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# Understanding pedagogical and relational dimensions of laptop use in Abu Dhabi schools

Hanan Alshehhi[1] and Nurullah Eryilmaz[2,3,4*]

*Correspondence:
Nurullah Eryilmaz
ne331@bath.ac.uk; nurullah.eryilmaz@iea-hamburg.de
[1]ADEK, Abu Dhabi, United Arab Emirates
[2]University of Bath, Bath, UK
[3]IEA, Hamburg, Germany
[4]Leuphana University, Lüneburg, Germany

**Abstract**
Despite growing global investments in one-to-one laptop programs, the successful integration of digital technology in schools remains highly uneven, particularly in under-researched regions like the Gulf. This qualitative case study investigates how middle school students and teachers in Abu Dhabi experience the introduction of laptops through the national Alef platform. Drawing on semi-structured interviews with six teachers and six students across two public schools, the study explores key sociotechnical and emotional dimensions of technology adoption. The findings reveal significant gaps in structured training, especially for students—technical malfunctions in digital infrastructure (e.g., LMS failures), and gendered disparities in access to support. While students reported greater self-confidence and motivation when using laptops at home, challenges such as over-competitiveness, digital fatigue, and parental skepticism tempered these benefits. Teachers, meanwhile, described shifting professional roles, uneven digital readiness, and evolving classroom relationships. By highlighting the contextual, emotional, and relational factors shaping ed-tech uptake, this study contributes to more nuanced, equity-oriented approaches to digital reform in education.

**Keywords** Laptop integration, Educational technology, Digital learning, Teacher-student relationships, Digital equity, UAE schools, Qualitative case study

## 1 Introduction

Over the past two decades, one-to-one (1:1) laptop initiatives have evolved from small-scale experimental programs to widespread components of national education policy agendas. Governments and school systems across the globe have invested in providing individual digital devices to students, viewing such access as a pathway to enhancing student engagement, supporting personalized learning, and preparing learners for the demands of the 21st-century knowledge economy [25, 40]. Particularly in the wake of the COVID-19 pandemic, which amplified the urgency of digital transformation in education, the role of laptops and other personal devices has gained renewed policy momentum and public attention [27]. Similar studies have examined how teachers adapted to digital instruction during the pandemic, highlighting both rapid innovation and persistent disparities in preparedness [19, 38]. These devices are often portrayed

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as tools of educational equity—capable of bridging opportunity gaps, fostering learner autonomy, and enabling access to rich digital content and collaborative learning environments [8, 21]. Yet despite their widespread adoption, the actual impact of 1:1 laptop integration remains uneven, especially in terms of pedagogical change and meaningful student learning.

Despite the global enthusiasm for one-to-one laptop programs, research consistently reveals a persistent gap between access to devices and their meaningful integration into everyday classroom practice. While many education systems have succeeded in distributing digital tools at scale, this infrastructural achievement does not automatically translate into improved learning outcomes [11, 33]. The promise of personalized and engaging digital learning often falters due to challenges related to teacher preparedness, pedagogical adaptation, and contextual constraints, particularly in non-Western or under-researched educational settings [22, 45]. This aligns with broader findings that teachers' digital competence and attitudes toward technology are decisive for effective pedagogical integration [6, 31].

In many cases, the focus on hardware provision has overshadowed the deeper work required to foster digital pedagogy—namely, rethinking classroom practices, assessment methods, and student-teacher relationships in technology-rich environments [13]. This "implementation gap" is particularly acute where professional development is limited, socio-cultural factors affect technology use, or students lack digital support at home [14]. Furthermore, much of the existing evidence relies on survey or performance data, leaving a critical need for rich, qualitative accounts of how students and teachers experience and interpret technology integration in their daily school lives [18].

The integration of educational technologies in the Gulf Cooperation Council (GCC) region—particularly in Abu Dhabi—has unfolded against a backdrop of rapid economic development, policy-driven modernization, and ambitious national visions for educational transformation [28, 29]. As part of the United Arab Emirates' Vision 2030 and the Ministry of Education's digital learning strategy, large-scale investments in one-to-one device programs and smart learning platforms, such as Alef, have been deployed to enhance personalization, digital skills, and student autonomy. Abu Dhabi's education system is shaped by a unique mix of multilingual student populations, a predominantly expatriate teaching workforce, and centralized governance structures that facilitate swift policy rollout, but may challenge bottom-up responsiveness [5].

Despite these developments, the Gulf remains underrepresented in global conversations on educational technology. Much of the existing literature on technology integration continues to be grounded in Western or East Asian contexts, overlooking the socio-cultural dynamics, policy environments, and pedagogical norms specific to the Arab world [33, 46]. In particular, there is a dearth of qualitative studies capturing how students and teachers in the Gulf experience and interpret technology use in everyday classroom practice. This study addresses that gap by providing localized insights into the implementation of laptop programs in Abu Dhabi middle schools—offering both a theoretical and empirical contribution to global ed-tech literature.

This study explores how students and teachers experience the integration of laptops into classroom practice in Abu Dhabi public middle schools. While many technology-focused educational reforms emphasize infrastructure and policy metrics, this research foregrounds the everyday realities of implementation as perceived by those most directly

affected: learners and educators. Through in-depth interviews with students and teachers, the study investigates how laptop use intersects with self-confidence, self-efficacy, pedagogical routines, and classroom relationships.

By adopting a qualitative, contextually grounded lens, this research addresses an important gap in the educational technology literature: the need to understand how digital tools are interpreted, appropriated, and negotiated in real-world settings—particularly within underrepresented regions such as the Gulf. The findings contribute to international debates on equitable and effective technology use in schools, offering actionable insights for policymakers, school leaders, and ed-tech designers seeking to make digital learning meaningful, inclusive, and sustainable across diverse educational contexts. To guide our analysis, we draw on two widely used theoretical frameworks in educational technology research: the Technology Acceptance Model (TAM; [12]) and the Unified Theory of Acceptance and Use of Technology (UTAUT; [44]). These models help explain how students' and teachers' perceptions of usefulness, ease of use, and institutional conditions influence their acceptance and integration of laptops in everyday classroom practice.

## 2 Theoretical framework and literature review

### 2.1 Theoretical framework: technology acceptance in education

In presenting the findings, we therefore use TAM and UTAUT as interpretive lenses rather than predictive models. Each emergent theme was examined in relation to these constructs to trace how teachers' and students' lived experiences reflect key determinants of technology acceptance. Table X summarizes these connections, mapping the experiential themes (e.g., training, infrastructure, home use, stakeholder relationships, and emotional experiences) to the corresponding TAM/UTAUT dimensions such as facilitating conditions, effort expectancy, performance expectancy, and social influence.

Understanding how teachers and students adopt and use new technologies in classroom settings is central to evaluating the impact of one-to-one laptop initiatives. This study draws on two influential frameworks in educational technology research—the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT)—to explore how individual perceptions and contextual factors shape the uptake of laptops in Abu Dhabi middle schools.

The Technology Acceptance Model (TAM), introduced by Davis [12], posits that users' behavioral intentions toward a technology are driven by two key beliefs: perceived usefulness and perceived ease of use. In educational contexts, these constructs help explain why some teachers and students embrace digital tools while others resist them—often regardless of access. For instance, teachers are more likely to integrate technology when they believe it enhances instructional effectiveness and can be used with minimal effort [32, 36].

Expanding on TAM, the Unified Theory of Acceptance and Use of Technology (UTAUT) integrates additional sociotechnical factors including performance expectancy, effort expectancy, social influence, and facilitating conditions [44]. This model is particularly useful in studying systems like Abu Dhabi's, where digital reforms are centrally mandated and implemented rapidly across a culturally diverse teaching force [5, 16]. The UTAUT framework allows us to examine how perceptions of institutional

support, peer expectations, and infrastructure availability influence real classroom use of laptops.

Together, TAM and UTAUT provide a theoretically robust lens to investigate the complex interplay between policy structures, teacher agency, and sociocultural realities. In Abu Dhabi, where top-down initiatives meet diverse classroom ecologies, these models illuminate how digital technologies are negotiated and adapted in practice.

In this study, TAM and UTAUT served as sensitizing frameworks that shaped both data collection and analysis. We selected these models because they link individual perceptions (usefulness, ease/effort) with institutional and contextual conditions (facilitating support, social influence)—a strong fit for Abu Dhabi's centrally driven digital reforms. While alternatives such as TPACK or Diffusion of Innovations emphasize pedagogical knowledge or macro-level spread, TAM/UTAUT directly address why and how teachers and students accept or resist mandated technologies in everyday practice. Their constructs guided our interview protocol and later informed the interpretation of themes on training, infrastructure, home use, stakeholder relationships, and emotional experiences.

### 2.2 Laptop integration in K–12 classrooms

Over the past two decades, one-to-one (1:1) laptop initiatives have become central to education reform agendas worldwide, particularly as policymakers seek to promote digital literacy, personalized learning, and 21st-century competencies. From large-scale programs in the United States and Australia to national efforts in countries like Uruguay (Plan Ceibal) and Thailand, laptop integration in K–12 classrooms has aimed to close digital divides and foster student autonomy [8, 37].

Empirical findings suggest that laptops, when meaningfully integrated, can support a range of pedagogical benefits. These include enhanced student engagement, greater opportunities for collaborative and inquiry-based learning, improved access to digital content, and increased student agency through self-paced learning [26, 47]. Laptops also facilitate multimedia and multimodal instruction, allowing teachers to differentiate content delivery and assessment [35].

However, the promise of 1:1 initiatives is frequently undermined by persistent implementation challenges. Chief among these are limited teacher preparedness, lack of ongoing professional development, and weak alignment between digital tools and existing curricular frameworks [11, 13]. Even where infrastructure is in place, digital inequities often re-emerge through disparities in students' home access, parental support, and prior exposure to technology-rich environments [14, 33]. In many settings, laptops are used primarily for administrative or low-level tasks rather than for transformative pedagogical purposes [15].

Moreover, much of the literature on 1:1 computing originates from Western, high-income countries, leaving a gap in understanding how such programs unfold in Global South or non-Western education systems. Studies that do explore these contexts often highlight unique sociocultural, infrastructural, and linguistic challenges that shape the uptake and impact of digital technologies in schools [22].

Overall, while 1:1 laptop programs hold considerable potential, their success depends on more than device distribution. They require sustained attention to pedagogical transformation, equitable support systems, and local educational ecologies—issues this study

addresses by focusing on the lived experiences of teachers and students in Abu Dhabi middle schools.

### 2.3 Challenges of digital equity and pedagogical change

While one-to-one laptop initiatives have expanded digital access, they have not automatically translated into equitable or transformative educational practices. This reflects what researchers term the “second-level digital divide” or digital divide 2.0—a shift from unequal access to unequal use of technology for meaningful learning [14, 42]. Cross-system studies link infrastructure and school readiness to persistent usage gaps—and in the Gulf, educator readiness remains uneven [2, 41]. In this sense, the digital equity challenge is not just about providing devices but ensuring that students—particularly those from disadvantaged backgrounds—have access to high-quality, technology-enhanced pedagogy and appropriate support systems.

Despite infrastructure gains, many education systems face a persistent implementation gap between the promise of digital innovation and its actual classroom impact. Studies across diverse contexts reveal that technology often reinforces traditional pedagogies unless accompanied by changes in instructional culture and teacher beliefs [11, 33]. For example, Voogt et al. [45] found that even when technology was available, its integration often remained superficial—limited to content delivery rather than active, student-centered learning. This is especially evident in settings where teachers lack autonomy or training to adapt curriculum and assessment strategies to digital contexts.

Teacher agency plays a pivotal role in bridging this gap. As Ertmer and Ottenbreit-Leftwich [13] argue, effective technology integration depends not only on access and policy support but also on teachers’ pedagogical beliefs, confidence, and professional learning environments. Without adequate space for contextual adaptation and reflective practice, top-down reforms risk reproducing existing inequalities rather than addressing them. In multilingual, diverse, and policy-driven systems such as those in the Gulf, challenges of alignment between national ed-tech strategies and local classroom realities remain pronounced.

### 2.4 Laptop use in Gulf education contexts

The integration of educational technologies in the Gulf Cooperation Council (GCC) countries has accelerated in recent years, driven by state-led modernization agendas and national visions that place digital transformation at the heart of economic and educational reform. In the United Arab Emirates (UAE), initiatives such as Vision 2031 and the Smart Learning Program have promoted one-to-one laptop distribution, digital learning platforms like Alef, and an expanded role for educational technologies in classrooms [39]. These policy frameworks aim to enhance student engagement, foster independent learning, and prepare learners for participation in the global knowledge economy.

Abu Dhabi, in particular, has emerged as a regional leader in digital education due to its centralized policy infrastructure, significant investment capacity, and diverse student population. Its schools are characterized by multilingual classrooms and a largely expatriate teaching workforce—features that create both opportunities and tensions in the implementation of top-down reforms [1, 3]. While infrastructure and access have rapidly expanded, challenges related to digital pedagogy, equity, and contextual responsiveness persist.

Despite these developments, the Gulf region remains underrepresented in global educational technology research. Most scholarly discussions on one-to-one laptop programs originate in North American, European, or East Asian contexts, where school governance structures, teacher training systems, and cultural values often differ significantly from those in the Gulf [18, 33]. Moreover, few studies have explored how technological reforms are experienced by teachers and students in the region. Qualitative investigations of classroom practices, particularly from the perspectives of educators and learners themselves, are notably rare. This study addresses the gap by documenting lived experiences of laptop integration in Abu Dhabi public middle schools—offering localized insights that contribute to international debates on equity, implementation, and digital pedagogical change.

### 2.5 Existing research and study contribution

Globally, the integration of one-to-one (1:1) laptop initiatives has been associated with improvements in student engagement, digital literacy, and academic self-efficacy [8, 25]. However, researchers emphasize that access alone does not guarantee meaningful learning outcomes. Rather, effective implementation hinges on factors such as teaching digital pedagogy, robust infrastructure, and socio-cultural responsiveness [18, 33, 45].

Teacher preparedness is particularly critical. Studies show that insufficient professional development undermines technology integration in both Western and non-Western contexts [13, 18, 22]. Even in resource-rich settings, technical issues—such as connectivity challenges and device failures—frequently obstruct classroom use [4, 14].

Socioeconomic and gender disparities further complicate digital equity. Students from higher-income households often have greater home access to the internet, digital support, and quiet learning spaces [17, 25]. Gendered differences in digital confidence also persist, with male students frequently reporting more comfort using technology—though targeted support can close these gaps [34, 43].

Despite this growing literature, few studies provide qualitative insight into how technology is actually experienced in everyday schooling, particularly in the Gulf region. This study addresses that gap by capturing how students and teachers in Abu Dhabi middle schools interpret and navigate the affordances and constraints of large-scale laptop integration. In doing so, it offers a critical, contextually grounded contribution to international debates on equitable and effective digital learning.

## 3 Methodology

### 3.1 Research design

This study employs a qualitative case study design to investigate how students and teachers experience the integration of laptops in public middle schools in Abu Dhabi. A qualitative approach is particularly well-suited for capturing the nuanced, context-specific dimensions of technology use, allowing for a deep exploration of participants' perspectives, emotions, and day-to-day practices [10, 23]. By focusing on lived experience, this design foregrounds the interpretive processes through which individuals navigate and make sense of technological change in educational settings.

Semi-structured interviews served as the primary method of data collection. This approach balances the structure necessary for comparability across cases with the flexibility needed to probe emerging themes and follow participants' unique narratives [30].

The interview protocol included open-ended questions targeting multiple facets of technology integration: instructional practices prior to laptop implementation, professional development and support structures, perceived shifts in student motivation and engagement, and the influence of socio-cultural dynamics on digital learning. These domains were informed by prior research on ed-tech adoption and adapted to the specific policy and cultural context of Abu Dhabi.

The protocol was aligned with TAM/UTAUT constructs. Items on professional development and school support probed *facilitating conditions*; questions on motivation, perceived instructional value, and autonomy addressed *perceived usefulness/performance expectancy*; prompts about peer, parent, and leadership expectations examined *social influence*; and items on ease, barriers, and usability tapped *perceived ease/effort expectancy*. This ensured conceptual coherence between theory and inquiry.

This design enabled the study to move beyond surface-level metrics of access and usage, offering insight into how digital reforms are enacted, challenged, and reinterpreted by the individuals most directly affected.

### 3.2 Participant selection

This study used purposive sampling to recruit participants directly engaged with the Alef smart learning program in public middle schools in Abu Dhabi. The final sample comprised six teachers and six students from two participating schools, selected to represent variation in gender, subject specialization, teaching experience, and digital familiarity.

Inclusion/exclusion criteria. Teachers were eligible if they had integrated laptops into instruction for $\geq 1$ semester within the Alef program; teachers not currently using laptops (e.g., control classes) were excluded. Students were eligible if they were enrolled in laptop-using (test) classes for $\geq 1$ term; students from control classes (traditional instruction without devices) were excluded. Participation required parental/guardian consent for minors and individual assent.

Composition and diversity. The teacher sample included Arabic, Mathematics, Science, and Islamic Studies educators, reflecting the initiative's interdisciplinary scope. Digital pedagogy exposure varied—from formally trained teachers holding ICT/professional development certifications to those with minimal prior experience. The student sample similarly varied in digital literacy and home technology access, ranging from highly confident users to first-time laptop learners. Table 1 summarizes the distribution of participants by school and gender, and recruitment aimed to approximate gender balance within each school (final distribution reported in Table 1).

Recruitment process and gatekeepers. Initial access was facilitated by school principals/ICT coordinators who acted as institutional gatekeepers by circulating study information. To minimize gatekeeper influence, all invitations emphasized voluntariness and

**Table 1** Participant composition by group and method

| Group | School gender | Student survey sample | Student interview sample | Teacher interview sample |
|---|---|---|---|---|
| Test | Boys | 59 | 3 | 3 |
| | Girls | 50 | 3 | 3 |
| Control | Boys | 46 | n/a | n/a |
| | Girls | 43 | n/a | n/a |
| Total | | 198 | 6 | 6 |

Only students from the test group were interviewed, as they had direct exposure to the laptop integration program

the absence of any academic or professional consequences for declining. Scheduling and consent were handled privately with participants (and parents/guardians for students).

Researcher–participant relationships and compensation. The research team had no prior personal or supervisory relationships with participants. No monetary incentives were offered; participants received a brief thank-you certificate via their schools.

Bias-mitigation steps. To reduce social desirability and acquiescence, interviews were conducted privately (without administrators present), began with neutral, open prompts, and used follow-up probes to clarify rather than steer responses. The interviewer reiterated confidentiality and the value of both positive and negative experiences. Reflexive notes documented contextual factors (including potential gatekeeper effects) after each interview, and any indications of perceived pressure or status dynamics were discussed during team debriefs to refine interpretation.

By incorporating variation in gender, subject background, and digital readiness, the sample design allows for a rich, multidimensional exploration of how different actors experience technology integration within the same systemic context.

## 4 Data collection

### 4.1 Semi-structured interviews

To explore the multifaceted experiences of students and teachers involved in the laptop-integration initiative, we used semi-structured interviews. This approach offered consistency across participants while allowing follow-up prompts to capture nuanced accounts [30].

Interviewer background, reflexivity, and training. All interviews were conducted by the first author, a postdoctoral researcher with formal qualitative training and prior fieldwork experience in Abu Dhabi schools. Before data collection, the protocol was piloted with two participants and refined for clarity and cultural sensitivity. The interviewer kept brief reflexive memos after each session, and emerging interpretations were discussed with a co-author to surface assumptions and reduce potential bias.

Interview protocol and logistics. The guide covered: (i) ICT training and professional development; (ii) students' engagement with laptops at school and at home; (iii) technical and pedagogical challenges; (iv) infrastructure and institutional support; (v) perceived effects on classroom dynamics and motivation; and (vi) socio-cultural factors (e.g., gender, digital access, family environment). Interviews were conducted remotely via Microsoft Teams in line with COVID-19 safety measures. Informed consent (including recording and transcription) was obtained in advance. Sessions typically lasted 30–45 min.

Language, translation, and transcription. Interviews were conducted in English or Arabic according to participant preference. Arabic interviews were translated and then back-translated by two independent bilingual assistants to support semantic equivalence. All audio was transcribed verbatim. The interviewer checked transcripts against recordings, and any discrepancies were resolved through discussion within the team.

Analysis and coding protocol. We used a hybrid inductive–deductive thematic approach in [NVivo 14]. A preliminary codebook was developed from the first five transcripts by combining sensitizing concepts from the guide with emergent codes. Two researchers independently coded these initial transcripts, discussed differences

to reach negotiated consensus, and refined code definitions and decision rules. The remaining transcripts were coded by the first author, with periodic double-coding (≈ 10%) and brief calibration meetings to limit coder drift. Rather than emphasize a single coefficient, we prioritized negotiated reliability and explicit use of definitions when resolving disagreements, including attention to disconfirming evidence.

Saturation and negative cases. We monitored the appearance of new codes and considered thematic saturation achieved when no new codes emerged in two consecutive interviews; in this study, this point appeared around interview [≈ 18], with subsequent interviews used to check the stability and nuance of themes. We also noted accounts that did not align with dominant patterns (negative/deviant cases) and used them to qualify and refine interpretations.

### 4.2 Participant characteristics

The teacher sample consisted of six educators from public middle schools in Abu Dhabi, selected to reflect diversity in subject areas, professional experience, and digital readiness. As shown in Table 2, participants ranged in age from 31 to 47 and held degrees from universities in the UAE, Egypt, and Syria. Their subject specializations included Arabic, Islamic Education, Mathematics, and Science. Technology usage varied widely—from basic use of smartphones and laptops for classroom tasks to more advanced engagement with educational tools and certification programs such as the International Computer Driving License (ICDL), Intel Teach, and Microsoft Office.

To complement the teacher sample, six students (aged 11) were selected to represent different experiences with technology both at school and at home. All participants were drawn from the "test group"—students who had direct exposure to the laptop integration program. As summarized in Table 3, the students reported using a range of devices (e.g., iPads, computers, smartphones), and their primary uses spanned education apps, homework, research, programming, and entertainment. This variation allowed the study to explore how different levels of digital access and literacy influenced learners' engagement and confidence.

**Table 2** Teacher interview characteristics

| Pseudonym | Age | Gender | Year of graduation | University | Major | Technology used/ Training certificates |
|---|---|---|---|---|---|---|
| Ahmad | 47 | M | 1995, 2000 | Cairo University (Egypt) | Education, Arabic | ICDL, ITV, Professional Development in Education |
| Hassan | 46 | M | 1998, 1999 | Damascus University (Syria) | Arabic, Islamic Education | Laptop, Mobile, iPad, TV |
| Ali | 32 | M | 2016 | Cairo University | Mathematics | iPad, Phone, Laptop (for work) |
| Nora | 38 | F | 2005 | UAE University | Arabic | ICDL, Intel, Mobile & Computer (work) |
| Asma | 34 | F | 2010 | United Arab Emirates University | Science | iPhone, MacBook (work), MS Office Certificate |
| Abeer | 31 | F | 2014 | Abu Dhabi University | Mathematics | Smartphone, Laptop (work & personal), AutoCAD |

**Table 3** Student interview characteristics

| Pseudonym | Gender | Age | Technology used | Primary use |
|---|---|---|---|---|
| Male A | M | 11 | Apple phone, computer | Digital programs, education apps |
| Male B | M | 11 | Computer, iPad | Studying, programming |
| Male C | M | 11 | Smartphone, tablet | Homework, entertainment |
| Female A | F | 11 | Computer, mobile, iPad | Studying, social media |
| Female B | F | 11 | School computer, iPad | Online classes, assignments |
| Female C | F | 11 | Mobile phone, computer | Research, learning |

### 4.3 Data analysis

The data were analyzed using thematic analysis, following Braun and Clarke's [7] six-phase framework. This method allowed for a systematic and interpretive approach to identifying, analyzing, and reporting patterns within the data.

The analysis involved the following stages:

1. Familiarization: Interview recordings were transcribed verbatim and read multiple times to ensure immersion in the data.
2. Initial Coding: Key phrases and segments were coded manually to identify salient patterns across the dataset.
3. Theme Construction: Codes were clustered into broader thematic categories representing shared concepts or tensions.
4. Review and Refinement: Themes were refined and cross-checked for coherence and distinctiveness.
5. Definition and Naming: Each theme was clearly defined in relation to the research questions.
6. Interpretation: Final themes were interpreted through the lens of existing theory and literature to inform discussion and implications.

From this process, four central themes emerged:

- Teacher Training and Support: Highlighting uneven levels of digital competence and professional development access.
- Infrastructure and Digital Access: Addressing technical barriers, including unreliable connectivity and device limitations.
- Student Engagement and Learning Outcomes: Exploring how laptops influenced motivation, participation, and perceived academic benefits.
- Socio-Cultural Influences: Revealing how gender, home environment, and socioeconomic factors shaped experiences with digital learning.

During interpretation, emergent codes and themes were read through TAM/UTAUT to explicate how usefulness/expectancy, ease/effort, social influence, and facilitating conditions shaped teachers' and students' engagement with laptops.

Table 4 provides a summary of the five overarching themes that emerged from the thematic analysis, accompanied by related subthemes, illustrative insights, and their theoretical alignment with the constructs of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). The table offers an overview of how teachers' and students' experiences with laptop integration were organized conceptually around dimensions such as training, infrastructure, home technology use, stakeholder relationships, and emotional responses. This summary serves as a visual

**Table 4** Summary of key Themes, Subthemes, and illustrative insights from thematic analysis

| Main theme | Subthemes/Focus areas | Illustrative evidence or summary insight | Related TAM/UTAUT construct |
|---|---|---|---|
| 1. Training as a Foundation for Digital Adaptation | • Uneven student training<br>• Variable teacher preparedness<br>• Role reversal between students and teachers<br>• Self-directed professional learning | Training provision was inconsistent across schools; male students often received structured sessions while female students did not. Older teachers struggled more with adaptation, and students sometimes supported teachers technically. Some educators turned to self-learning but risked exclusion without digital capital. | *Effort Expectancy/Facilitating Conditions* |
| 2. Infrastructure and Digital Access | • Technical malfunctions and LMS failures<br>• Inconsistent technical support<br>• Gender disparities in support access<br>• Internet filtering and restrictions | Teachers and students reported frequent LMS crashes, delayed support, and gendered inequities—female schools experienced longer delays. Internet filtering limited student research freedom. Infrastructure alone proved insufficient without equitable human support. | *Facilitating Conditions* |
| 3. Using Technology at Home | • Academic improvement through home learning<br>• Reduced psychological barriers<br>• Motivation and learner autonomy<br>• Parental engagement and oversight<br>• Risks of misuse and over-competitiveness | Home use enhanced student autonomy, motivation, and family engagement. Technology helped shy students participate and improved performance. Yet gamified features led to account sharing and over-competitiveness, raising concerns about digital ethics. | *Performance Expectancy/Social Influence* |
| 4. Relationships Among Stakeholders | • Shifting teacher–student dynamics<br>• Redefined teacher roles (monitor, facilitator)<br>• Changing collegial relationships (gendered differences) | Digital platforms extended teacher–student interaction beyond classrooms but sometimes reduced verbal communication and spontaneity. Teachers became facilitators rather than sole knowledge providers. Female teachers reported social isolation, while male teachers viewed digital tools as time-saving. | *Social Influence/Facilitating Conditions* |
| 5. Emotional Experience | • Mixed student emotions (relief vs. anxiety)<br>• Teacher resistance and adjustment<br>• Parental skepticism<br>• Screen fatigue and confusion over resources | Students and teachers experienced both empowerment and fatigue. Anxiety emerged due to system glitches, excessive screen time, and unclear platform priorities. Parents expressed skepticism about digital reforms. | *Effort Expectancy/Perceived Ease of Use* |

guide to the subsequent sections, where each theme is discussed in depth with supporting quotations and interpretation.

### 4.4 Ethical statement

This study received ethical approval from the Abu Dhabi Department of Education and Knowledge (ADEK) prior to data collection (Approval Date: 30 January 2019). All procedures complied with the British Educational Research Association (BERA) ethical guidelines. Institutional permission was obtained from all participating schools. Informed consent was obtained from all participants, and for participants under the age of 16, informed consent was obtained from their parents or legally authorized representatives prior to data collection. Participants were informed that participation was voluntary,

that they could withdraw at any time, and that their data would be kept confidential and used solely for academic research. All data were stored securely.

## 5 Results

### 5.1 Training as a foundation for digital adaptation

Training emerged as a pivotal factor influencing the effectiveness of laptop integration in Abu Dhabi middle schools. Both students and teachers highlighted disparities in preparedness, shaped by institutional decisions, access to support, and prior digital experience.

### 5.2 Student training gaps and inconsistencies

Students reported mixed experiences with training, with some recalling structured sessions facilitated by specialists. A male student described:

> *"The specialist asked us to watch him and do the same… then he asked us to repeat what we learned… he offered help to the ones who faced a problem."*

However, others—particularly in female schools—received no formal training. One teacher noted:

> *"For students, there were no training sessions; however, teachers trained them eventually in the classrooms. The responsibility was given to respective class teachers."*

This inconsistency appeared influenced by school size and gender, with male students sometimes trained collectively in larger spaces like gyms.

### 5.3 Teacher training: uneven impact despite formal provision

Teachers were provided with both on-campus and off-campus training by the Ministry of Education, supported by certificates and credit hours. As one teacher explained:

> *"There is training and application on this training, as well as tests… and you will be credited with credit hours from the Ministry."*

Yet the quality and impact of training varied. Teachers with stronger prior ICT experience adapted quickly, while others—particularly older educators, struggled. One science teacher observed:

> *"Teachers of an older age had issues adjusting… and took longer to adopt the new technology."*

### 5.4 Role reversals and the limits of training

Students sometimes became the more digitally fluent users in the classroom. One male student shared:

> *"Some teachers did not know how to do screen sharing… we told them, and we taught the teachers other things."*

Likewise, a female teacher noted:

> *"Sometimes students could tell us about things in Alef that we did not know, because they were skillful at technology and computers."*

These accounts point to a mismatch between formal training content and the practical demands of classroom technology use—suggesting that many teachers were unprepared for the day-to-day realities of digital instruction.

### 5.5 Toward self-directed professional learning

While some teachers expressed frustration over limited support, others embraced a more self-directed model. As one teacher remarked:

> *"Now it feels that many online learning sources have made the information readily available to everyone, and the importance of training sessions has declined."*

This shift reflects broader changes in the culture of professional development but also risks excluding those without the digital capital to learn independently. As Carlson and Isaacs [9] argue, technical capital is built not only through access, but through sustained opportunities to develop confidence, awareness, and practical capacity.

## 6 Infrastructure

Infrastructure plays a foundational role in the effective implementation of educational technology, shaping both teachers' and students' day-to-day engagement with digital tools. In the context of Abu Dhabi's public middle schools, major investments in modern digital infrastructure—including laptops, digital platforms, and learning management systems—were guided by national initiatives such as Vision 2021 and Centennial Strategy 2071. These investments were designed to create future-ready learning environments through the integration of modern teaching aids, digital libraries, and high-speed internet access. However, as this study indicates, the success of these reforms is experienced by participants as being shaped as much by technological reliability and support structures as by hardware availability alone.

Despite the provision of advanced infrastructure, both students and teachers reported recurring system issues, particularly with the Learning Management System (LMS), which they associated with reduced classroom productivity and confidence. As one eighth-grade male student noted:

> *"There are difficulties in LMS; great difficulties. Now, when we enter any test and finish it, a message appears that our work has not been submitted, so we must do it again."*

Similarly, a female student recalled experiencing system glitches during assessments that she felt undermined her performance:

> *"At the time of the exam, for example, the computer would freeze and answer by itself. I mean, I was clicking on one thing, and it was pressing on another thing, and that affected my grades a little."*

Such technical malfunctions were described by several participants as disrupting learning flow and creating stress, suggesting a perceived implementation gap between policy-level infrastructure provision and reliable, classroom-level execution.

### 6.1 Technical support and its limitations

Teachers acknowledged the presence of designated technical personnel intended to assist with such challenges. For instance, Teacher Ahmad explained:

> *"We encountered problems such as technical problems and problems in the Alef platform about certain points… There are two people responsible for the Alef platform: one is an academic and the other is a technician, and these two exist in all schools."*

Yet, support systems were not always perceived as effective. Teachers reported delays and inconsistencies in response times, particularly in larger or under-resourced schools. As Ahmad further elaborated:

> *"There is an academic person who supervises more than one school, such as five schools; he is the main reference for the Alef platform that receives feedback, questions, or errors in communication."*

These inconsistencies point to the importance of not only deploying infrastructure but also ensuring that adequate human support systems are in place to sustain digital transformation.

### 6.2 Gender disparities in support access

A significant finding was the gendered disparity in access to technical support. Male students described more consistent access to on-site IT support and active engagement from their teachers. One male student explained:

> *"Yes, there were training sessions given to students from respective subject teachers in the beginning. Also, any technical support was fulfilled by the IT supervisor in the school."*

Conversely, female students expressed frustration over delayed support and unresolved device issues. One student described an extended period during which her computer remained unfixed despite repeated complaints:

> *"From the beginning of the semester, she was telling me that she would fix the computer or bring me a new one, but until the end of the semester, she did not. I used to remind them and tell them, but they did nothing."*

These inequities underscore the need for more responsive, inclusive support structures to ensure that all students—regardless of gender or school—benefit equally from digital learning environments.

### 6.3 Internet restrictions and digital access

Another infrastructure-related challenge was internet filtering, designed to block access to non-educational content. While intended to safeguard focus, these restrictions also curtailed students' ability to conduct research and access wider learning materials. As one student explained:

> *"Yes, from the beginning until now, YouTube has been banned. The students were annoyed by this. Undesirable websites wouldn't open because of the Ministry's measures."*

This tension between control and exploration illustrates a key dilemma in digital policy: how to balance protective measures with the flexibility needed for student-driven inquiry.

The findings emphasize that infrastructure alone is insufficient for ensuring meaningful technology integration. Consistent with the UTAUT model, which highlights the importance of facilitating conditions [44], this study shows that effective infrastructure must be accompanied by reliable technical support, equitable access, and responsiveness to users' needs. Without these elements, even the most well-funded digital initiatives risk falling short of their educational goals.

## 7 Using technology at home

The use of educational technology at home emerged as a critical dimension of the laptop integration experience, influencing students' academic performance, emotional well-being, motivation, and capacity for self-directed learning. Teachers and students alike described home-based digital learning as both an enabler of academic progress and a source of new social and behavioral challenges. This section explores the dual nature of technology use outside the classroom, revealing its potential to enhance learning outcomes while simultaneously raising concerns about equity, academic integrity, and overuse.

### 7.1 Academic improvement through home use

Several teachers noted that home access to digital tools significantly improved student performance, particularly for previously low-achieving students. For example, Teacher Nora observed a marked transformation in her Arabic language class:

> *"Some female students made a big leap from a student of acceptable or successful level to a superior girl... girls who got marks of 90, 80, and 85, and this was not their level before... But now, there are fantastic scores."*

These improvements suggest that asynchronous access to multimedia resources, practice exercises, and lesson recordings offered students the flexibility to learn at their own pace and reinforce challenging content, fostering deeper understanding and academic confidence.

### 7.2 Reducing psychological barriers

Teachers also emphasized that digital learning helped some students overcome psychological and social barriers to participation. Technology created alternative modes of expression for students who were reluctant to speak in traditional classroom settings. Teacher Nora described one such transformation:

> *"There is another girl who did not speak at all... But through distance education, she was participating and reading."*

A male religious studies teacher echoed this sentiment, noting that digital assignments allowed students to bypass the fear of public speaking:

> *"Shyness sometimes prevents him from speaking... I broke the barrier of fear and dread."*

These findings highlight the emotional affordances of digital tools, which provide safer spaces for students to express themselves and engage in learning on their own terms.

### 7.3 Freedom of choice and motivation

Teachers widely reported that technology supported student autonomy by enabling choice in how and when to learn. A male Arabic teacher described this shift from passive to self-directed learning:

> *"In the past, the student was forced to learn, but now it is by his choice... The student is now at home, neither bored nor lazy."*

This freedom was amplified through platform features such as learning games and personalized task structures, which increased students' intrinsic motivation and enjoyment of the learning process.

### 7.4 Self-learning and independent study

Mathematics teachers in particular highlighted how digital platforms encouraged step-by-step mastery through adaptive learning paths and continuous self-assessment. One teacher described how students progressed through scaffolded levels of knowledge:

> *"At the end of the lesson... there is a self-evaluation... There is a second knowledge summary, which goes gradually from an easy level to a higher one...".*

Such features nurtured students' ability to monitor their own learning, build confidence, and develop metacognitive strategies essential for long-term academic success.

### 7.5 Motivation and misuse: unintended consequences

While digital rewards and gamified learning elements (e.g., stars, badges, games) motivated many students, they also led to some unintended behaviors. A mathematics teacher explained:

> *"There is also a thing called 'add games'... This also gave motivation through educational games."*

However, competition for rewards also sparked incidents of peer manipulation. One eighth-grade female student recounted:

"Even my friends said to me, 'Give me your account and I will solve your homework...' But after that, they would write anything, and the result was zero."

This highlights the tension between motivational design and academic integrity, emphasizing the need for teacher monitoring and digital citizenship education.

### 7.6 Parental engagement and oversight

A major benefit of digital learning at home was the increased visibility it offered parents into their children's academic progress. Teachers observed that technology enabled parents to become more proactive in supporting their children. A male Arabic teacher explained:

> *"Parents began to follow their children... Exactly, they had programs, and it was easy for them to get information... while sitting at home without the trouble of going to school."*

This shift reflects how technology not only reshaped student experience but also transformed family-school relationships by fostering greater transparency and accountability.

## 8 Relationships among stakeholders

The integration of laptops in Abu Dhabi's public middle schools has significantly reshaped interactions between key educational stakeholders, particularly teachers and students. As communication and instruction shifted to digital platforms, so too did the social and pedagogical dynamics within classrooms and staffrooms. This section explores three key relational transformations: teacher–student communication, changes in teacher roles, and the evolving collegial environment.

### 8.1 Teacher–student interaction: from proximity to platform

Technology-mediated instruction has extended the boundaries of teacher–student interaction beyond the physical classroom. One female Arabic language teacher described this shift:

> *"Before using technology, if I wanted to communicate with the student, the communication was at school only. I could not communicate with him outside the school, and if I wanted to communicate with him outside the school, it was by using the landline or the mobile."*

While digital access enhanced flexibility, several teachers felt that it diluted student engagement. A mathematics teacher noted:

> *"In the past days where technology usage was limited, students learned and communicated more verbally; the expression skills of the students were more admired. This made students involve themselves fully, physically and mentally, in the classroom."*

Others described digital learning as more procedural and less dialogic. A religious studies teacher remarked:

> *"The relationship was natural between the teacher and the student, and it was monotonic."*

Still, some educators perceived gains. One female science teacher observed:

> *"The relation of teachers and students was more significant, because students now had new gates open to learn easily, and teachers now had gates open to use new activities and share lessons with students on their laptops."*

### 8.2 Evolving role of the teacher: from instructor to facilitator

The implementation of digital learning tools reframed teachers' roles from direct instructors to monitors and facilitators. As a female Arabic language teacher shared:

> *"Some of the students completed the tasks and delivered them to the Alef platform to the fullest… my role as a teacher was to follow up the students' progress… and make the students try to commit, especially with the issue of commitment to the two platforms."*

Technology also accelerated instructional pacing. Teacher Ahmed emphasized:

*"The teaching-learning process has become easier and more communicative, and the information arrives quickly, and the speed of achievement begins to be applied in the designated places on the Teams."*

Several teachers highlighted the shift toward reciprocal learning. As Ahmed elaborated:

*"The teacher can present in the virtual class some projects or some competitions, so the students implement them at home and display them in the next class… So, there became a relationship of exchanging experiences."*

### 8.3 Teacher–teacher interaction: diverging gendered perspectives

The introduction of digital tools also influenced peer relationships among teachers, though perceptions varied by gender. All female teachers interviewed expressed concern about diminished collegial interaction. A female Arabic teacher recalled:

"I worked in the first two schools in which we did not use the means of technology. The relationship between us and the administration was more than a family relationship. We were not busy with technology… everything was based on paperwork."

Another added:

*"Before introducing technology, the colleagues were talking to each other most of the time. Rather, now they are busy on their phones."*

A female mathematics teacher similarly noted:

*"Technology has given good but also led to a decline in social relationships and interaction among colleagues."*

In contrast, male teachers viewed digital systems as strengthening collaboration and saving time. A male Arabic teacher observed:

*"After the introduction of technology, it became easier to conserve time and effort. In the past, teachers needed to gather in a specific place for meetings. Now, through Teams, meetings can happen quickly."*

A male religious studies teacher went further, suggesting:

*"Now, we find there is more intimate communication than before, because we work within one framework."*

These contrasting views reveal how technology alters not just pedagogy but also the social structure of school communities, sometimes deepening collaboration, and at other times eroding informal support networks.

## 9 Emotional experience

The introduction of laptops in UAE middle schools triggered a wide range of emotional responses among students and teachers. While some experienced empowerment and excitement, others encountered anxiety, confusion, or resistance. These emotional dynamics were shaped not only by technological design and infrastructure but also by cultural expectations, pedagogical routines, and institutional readiness.

### 9.1 Mixed student emotions: relief vs. anxiety

Students expressed both appreciation and frustration. One male student described the flexibility offered by recorded lessons:

> *"With technology, we can repeat the lesson anytime we want because of the recorded explanation, so it is easy."*

Yet, others found the pressure to work quickly detrimental to learning. As one female student put it:

> *"In the computer lab, we do not understand much, but we solve very quickly… when our answer is correct, it is just by luck."*

These perspectives highlight a tension between accessibility and depth of engagement—where ease of access does not always translate to meaningful comprehension.

### 9.2 Teacher anxiety and resistance to change

Many teachers initially viewed the shift to digital learning with skepticism or discomfort. A religious studies teacher noted:

> *"At the beginning of everything, new ideas may not meet others' satisfaction… because it is something new that came against traditional methods."*

A female teacher echoed this, recalling how teachers had to "get used to it bit by bit," learning through trial and error. Meanwhile, students noticed this discomfort. One girl remarked:

> *"Most of the teachers hated the Alef platform… there was not enough time to explain the lesson."*

### 9.3 Fears of over-engagement and skill loss

Concerns about excessive reliance on technology were common. A male Arabic teacher warned:

> *"Some students would be preoccupied with technology… and would not master some skills in subjects that need writing and a pen."*

This concern mirrors broader debates on digital distraction and erosion of foundational literacies.

### 9.4 Parental skepticism and health strain

Negative attitudes toward the platform extended beyond the classroom. Students shared how their families disapproved of the system:

> *"Even my family, and my friends' families, when I visit them… they say they do not like the new system."*

Moreover, screen fatigue has become a serious concern. As one male student stated:

> *"We are all day long on the computer; our eyes hurt us now… there is no time without the computer."*

### 9.5 Confusion over educational resources

A lack of clarity about whether to prioritize digital or textbook-based instruction frustrated both teachers and students. A male student explained:

> *"The problem is that they set up more than one site for us… such as the Alef platform and the LMS site."*

A science teacher voiced a similar dilemma:

> *"Are we working on Alef permanently? Or do we divide work equally between Alef and the book? This dilemma persists until now."*

### 9.6 Anxiety over online testing

Finally, online assessment proved especially anxiety-inducing due to technical glitches. One student recounted:

> *"Now when we enter any test and finish it, a message appears that our work has not been submitted, so we must do it again."*

Another added:

> *"The computer would freeze and answer by itself… that affected my grades a little."*

These findings point to the need for not just robust digital infrastructure but also empathetic implementation that acknowledges and supports the emotional labor of technological change.

## 10 Discussion

This study explored the lived experiences of teachers and students following the integration of laptops into middle school classrooms in Abu Dhabi. Through rich qualitative insights, five key themes emerged: training, infrastructure, home technology use, relationships among stakeholders, and emotional responses. Across these domains, several recurring patterns point to a persistent gap between the policy promise of one-to-one laptop initiatives and their classroom realities.

First, disparities in training—particularly the near absence of structured student training— were perceived by both teachers and students as contributing to uneven readiness across classrooms. While teachers received some professional development, its quality and impact varied widely depending on prior digital experience, age, and subject area.

Second, infrastructure-related challenges such as system malfunctions, LMS failures during assessments, and delayed technical support undermined confidence in digital platforms. These issues were especially pronounced in female schools, where support was perceived as slower or less accessible.

Third, students' home use of laptops was experienced in varied ways that they associated with learning outcomes. For some, the opportunity to review recorded lessons, complete tasks independently, and access interactive content enhanced motivation and autonomy. For others, lack of reliable internet, family resistance, and overexposure to screen time created barriers to meaningful engagement.

Fourth, the shift toward digital learning reconfigured relationships between students and teachers. Teachers described a shift toward facilitation rather than direct instruction, while students perceived greater responsibility for their own learning. However,

this transition also strained traditional communication patterns and reduced face-to-face interaction, particularly among female staff.

Finally, the emotional experiences of both students and teachers were deeply mixed. Students expressed both excitement and frustration—describing motivation in gamified tasks but also noting anxiety from technical failures. Teachers, particularly older ones, described fear, stress, and initial resistance, compounded by uncertainty in balancing digital and traditional methods.

Taken together, the findings suggest that participants' experiences highlight the gap between device access and pedagogical transformation. Instead, successful digital integration is shaped by a constellation of sociotechnical factors—including training quality, support infrastructure, home conditions, institutional expectations, and emotional readiness. The results highlight the importance of contextual sensitivity in educational technology reform, particularly in under-researched and rapidly modernizing regions like the Gulf.

The findings of this study offer important insights into how technology adoption theories play out in real-world school settings. In particular, they speak directly to the Technology Acceptance Model (TAM; [12]) and the Unified Theory of Acceptance and Use of Technology (UTAUT; [44]), both of which emphasize perceived usefulness, ease of use, and the role of institutional support in shaping technology uptake.

Students' and teachers' experiences suggest that perceived usefulness alone is insufficient when technical malfunctions, ambiguous expectations, and lack of training erode confidence and motivation. For instance, while students found features like lesson replay and self-paced exercises helpful, their utility was compromised by LMS breakdowns and unclear platform instructions—demonstrating that effort expectancy [44] remains a critical bottleneck. Likewise, the uneven training structure and support systems challenge assumptions in TAM that users will adopt technology if it is "easy to use"; in reality, *ease* is shaped by infrastructural reliability and pedagogical scaffolding.

The findings also reinforce the importance of facilitating conditions—a core construct of UTAUT. Although schools were technically well-equipped, teachers in female schools reported slower support responses and larger class sizes, revealing that systemic structures mediate whether technology can be used effectively. Furthermore, the social influence of peers and families—another UTAUT dimension—was evident in both positive (peer-led troubleshooting) and negative (pressure to share accounts or cheat) interactions.

Critically, the study challenges the *instrumentalist* view of technology as a neutral enhancer of learning. Consistent with scholars such as Selwyn [33] and Ertmer and Ottenbreit-Leftwich [13], our data suggest that educational technologies are socially situated and politically entangled, shaped by users' histories, institutional norms, and cultural expectations. For example, older teachers' resistance and students' emotional exhaustion reveal how digital transformation intersects with generational, gendered, and institutional factors.

Finally, the results support calls for greater contextualization in ed-tech research, especially in rapidly modernizing systems like Abu Dhabi's, where top-down reforms collide with diverse teaching workforces and multilingual student populations [46]. These dynamics require moving beyond acceptance models to critically engage with

implementation realities—highlighting the need for long-term, responsive, and equity-focused professional development and infrastructure investment.

This study contributes to the expanding body of international research on educational technology integration by foregrounding the relational, emotional, and contextual dimensions that shape how students and teachers experience one-to-one laptop programs. While prior scholarship has largely focused on issues of infrastructure, access, and digital skills [20, 24], our findings underscore that the success of technology integration is equally contingent upon social support structures, pedagogical adaptation, and emotional readiness.

In line with Cuban's [11] critique of techno-solutionism, this study challenges assumptions that simply providing hardware or digital platforms will produce meaningful learning gains. The persistent gaps in student training, the emotional fatigue from overexposure to screens, and confusion over curricular materials reveal that device access is only the beginning—not the end—of the implementation challenge.

Our findings also extend Ertmer and Ottenbreit-Leftwich's [13] emphasis on teacher beliefs and agency by showing how uneven professional development and gendered differences in support create differentiated experiences of technological change. Female teachers often felt isolated in navigating new systems, while male staff reported greater access to hands-on assistance. These gendered patterns of support access have been rarely addressed in prior ed-tech literature, especially in Middle Eastern contexts.

Importantly, this study fills a critical gap in the literature by offering rich, qualitative insights from the Gulf region, where educational technology research remains sparse and often limited to survey-based evaluations [5]. By centering the lived experiences of both students and teachers, our analysis illuminates how sociotechnical systems are perceived, negotiated, and resisted in the context of centralized reform and multilingual classrooms.

Finally, the study contributes to emerging discussions about digital emotion work in schools. It highlights how digital learning environments not only affect academic outcomes but also provoke emotional responses—including anxiety, skepticism, motivation, and parental concern—that influence long-term engagement. This suggests that future ed-tech research and policy must account for the affective realities of digital transformation, not just its technical or instructional components.

### 10.1 Implications for practice and policy

This study shows that successful laptop integration requires more than devices; it depends on coherent, human-centred implementation across training, support, pedagogy, and well-being. First, build inclusive, tiered capacity. Teachers and students start with different levels of digital readiness. Provide scaffolded pathways (introductory → advanced), classroom-embedded coaching, and micro-credentials; for students, add short skills workshops (platform use, digital citizenship, assessment routines) at rollout and key milestones. Second, pair infrastructure with rapid, equitable support. Reliability issues and slow response—especially reported in female schools—undermined confidence. Establish service-level targets (e.g., same-day triage), designate on-site IT "first responders," create clear escalation channels, and conduct periodic equity audits to ensure balanced support and replacement cycles. Third, anticipate the emotional labour of change. Clarify platform expectations and assessment workflows, pace timelines, and

institutionalize peer mentoring (student digital leaders; teacher tech buddies) plus brief well-being check-ins and parent orientations to reduce anxiety and build trust. Finally, treat digitalisation as pedagogical transformation, not a technical upgrade. Align platform use with instructional goals (formative assessment, inquiry, collaboration), protect time for co-design and observation, and use professional learning communities to curate exemplars and adapt practices by subject. When access, support, pedagogy, and well-being are intentionally aligned, laptop initiatives yield more equitable and sustainable gains in engagement, autonomy, and achievement—while strengthening teacher professionalism and school–home partnerships.

### 10.2 Limitations and directions for future research

This study provides rich, context-sensitive insights but has several limitations. Scope. Findings derive from a small, purposively selected sample in two public middle schools in Abu Dhabi and are not intended to be generalizable. Data sources. Evidence is based on self-reported interviews only; we did not collect classroom observations, platform usage logs/telemetry, or artifacts (e.g., assignments), which limits triangulation and may introduce social desirability and recall biases. Stakeholders. We focused on teachers and students; the perspectives of school leaders, IT support staff, and parents—who shape implementation conditions—were not included. Time frame. The analysis captures short- to medium-term experiences rather than long-run trajectories.

Ecological validity and well-being. Although interviews were grounded in everyday school routines, the absence of in-situ observation and log data constrains ecological validity (i.e., how closely accounts reflect on-the-ground practice). Reports about screen time, fatigue, and anxiety could not be independently verified or linked to usage intensity or timing.

Directions for future research. We recommend (a) multi-site, multi-sector designs (public/private; varied SES and linguistic profiles); (b) mixed-methods triangulation combining interviews with classroom observations, LMS/device logs, and brief surveys; (c) inclusion of leaders/IT staff/parents to surface system-level enablers and constraints; and (d) longitudinal designs that track practice, engagement, and well-being/screen-time outcomes over time. Such designs would strengthen transferability and support more precise, equity-oriented guidance for ed-tech policy in the Gulf and comparable settings.

### 10.3 Conclusion

This study has illuminated the complex and often uneven terrain of laptop integration in Abu Dhabi's middle schools, offering rare qualitative insights into how students and teachers experience educational technology on the ground. While national investments in infrastructure and digital platforms such as Alef are commendable, our findings demonstrate that the success of such reforms depends not just on device provision, but on sociotechnical alignment—adequate training, equitable support, emotional readiness, and pedagogical adaptation.

Importantly, this research moves beyond dominant narratives of access to highlight how gendered disparities, infrastructural inconsistencies, and emotional fatigue can undermine well-intended reforms. It also challenges techno-solutionist assumptions by showing that digital transformation in education must attend to human relationships, institutional constraints, and contextual realities that shape daily school life.

As education systems continue to digitize, especially in the Global South, policymakers and practitioners must rethink digital equity not as a technical problem, but as a pedagogical, emotional, and relational challenge. Bridging this implementation gap is not only necessary for improving learning outcomes, it is vital for ensuring inclusive, just, and sustainable educational futures.

## Appendix A

### Student interview questions

**Opening Questions**

1. To begin, can you share your general thoughts on using technology in the classroom?
2. What kinds of technology do you use in your daily life, and for what purposes?

**Context Before the Intervention**

3. Can you describe your school environment before the implementation of Alef?

   a. How were relationships among students?
   b. How were relationships between teachers and students?

4. Did you receive any information about Alef before its implementation? If so, please describe what you were told.

**Implementation of Alef**

5. Can you describe the process followed in your school to implement Alef?

   a. Were there any clear stages?
   b. Did you receive any training or information sessions? If so, for whom?
   i. Teachers
   ii. Students
   iii. Others
   c. How was the distribution of laptops handled?
   i. What were the rules?
   ii. Were there any challenges or problems?

6. How were the first days after Alef was introduced?

   a. What were the general feelings or perceptions of:
   i. Students
   ii. Teachers
   iii. Parents
   b. Was there any support, monitoring, or additional training?

7. After the initial excitement wore off, how did people feel about Alef?

   a. What were the general feelings or perceptions of:
   i. Students
   ii. Parents
   b. Was there continued support, monitoring, or additional training?

**Attitudes and Beliefs After the Initial Stages of Alef**

8. How do you think the introduction of laptops has influenced your school environment?

    a. How has it affected relationships among students?
    b. How has it affected relationships between teachers and students?
    c. Have you noticed any impact on your academic or non-academic performance?

9. Do you see any opportunities or challenges in your studying practices as a result of laptop use in the classroom?

    a. How has it affected your day-to-day studying at school and at home?
    b. Has it influenced your motivation?

**Closing Questions**

10. Is there anything else you think would be helpful for me to know?
11. I appreciate your time and insights. If I have any follow-up questions, would it be alright to contact you?

## Appendix B

### Teacher interview questions

**Opening Questions**

1. To start, can you tell me a bit about yourself and your views on the use of technology in the classroom?
2. How old are you?
3. When did you graduate?
4. From which university did you graduate?
5. What kinds of technology do you use in your daily life, and for what purposes?
6. Do you have any training certificates related to the use of technology? Have you participated in any CPD (Continuing Professional Development) programs for ICT use?
7. What are your views on the use of technology in the classroom?

**Context Before the Intervention**

8. Can you describe what teaching was like in your school before the implementation of classroom technology?

    a. How were relationships among colleagues?
    b. How were relationships with school management?
    c. How were relationships between teachers and students?
    d. What was the state of school infrastructure?
    e. What professional development opportunities were available at that time?

9. Did you receive any information about Alef before its implementation? If so, please describe

**Implementation of Technology in the School**

10. Can you describe the process followed in your school to implement Alef?

    a. Were there any clear stages in the implementation?
    b. Were there any training or information sessions? If so, for whom?
    i. Teachers
    ii. Students
    iii. Others
    c. How was the distribution of laptops handled?
    i. What were the rules?
    ii. Were there any challenges or problems?

11. How were the first days after the implementation of Alef?

    a. What were the general feelings or perceptions of:
    i. Students
    ii. Teachers
    iii. Parents
    b. Was there any support, monitoring, or additional training?

12. After the initial excitement wore off, how did people feel about Alef?

    a. What were the general feelings or perceptions of:
    i. Students
    ii. Teachers
    iii. Parents
    b. Was there continued support, monitoring, or additional training?

**Attitudes and Beliefs After the Initial Stages of Alef**

13. How do you think the introduction of laptops has influenced the school environment?

    a. How has it affected relationships among colleagues?
    b. How has it affected relationships with school management?
    c. How has it affected relationships between teachers and students?
    d. Have you noticed any impact on students' academic or non-academic outcomes?

14. Do you see any opportunities or challenges for your teaching practice as a result of laptop use in the classroom?

    a. How has it affected your day-to-day teaching?
    b. How has it influenced marking and assessment?
    c. Has it had any impact on your motivation as a teacher?

15. Have you noticed any changes in students' attitudes toward learning or behavior since the introduction of Alef?

**Closing Questions**

16. Is there anything else you think would be helpful for me to know?
17. I appreciate your time and insights. If I have any follow-up questions, would it be alright to contact you?

**Author contributions**
N.E. provided supervision, contributed to conceptual development, and was responsible for writing, review, and editing of the manuscript. H.A. conducted the data analysis, prepared the figures, and drafted the initial manuscript text. Both authors reviewed and approved the final version of the manuscript.

**Funding**
Open Access funding enabled and organized by Projekt DEAL. There was no funding for this study.

**Data availability**
Due to the qualitative nature of the study and to protect participant confidentiality, the datasets generated and/or analyzed during the current study are not publicly available. Anonymized excerpts from the interview transcripts may be made available from the corresponding author on reasonable request.

## Declarations

**Ethics approval and consent to participate**
This study received ethical approval from the *Research Ethics Committee of the Department of Education*, *University of Bath* (Approval Date: 30 January 2019). The research was carried out in accordance with the ethical guidelines of the British Educational Research Association (BERA) and with the principles of the 1964 Helsinki Declaration and its later amendments, as well as relevant national regulations. Informed consent was obtained from all participants. Written informed consent to participate in the study was obtained from all teacher participants. For student participants under the age of 18, written informed consent was obtained from their parents or legal guardians, and assent was obtained from the students themselves.

**Consent for publication**
Not applicable.

**Competing interests**
The authors declare no competing interests.

Received: 4 July 2025 / Accepted: 1 January 2026
Published online: 23 January 2026

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