack of training, and infrastructural constraints as key impediments to digital integration. Similarly, in South Africa, Makoe (2016) explored efforts toward inclusive mobile learning, noting the importance of affordable access and localized content in fostering equitable technology use in education. These studies provide a broader African context that aligns with Zimbabwe's situation, where cultural, economic, and gender-based factors shape the adoption of smartphones among science teachers. The limited literature on smartphone use-ownership in LMIC schools creates a knowledge gap in its distribution, especially in technologically lagging schools. In Zimbabwean schools, 87% of science teachers own smartphones (Manyeredzi, 2021), but gender distribution is unclear, with usage favoring socialization over academics and varying by age.

Existing literature on gender and smartphone use-ownership focuses on learners, ignoring teachers, key to the teaching-learning process (Chen et al., 2017a; Nayak, 2018; Taywade & Khubalkar, 2019; Van Deursen et al., 2015). It is against this background that the current study examined the gender gap in smartphone ownership and usage among science teachers in LMICs, using Zimbabwe as a case. The study aims to address the following main research question:

- What are the prevalence and patterns of smartphone ownership and use among science teachers in LMICs, and how do these vary with gender?

2. Theoretical framework: The Adaptive Structuration Theory for Individuals (ASTI)

To comprehend gender differences in smartphone use and ownership among LMIC science teachers, an analysis of actor-institution interactions and social behavior is required. This can be achieved by analyzing processes that take place at the interface between the actor (smartphone user) and the institutions (structure) are fully explored. The interface at which an actor meets a structure is termed 'structuration', where structures are maintained and adapted through the exercise of individual expression of will (agency) (Turner et al., 2019). Agency lies in individual action within structure (Dixon et al., 2014), not intentions (King, 2010), as per Giddens' structuration theory (ST). Agency therefore lies in the possibility of individual action within the structure (Dixon et al., 2014) and not the intentions people have in doing things (King, 2010). This forms the basis of the structuration theory (ST). The ST suites well as footing for this study as it allows a "higher level of synthesis that permits us to see the connection between ongoing human activities, social processes, contexts of use, and enduring social structures", (Albano et al., 2010). The ST views technology users as operators within societal rules, reinforcing structures through compliance. However, it's less effective in modeling technology-society connections. The adaptive structuration theory (AST) is more suitable, focusing on technology appropriation and change in social setups (Greenhalgh & Stones, 2010).

The AST is a pragmatic approach that models the reciprocal relationship between information technologies (smartphones), social structures, and human activities in context (Lethbridge, 2003). Nonetheless, AST models adaptation and change at a level beyond individuals hence further narrowed it to become the adaptive structuration theory for individuals (ASTI) that was adopted in this study. ASTI acknowledges, the major limitation of the preceding theories, that individuals uniquely internalize a broad range of structural influence from technologies that include gender and ethnic stereotypes, politeness and reciprocity, and even personality (Nass & Moon, 2000). According to the ASTI, ICT-facilitated social interactions follow the sequence;

$$\text{input} \rightarrow \text{process} \rightarrow \text{output}$$

Figure 1. *ICT-facilitated social interactions sequence*

Technology, task, and individual characteristics form the input, while adaptation of both technology and task is the process, constrained by individual traits within society, leading to an output relevant to society. Adaptation is thus exploitative (standard use of technology) and/or

exploratory (innovative use of technology) (Hah et al., 2019). Structures for adaptation are either transient or persistent, influencing performance outcomes. Only if these outcomes conform with prescribed rules can a smartphone user's behavior be considered orthodox. **Erreur ! Source du renvoi introuvable.** is a schematic diagram summarizing the smartphone-facilitated social interactions sequence as modelled by the ASTI.

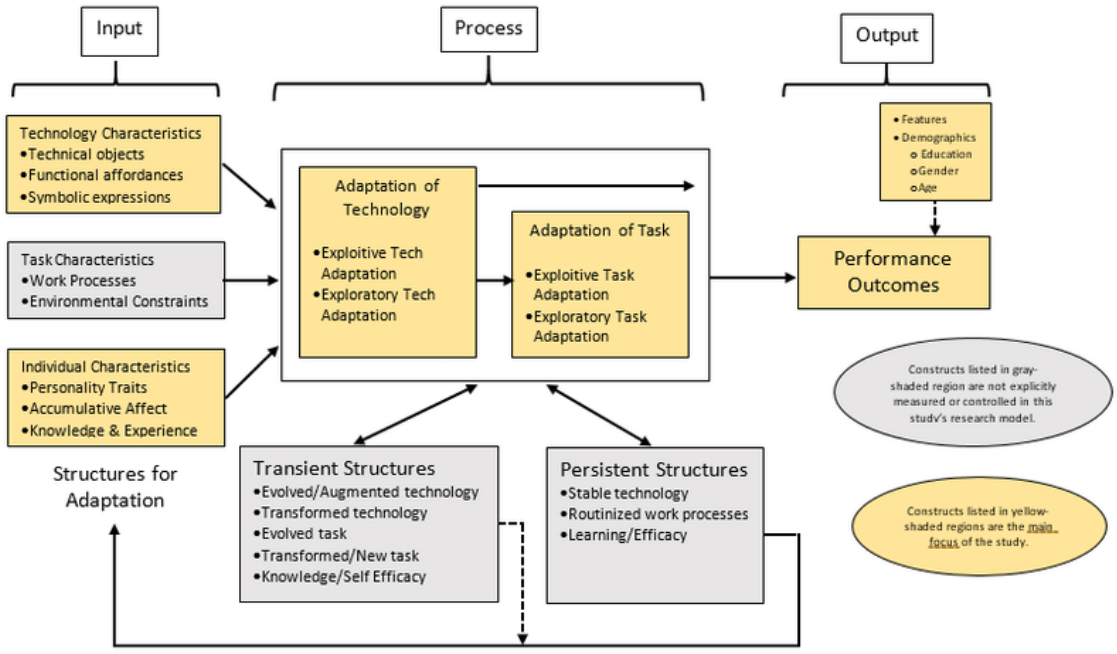


Figure 2. *Schematic diagram of the adaptive structuration theory for individuals (Trapero, 2018)*

The ASTI model, summarized in Figure 2, views smartphone characteristics, task attributes, and teacher traits as inputs, processed to adapt the smartphone within societal norms. As schools and society are linked (Fowler, 2011), compliant behavior reinforces societal structures, making performance outcomes acceptable. Non-compliance labels the user deviant. This study explores the gender gap in smartphone ownership and use by science teachers in LMICs, based on the ASTI model.

3. Methodology

Data was collected using a descriptive survey design within a quantitative research approach, chosen for its robustness in handling statistical data and identify frequencies, trends, and categories. An online questionnaire was developed using the Kobo Toolbox online survey application. The questionnaire was optimized for compatibility with smartphones and randomly distributed through online platforms that included e-mail, WhatsApp, Twitter and Facebook that are popular among teachers in Zimbabwe. Closed-ended questions constituted the questionnaire

that was tailored to lead respondents into addressing researchers' interests on the smartphone-facilitated social interaction sequence that culminates in performance outcomes as depicted in **Erreur ! Source du renvoi introuvable.**. Sex, age and type of smartphone use were of particular interest in this study.

The target group was 600 secondary school science teachers who had graduated from one of the universities in Zimbabwe. The science teachers were from the ten provinces in Zimbabwe. Proportional stratified random sampling was used to select 350 science teachers from a population of 600 across 10 provinces in Zimbabwe. The population was divided into 10 strata based on province. The proportion of teachers in each province was calculated relative to the total, and this proportion is multiplied by 350 to determine the number of teachers to sample from each province. In each province, simple random sampling is used to select the required number of teachers, ensuring an equal chance of selection. Randomly selecting participants from the population was done by gathering email lists and then randomly select a certain number of contacts. The selected teachers from each province are then combined to form the final sample (350). However, during the questionnaire distribution only 315 acknowledged the receipt of the questionnaires. Out of the 315, 179 responded to the questionnaire.

4. Data Analysis Procedures

The type of smartphone use was categorized into socialization/communication and academic use. Socialization/communication included social networking (WhatsApp, Facebook, Twitter), reading news, and gaming, while academic use involved teaching (instructional interface, accessing teaching aids) and career advancement (self-capacitation for promotion or career change).

Composite graphs were plotted to show weighted percentages of male and female smartphone users for socialization/communication and academic use by age. Weighted percentages were calculated by separately determining the percentage of male and female users for each category, then averaging them by age group.

5. Results

Data collected for exploring gender gaps in smartphone use-ownership patterns for science teachers is presented in this section.

5.1. Average Completion Rate

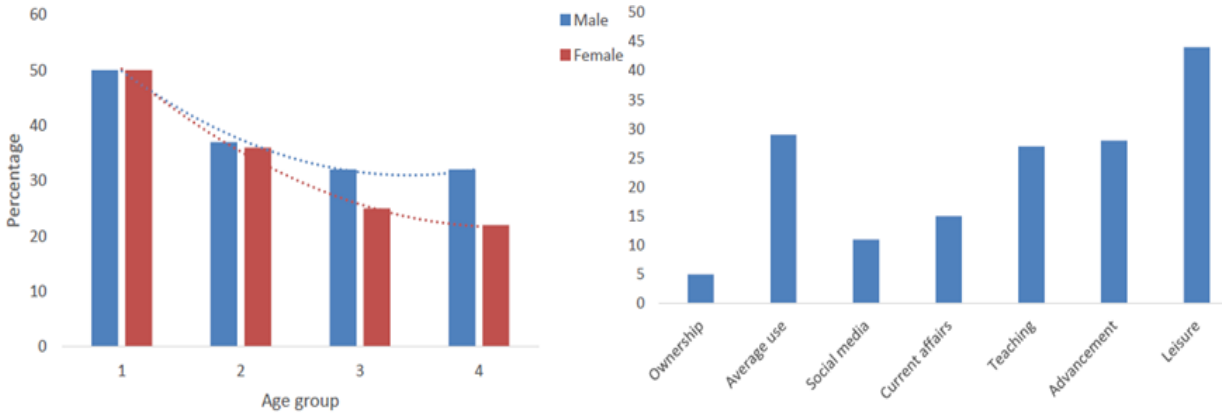
Erreur ! Source du renvoi introuvable. is a statistical summary of data obtained from the study.

Table 1. *Statistical data obtained from the survey*

Age group		1		2		3		4		Average (%)	
Gender		M	F	M	F	M	M	F	M	F	M
Number of respondents		37	40	27	27	15	37	40	27	27	15
Smartphone ownership (%)		50	50	37	36	32	50	50	37	36	32
Device used on questionnaire	Smartphones/Tablet	33	40	25	26	10	33	40	25	26	10
	Computer	4	0	2	1	5	4	0	2	1	5
Frequency of smartphone use (%)	Daily	50	50	45	50	29	50	50	45	50	29
	Occasionally	0	0	1	4	20	0	0	1	4	20
Type of use (%)	Social media	46	52	32	51	39	46	52	32	51	39
	Current affairs	20	4	43	16	43	20	4	43	16	43
	Teaching	26	17	38	20	28	26	17	38	20	28
	Advancement	51	34	57	19	39	51	34	57	19	39
	Leisure	52	48	43	16	42	52	48	43	16	42
Average use (%)		34	30	38	24	32	34	30	38	24	32

5.2. Gender Variation of Smartphone Ownership with Age and Ownership-Use Gender Gap Distribution

The detailed pattern of the variation how smartphone ownership varies with age and gender as shown on Erreur ! Source du renvoi introuvable.a and 3b.

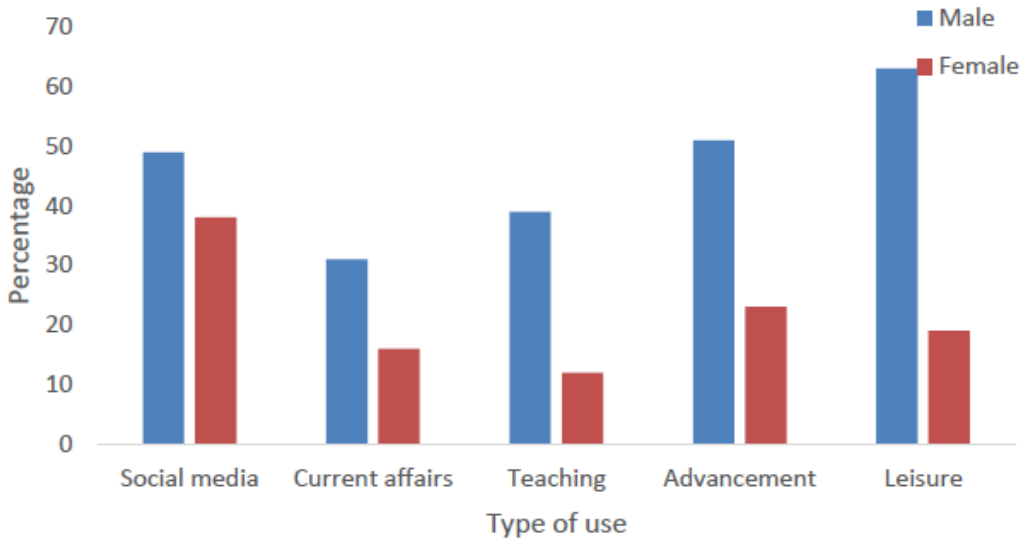


(a) (b)

Figure 3. *Variation of smartphone ownership with age of science teachers and ownership-use gender gap distribution profile.*

5.3. Gender Distribution of Smartphone Use by Science Teachers

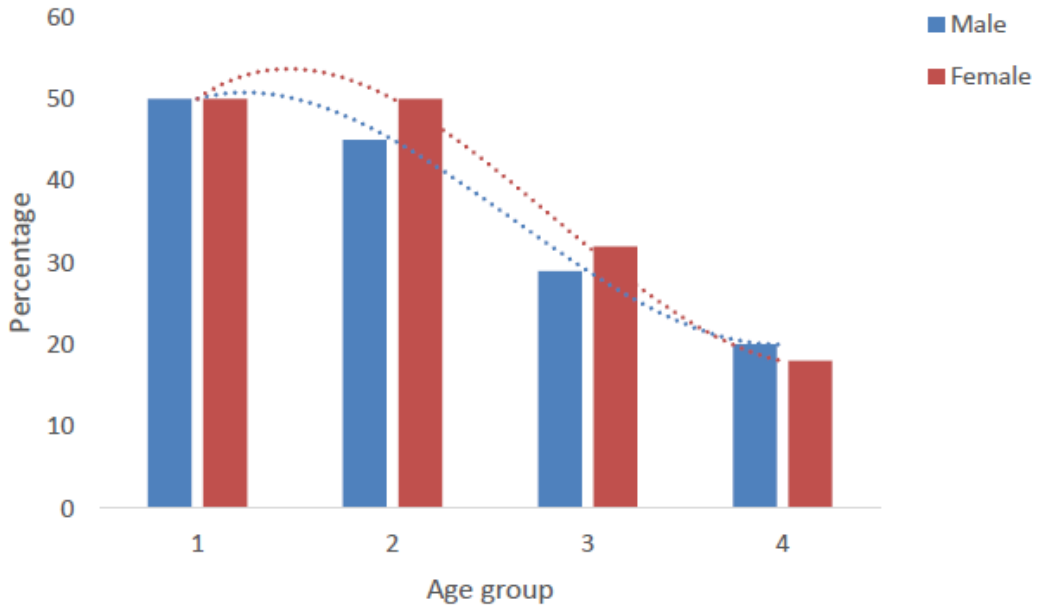
Overall smartphone use by both male and female science teachers in Zimbabwe is presented graphically on **Erreur ! Source du renvoi introuvable.**.



Figures 4. *Gender distribution profile for smartphone use by science teachers*

5.4. Frequency of Use Distribution Pattern

Frequency of use distribution profile is presented on **Erreur ! Source du renvoi introuvable.**.



Figures 5. *Graph showing variation of the frequency of smartphone use with age*

5.5. Smartphone Use to Access Social Media

Erreur ! Source du renvoi introuvable. is a smartphone use distribution profile for accessing social media.

Erreur ! Source du renvoi introuvable.

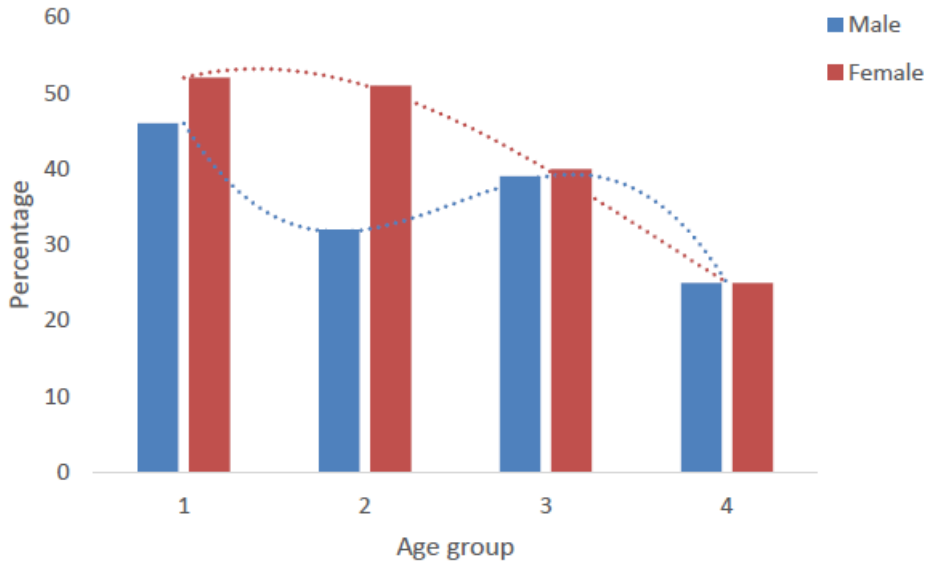


Figure 3. *Distribution pattern for social media use*

5.6. Use of Smartphones to Read Current Affairs

The age-gender distribution profile for smartphone use to access current affairs via the internet is presented on **Erreur ! Source du renvoi introuvable.**.

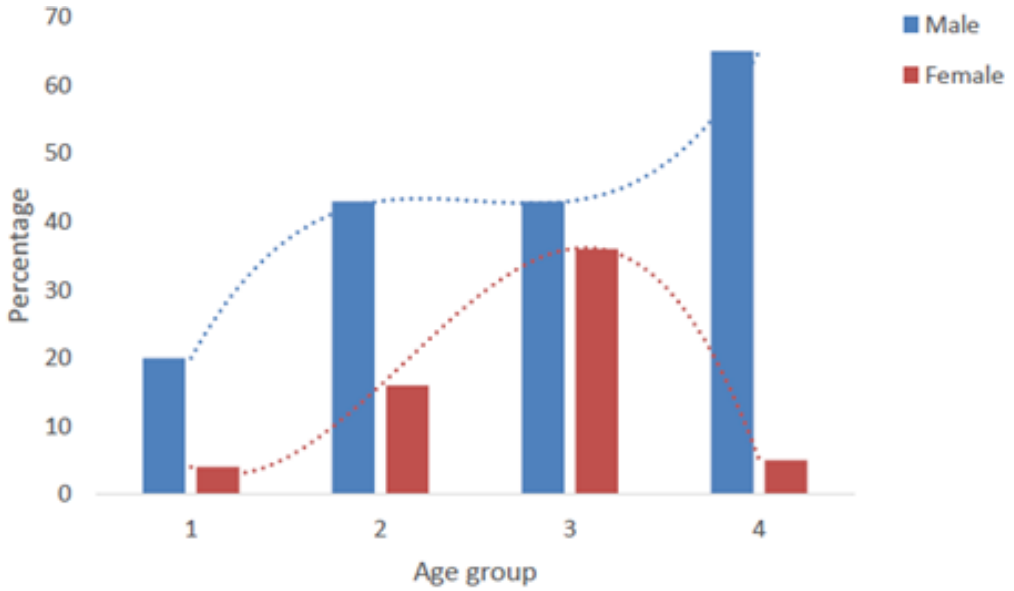


Figure 4. *Age-gender distribution profile for reading current affairs*

5.7. Use of Smartphones as DIIDs

The age-gender distribution profile for smartphone use as digital instruction interface devices (DIIDs) is shown on **Erreur ! Source du renvoi introuvable.**.

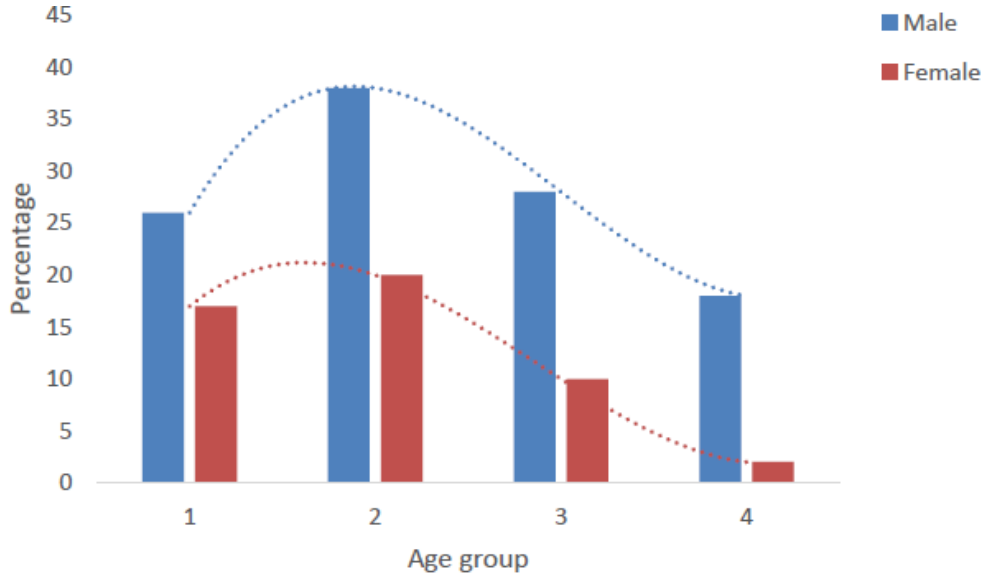


Figure 5. *Age-gender distribution profile for smartphone use as medium for teaching-learning.*

5.8. Career Advancement

Erreur ! Source du renvoi introuvable. is the age-gender distribution profile for smartphone use in career advancement by the respondents.

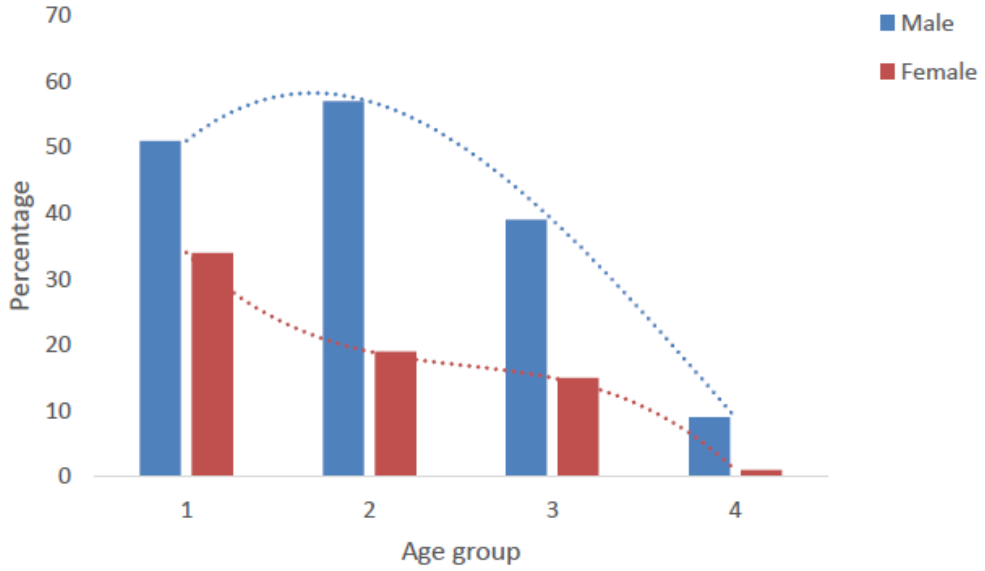


Figure 6. *Graph showing age-gender distribution profile for smartphone use in career development*

5.9. Smartphone Use for Leisure

Erreur ! Source du renvoi introuvable. is the age-gender distribution profile for science teachers who use smartphones to access leisure material.

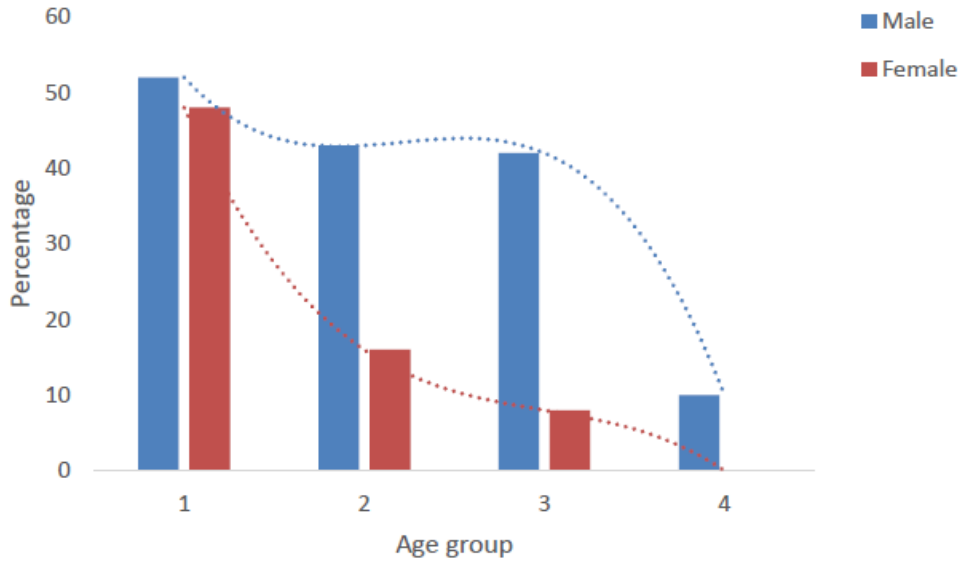


Figure 7. *Age-gender distribution profile for science teachers using smartphones to access leisure material*

6. Discussion

Results show that male and female science teachers in Zimbabwe exhibit statistically significant differences in smartphone ownership and usage. The results also show that irrespective of gender, the primary purpose of smartphone use among science teachers is not teaching but rather personal communication and entertainment.

6.1. Average Completion Rate

A total of number of 315 teachers confirmed having received the online questionnaire of which 179 (88 male and 91 female) completed the questionnaire translating to an average completion rate of 56%. The 56% completion rate indicates a strong preference for traditional data collection methods by group 4 participants who constituted the 46% non-completion rate with 35% opting for in-person interviews (14% female and 21% male) and 11% requesting hardcopy questionnaires (8% female and 3% male). The non-completion raised concerns about digital fatigue, anxiety or unfamiliarity with online technologies as well as ease of response, all which were attributed to technophobia as the main reason for not completing the online questionnaire. The completion rate varied with age with early career teachers (age group 1) constituting the greatest portion that gradually decreased to age group 4.

Statistics on **Erreur ! Source du renvoi introuvable.** show that 89% female science teachers used smartphones for the exercise against 81% for male science teachers. This gives an 8% gender gap in smartphone use for online surveys that favor females. This is in line with findings by Fitzgerald et al., (2019a) and Smith (2008) that women are more likely to participate in online surveys than men. Participation in the online survey indirectly reflects on smartphone ownership patterns. However, some participants used computers instead. The 56% completion rate is indicative of the exploratory use among respondents who adapted to online data collection methods. The gender gap (8% favoring females) reflects the differences in how males and females adapt to digital tools for specific purposes. Female teachers might be more inclined to explore new methods of engagement, reflecting higher adaptability to online surveys.

6.2. Ownership Trends

The results show that male science teachers dominate in smartphone ownership with early carrier teachers ranking highest.

6.2.1. *Gender Variation of Smartphone Ownership with Age*

Smartphone ownership varied quadratically with both age and gender of the science teachers (see Figure 3a). Early career science teachers are the highest in terms of ownership ranking with late career teachers being the lowest where male teachers dominate the overall statistics. Trend lines for the age variation show that variation is comparatively gentle for female teachers (gently dropping from 50% for early career teachers to 22% for late career teachers) while steep for the male teachers (steeply dropping from 50% to 32%). The gender gaps are as follows; 0% (50% both male and female) for age group 1, 1% (37% male and 36% female) for age group 2, 7% (32% male and 25% female) for age group 3 and 10% (32% male and 22% female) for age group 4. This gives an average gender gap of 5% in smartphone ownership thus addressing part of the research question on prevalence of smartphone ownership. The **quadratic variation in ownership** based on age highlights **exploitative use** where older male teachers are less likely to adopt smartphones for teaching purposes, showing how technology is exploited based on entrenched roles in the education system. Conversely, **younger teachers** (female or male) are exploring smartphones more frequently across diverse uses (teaching, leisure, career advancement).

6.2.2. *Ownership-Use Gender Gap Distribution*

Figure 3b shows that the average gender gap in smartphone ownership among science teachers is very small, 5%, while the corresponding average gender gap in smartphone use is significantly high at 29%. Gender gaps in smartphone use are generally below the 29% average with only the exception of leisure that exceeds the average by 15%. This shows that male science teachers use smartphones more for leisure purposes than female teachers while the gender gap in social media use is the lowest at 11%. The gender gap in the use of smartphones as instructional interface is 27% against an ownership gap of 5%. This shows that female science teachers use their smartphones for other purposes other than teaching more than their male counterparts. The gender gap indirectly supports the notion that boys and male teachers use technology while girls and female teachers do not. The findings of the study are in line with Manyilizu and Gilbert (2015) who reported that male teachers seem to use ICT tools than females in science subjects. The overall gender gap in smartphone use (29%) reflects how men and women exploit smartphones in different ways, with males leaning more towards leisure activities, and females using smartphones more for social media and communication. The

disparity indicates how exploitative use is influenced by gender norms and how technology is appropriated based on societal roles.

6.3. Usage Patterns

The results also show that male science teachers dominate in smartphone use and early carrier teachers also rank highest.

6.3.1. *Gender Distribution of Smartphone Use by Science Teachers*

Male science teachers are the most dominant smartphone users with statistics showing that males dominate in all forms of smartphone use. **Erreur ! Source du renvoi introuvable.** shows that smartphone use is prevalent in male science teachers than it is in their female counterparts. Smartphone use for leisure is most popular among male science teachers (63%) while social media access is the most common for female science teachers (38%). The average gender gap is 25%, a value that is too big showing that smartphones use for accessing leisure material is less popular amongst female science teachers than it is in their male counterparts. The findings show an exploitative use by male teachers, who predominantly use smartphones for leisure activities, compared to female teachers who explore smartphones for social media or teaching purposes. These variations illustrate the extent to which gender roles and career stages influence technology adaptation.

On the other hand, smartphone use for reading current affairs is the least common among male science teachers (31%) while teaching is the least common among female science teachers (38%). The gender gaps for smartphone use are; 11% (49% male and 38% female) for social media, 15% (31% male and 16% female) for reading current affairs, 27% (39% male and 12% female) for teaching,28% (51% male and 23% female) for personal advancement and 44% (63% male and 19% female) for accessing leisure material like games, music and videos. This gives an average gender gap of 29% in overall smartphone use thereby addressing part of the research question on smartphone usage patterns and gender variation with gender. The dominance of men in smartphone use agrees with findings by Chen et al. (2017) and Sarraute et al (2014), which the later even identified as a precursor to addictions. Moreso, the dominance of male science teachers in using smartphones for leisure purposes agrees with findings by Lopez-Fernandez et al (2018) and Sama et al (2020) who concluded that males are more dominant users of gaming applications on smartphones than females.

Now considering the average gender gap in smartphone use for personal development (28%), this can be attributed to a higher job satisfaction that is characteristic of women as identified by Miao et al (2017) as well as Redmond & Mcguinness (2019) who also concluded that women have greater job satisfaction than men. Dissatisfaction with a job is among reasons behind career advancement hence a high job satisfaction in female science teachers results in lower chances of career advancement using smartphones as is shown by the statistics from the study. Bearing in mind that the teacher is central to every curriculum implementation exercise, the gender gap in smartphone use for teaching and learning therefore gives a picture of the nature of gender bias in technology use in science education. Based on findings of this study, the gender gap is 27% against a composite average that Manyeredzi (2021) found to be 51%. This shows that male science teachers in LMICs dominate use of smartphones as instructional interface devices in LMICs. This is in line with findings by Manyilizu & Gilbert (2015) that Tanzanian male teachers use ICT tools more than females in both science and non-science subjects. To fully explore gender-based smartphone usage patterns that results show to be age dependent, trend analysis of clustered column charts of frequency of use as well as the various smartphone uses that are common among science teachers are presented.

6.3.2. *Frequency of Use Distribution Pattern*

It is important to note that, frequency of use refers to oftenity of smartphone is use, a measure of time that is silent on how the device is used. This is different from the previously discussed usage pattern that caters for 'where' the user navigates while using the smartphone, irrespective of how often the event is executed. Statistics show that female science teachers use smartphones more often than their male counterparts, and the frequency of use varies with age as shown on **Erreur ! Source du renvoi introuvable.**. The trend in variation of use is quartic, picking at 50% for age groups 1 and 2 in females and age group 1 in males. The trend falls from 50% to 18% in females while for males it falls from 50% to 20%. Statistics shows that female science teachers use smartphones more often than their male counterparts. The findings are in line with results obtained by Sama et al. (2020) and researchers like North et al (2014) who concluded that females show greater signs of smartphone addiction, a result of excessive frequent use of the devices. The **higher frequency of use** among female teachers aligns with **exploratory use,** as it may reflect their greater engagement with technology for communication, social interaction, and content consumption (such as news or social media). This trend is consistent

with findings that females tend to show higher levels of smartphone engagement, even when not using it for work (Sama et al., 2020).

6.3.3. *Smartphone Use to Access Social Media*

Female science teachers use smartphones to access social media more than male science teachers. Variation with age of smartphone use for accessing social media drops with age for both male teachers and female teachers, with early career teachers being dominant across the gender divide (Figure 3). The trend shows that female science teachers use smartphones to access social media more than their male counterparts. The results are in line with findings by North et al (2014) who noted that females use smartphones more for socializing compared to males, although their study concentrated on university students, feeders to high school teaching staff. Female teachers' higher use of smartphones for **social media access** is a classic example of **exploratory use,** where the tool is adapted for communication and networking, rather than merely exploiting it for work-related tasks like teaching.

6.3.4. *Use of Smartphones to Read Current Affairs*

Using smartphones to read current affairs is common with male teachers and very unpopular with female teachers as shown on Figure 4. Late career teacher male teachers use smartphones to access current affairs (65%) and the trend gradually decreases to early career male teachers (20%). Age group 3 female teachers on the other hand are the highest consumers of current affairs via smartphones at 36% while age group 1 teachers are the least at 4%. Nonetheless, the use of smartphones for accessing current affairs is generally less common among female science teachers than it is for male science teachers and is common with the elderly teachers. This view is also shared by Busch et al. (2021) who studied smartphone usage among older adults. The dominance of **male teachers** in using smartphones for current affairs shows **exploitative use,** where smartphones are used for information gathering that aligns with their established roles as knowledge consumers. Female teachers' lower usage for this function suggests a more selective approach to smartphone adoption.

6.3.5. *Use of Smartphones as DIIDs*

The use of smartphones as Devices for Instructional Interaction Devices (DIIDs) is common with male teachers and less popular with female teachers as shown on Figure 5. Early mid-career teacher use smartphones for teaching-learning more than the other age groups (38% male and 20% female) while the devices are less popular among late career science teachers for the

same purpose (18% male and 2% female). Male teachers' use of smartphones as DIIDs is more aligned with exploitative use due to their higher engagement in using smartphones for teaching. In contrast, the lower use among female teachers reflects a gender-based divergence in adopting smartphones for educational purposes.

6.3.6. *Career Advancement*

Smartphones are most popular for use in career advancement by young professionals (early to early mid-career teachers), with male science teachers dominating the statistics. According to **Erreur ! Source du renvoi introuvable.**, the trend for using smartphones in career advancement by male science teachers picks at 57% on age group 2 with a gentle quadratic variation that falls to an average of 9% for age group 4 teachers. For female science teachers, the trend picks at age group 1 and gradually falls to 1% for age group 4 teachers. The gender gap is 17% (51% male and 34% female) for age group 1, 38% (57% male and 19% female) for age group 2, 24% (39% male and 15% female) for age group 3 and 8% (9% male and 1% female) for age group 4. However, male science teachers still dominate in smartphone use for career development. Male teachers' dominant use of smartphones for career advancement reflects exploitative use, leveraging smartphones as tools to enhance their professional standing. Female teachers, while still using smartphones for career-related purposes, engage in less career-focused smartphone use, possibly due to different career aspirations or job satisfaction levels.

6.3.7. *Smartphone Use for Leisure*

The use of smartphones to access leisure material is popular among male science teachers than it is in their female counterparts. With reference to Figure 7, age group 1 has the highest percentage of science teachers who use smartphones to access leisure material and the corresponding gender gap is the smallest at 4% (52% male against 48% females). The gender gap widens from 27% (43% male and 16% female) for age group 2 to 34% (42% male and 8% female) for age group 2 and falls back to 10% (10% male and 0% female) for age group 4. This shows that smartphones are very popular among early career teachers (both male and female) for accessing leisure material while they are least popular among late career teachers, the elderly who are only interested in the communication function of the smartphone. The significant gender gap in smartphone use for leisure (44%) shows that male teachers predominantly exploit smartphones for recreational purposes, highlighting a stark difference in how the same

technology is used across genders. This could be indicative of gendered roles where leisure activities are more heavily associated with male teachers, thus influencing the way they adapt smartphones to fit personal interests.

7. Conclusion and Recommendation

Results of this study show that smartphone usage patterns vary statistically with gender and that the primary purpose of smartphone use among science teachers, both male and female, is not teaching but rather personal communication and entertainment. The average gender gap in smartphone ownership by science teachers in Zimbabwe is 5% against the average gender gap in smartphone use of 29%, all which favor male teachers. This shows that male science teachers dominate in both smartphone ownership and use in LMICs using Zimbabwe as a case. However, female science teachers use smartphones more often than their male counterparts. Smartphone use for leisure purposes has the highest gender gap while access to social media is the lowest. Accessing current affairs using smartphones is generally less common among female science teachers than it is for male science teachers and is common with the elderly teachers. The use of smartphones as instructional interface devices is still very low and the corresponding 27% gender gap is too high compared to the gap in ownership. The overall picture therefore portrayed is that the use of smartphones as cyber-physical educational systems is common with male science teachers than it is with their female counterparts. It is therefore recommended that science curricula in LMICs should be tailored in compliance with Industry 4.0 dictates as this may go a long way in closing the gender gap in smartphone use and ownership.

8. Limitation of Study

A limitation of this study is that purchasing factors, mainly influenced by teacher salaries, were considered uniform, despite variations based on qualification levels. Additionally, cultural factors across Zimbabwe's diverse tribes were treated as uniform. This affects the generalizability of the results, as it overlooks potential differences in buying power and cultural influences that could impact smartphone use and ownership patterns among different teacher groups. These factors may introduce bias, limiting the applicability of the findings to a broader, more diverse population.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

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Dr. Sunzuma has made substantial contributions to the field of mathematics education, particularly in Zimbabwe. Since 2008, she has served as a Senior Lecturer in the Department of Science and Mathematics Education at Bindura University of Science Education (BUSE). Her career at BUSE spans roles such as Lecturer, Teaching Assistant, and Acting Chairperson, where she has played a pivotal role in shaping the direction of mathematics education in the country. Prior to her academic career, she taught mathematics and science in high schools under the Ministry of Primary and Secondary Education in Zimbabwe, where she held leadership roles as Head of Department for Science/Mathematics.

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