

Factors Influencing the Adoption of ICT by Teachers in Primary Schools in Saudi Arabia

Teachers' Perspectives of the Integration of ICT in Primary Education

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Abstract—Information and communication technology (ICT) has become part of everyday life for the many people in business, entertainment, education and many other areas of human activity. Students in primary school are just beginning to learn and accept new ideas, show a maturing creativity, develop critical thinking and decision making skills. ICT enriches all these processes. In education, the successful integration of ICT into learning and teaching depends on teachers' attitudes and their ability to use communication technologies, not just competently, but with skill and imagination. Experience is required with the medium, however, but ICT use in education has been largely ignored in Saudi Arabia. The study described here investigated the factors influencing the adoption of ICT as a teaching tool by teachers at Saudi Arabian primary schools. Analysis of the data showed computer literacy and confidence with technology registered a significant positive effect on the study, participants' effort expectancy, which in turn positively influenced their behavioural intention to adopt ICT. On the other hand, Saudi culture, social conditions, system quality, and other obstacles discourage the uptake of ICT by primary school teachers. The findings of this study will assist the Saudi government to enhance the positive factors and eliminate or reduce the negative factors to ensure successful adoption of ICT in primary education by teachers.

Keywords—Information and communication technology (ICT); primary education; Saudi Arabia; computer literacy; behavioural influence

I. INTRODUCTION

Information and communication technology (ICT) generally refers to the 'diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information' [1]. Although the components of ICT change and evolve rapidly, information and communication technologies of some sort are part of everyday life for many people worldwide in the business, social and education sectors.

Kozma [2] has argued that in the field of education, investment in ICT supports economic growth, promotes social development, advances education reform and supports education management. While ICT cannot solve all the issues common to education systems, such as low literacy rates or lack of resources, it can provide novel solutions to the learning and teaching obstacles encountered in a traditional educational

system by providing a platform for new teaching methodologies and efficient administration tools [3], [4]. Teachers can guide student learning in diverse subjects, arguments and theories with interactive ICT tools [5], [6]. The asymmetric communication offered by ICT can provide an easy way to share information on an 'anytime, anywhere' basis [7], and allows teachers to participate more fully in the learning process, while learners benefit from ready access to materials or assistance [4]. Dedicated channels of communication mean that ICTs can assist in the unification and bonding of students and schools while reinforcing good quality learning [8]. Students access information in a variety of ways, organise it and construct meaning from it. Thus, ICT in education can improve both individual and class academic performance [9].

At the primary level, young minds are open to new ideas, show creativity, develop critical thinking and above all, are ready to absorb surrounding information for informed decision-making at any later stage in life [10], [1], which makes exposure to ICT particularly important in primary education [1]. Realizing the importance and potential for accelerated or advanced learning, ICT has therefore been introduced in primary schools in many countries. The use of ICT has provided opportunities for primary school teachers to develop professionally [15], [16], and for education services to be improved in countries such as Belgium [11], China [12], and Korea [13].

Since it is the classroom teacher whose behaviour will have the greatest impact on the successful adoption and application of ICT for learning and teaching, the circumstances of its introduction for them is critical [14]. It is their acceptance, attitudes and intention to use ICT [17], [18], [19] that determine the quality of its integration into the school system and the success or failure of its use as a learning and a teaching tool. It is necessary therefore to understand the factors affecting teachers' adoption of ICT as part of their everyday pedagogy by investigating them in the midst of their teaching context.

In the context of education in Saudi Arabia, the use of digital technologies is new. The country does not have effective ICT programs like other developed nations, particularly for primary education. Although the government is making efforts to improve the whole education system, especially in terms of using ICT [20]-[22], it is a feature with which the nation has little historical experience.

ICT was officially implemented throughout secondary schools less than a decade ago. In 2007, the King Abdullah bin Abdul-Aziz Project for Public Education Development, *Tatweer* (to develop), was introduced at secondary school level. The *Tatweer* program¹ was established in an effort to reform secondary education in Saudi Arabia via the *Tatweer* Smart School, *Tatweer* Education, and *Tatweer* Transportation programs [23]. The program is not yet integrated into primary education, and despite the importance of ICT in primary education, the integration of ICT at primary level continues to be ignored [22], [24].

This leads to ongoing disadvantages for Saudi primary education, when compared with the secondary and tertiary level institutions that are moving towards ICT implementation through mandatory education leadership programs [25]. It follows logically that the use of ICT at the primary level would prepare the children from the very early stage of education to enable them to use ICT with confidence by the time they reach secondary school. However, effective strategies critical to the introduction and usage of ICT in Saudi primary schools are not currently in place [26].

In order to ensure the successful adoption of ICT in primary education by teachers in Saudi Arabia, the first and foremost task is therefore to determine the positive and negative factors influencing the adoption of ICT. For the use of technology to be accepted and adopted by the teachers, they must have a positive intention to use communication technologies for their daily activities. In general, there would be several factors that would modify the behavioural intention of the teachers.

This paper describes the selection of a theory of technology adoption with which to model the ICT use or potential use by Saudi primary school teachers. Consulting the literature, and using the Unified Theory of Acceptance and Use of Technology (UTAUT), we anticipated the factors most likely to motivate the adoption of ICT or its rejection, and explain them here, along with the development of additional constructs, and our hypotheses and their testing. This is followed by the ways in which we analysed the results, as well as a discussion of the results themselves and the implications for Saudi primary education.

II. THEORETICAL FRAMEWORK

A. Primary Education in Saudi Arabia

In Saudi Arabia, all education policies are subject to government control. The Educational Policy Document issued by the Council of Ministries is the basic reference on the fundamentals and goals of education. The aims of the policy are to make education efficient; to meet the religious, economic and social needs of the country; and to eradicate literacy among Saudi Arabians.

Thus, education is compulsory for children aged between 6 and 15 years in Saudi Arabia, where girls and boys are educated separately. The administration of education in Saudi Arabia is controlled through two main agencies, namely the

Ministry of Education (MoE) and the Ministry of Higher Education (MoHE) [27], [23].

The education system can be divided into two broad categories: general education and higher education. General education consists of three stages: six years of primary school, three years of intermediate school, and three years of secondary or high school. The curriculum, syllabus and textbooks are uniform throughout the country for all stages.

Children enter primary school at the age of six. The main objectives of primary education are to instill the correct Islamic spirit in the children by providing religious education, while ensuring they develop a sense of belonging to an Islamic nation. It is considered desirable that the students understand their rights and duties, and learn to take responsibility for their behaviour. The schools also seek to foster a desire to learn and make good use of one's time. Loyalty to the country's rulers and love for the country are encouraged.

At the same time as these affective factors are being encouraged, the students learn basic skills in language and numeracy, while participating in physical education. The children are promoted from one grade to the next if they pass an examination at the end of the academic year. At the end of grade six, the students passing the Elementary Education Certificate are considered qualified for secondary education.

B. Research Model and Hypotheses

A wide range of theoretical models related to technology acceptance have been developed and studied over the last three decades to understand and model an individual's reaction to innovation and the impact factors affecting the adoption of new technologies, specifically ICT [28], [29]. The theories of innovation diffusion can be applied to innovations of all types (e.g., mobile phones; cloud computing). The most commonly utilized primary theories of innovation diffusion related to technology adoption include the:

- Theory of Reasoned Action (TRA) [30]
- Theory of Planned Behaviour (TPB) [31], [32]
- Technology Acceptance Model (TAM) [32]
- Technology Acceptance Model 2 (TAM 2) [28]
- Technology Acceptance Model 3 (TAM3) [29]
- Unified Theory of Acceptance and Use of Technology (UTAUT) [28]

These theories and models have evolved with time and changing contexts. TAR, TPB and TAM are relatively older in terms of modelling ICT-related innovation acceptance and have been superseded and no longer reflect the needs of modelling ICT adoption in education. The UTAUT presents a more complete picture of the acceptance process by consolidating and unifying numerous technology adoption models [28], [33]. Elements from eight individual models are unified in the UTAUT – the TRA, TPB, TAM, combined model of TAM and TPB (C-TAM-TPB), the model of personal computer utilization (MPCU), diffusion of innovation theory (DOI), social cognitive theory (SCT), and motivational model

¹ King Abdullah bin Abdul-Aziz public educational development project. Retrieved from <https://www.tatweer.edu.sa/>

(MM). The model is a summary of current models related to the acceptance of new technology [28].

In addition to the basic elements of the UTAUT model, new variables integral to the Saudi context were introduced to examine the relationships between different variables and find the factors affecting teachers (positive or negative) which are essential for the improvement of ICT use in primary school in Saudi Arabia.

C. UTAUT Constructs to Model ICT use by the Teachers

The major constructs in the UTAUT model are: *performance expectancy*, *effort expectancy*, *social influence*, and *facilitating conditions*. *Performance expectancy* represents an individual's perception of the usefulness of a technology [28], defined as 'the degree to which an individual believes that using the system will help him or her to attain gains in job performance'. *Effort expectancy* represents an individual's perception about the ease of use, which is defined as 'the degree of ease associated with the use of the system'. *Social influence* represents the subjective norms and social factors, and is defined as 'the degree to which an individual perceives that important others believe he or she should use the new system'. *Facilitating conditions* is defined as 'the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system' [28].

Performance expectancy is the factor, in this case, that indicates the anticipated improvement of performance in school activities as a result of using ICT facilities in administrative and teaching processes. If the primary school teachers believe that ICT is useful and expect that their performance will improve with access to it, they will also develop a positive intention to use the technology in their classes. According to the UTAUT model, performance expectancy has a significant effect on behavioural intention towards the technology [34], [35].

Effort expectancy represents the amount of effort the users expect it will take to use a technology [36], [37]. In the Saudi Arabian school system, a lack of technical support and the low level of ICT competence among primary school teachers make the implementation of ICT difficult [38]. In addition, the lack of access to technology, the lack of training and the lack of time all lead to a discouraging effort expectancy [39], [40]. However, it was anticipated that if this study showed that the perceived difficulties involved in using ICT at the primary level could be eliminated, effort expectancy would become more positive. That is, if the primary school teachers could experience ICT and find it easy to use, they would be likely to find the technology useful and develop a positive behavioural intention to ICT in their daily activities in school.

Social influence affects primary school teachers, who would all belong to different social and interest groups. It is a factor also linked directly to the students and the environment of the school.

Social influence includes the impact of one teacher's behaviour on another's. Ultimately, colleagues, principals, family and friends all influence one another. If the environment in the school and among friends and family is technology

oriented, it is highly possible that the teachers will be interested to using technology in the classroom to make study more attractive and easy [34], [37]. They may, themselves, be familiar with ICT and enjoy using it.

Facilitating conditions are enablers in the environment, e.g., the availability of organisational resources and support structures to facilitate the use of a communications system. The quality of the resources influences a person's perception of the ease or difficulty of performing a task using a technology [37], [29], [41]. In primary schools, facilitating conditions for the teachers are the related resources, such as technical help, infrastructure, hardware, and software [43]. Facilitating conditions have a significant effect on users' effort expectancy of ICT use, and also have an impact on the intention to use new technologies [42], [44], [45]. Without a supportive environment, it is very difficult to plan to adopt ICT, regardless of how much a teacher might like to.

Given these observations from the literature, hypotheses regarding ICT acceptance amongst primary school teachers were formulated for the study. The ideas are related to one another, and the hypotheses only present possible scenarios for the teachers. These hypotheses were:

H1: Primary school teachers' performance expectancy of ICT has a significant positive effect on their attitude towards ICT.

H2: Primary school teachers' effort expectancy of using ICT has a significant positive effect on their behavioural intention to use ICT.

H3: Positive social influence on the primary school teachers has a significant positive effect on their behavioural intention to use ICT.

H4: Facilitating conditions of ICT has a significant positive effect on primary school teachers' perceived ease of use of ICT.

D. Additional Constructs to Model ICT use by the Teachers

In order to explore ICT acceptance as deeply as possible amongst primary school teachers, *computer literacy*, *ICT system quality*, *cultural factors*, and *external barriers* to the use of ICT by the teachers were incorporated as additional variables in the original UTAUT model. These constructs are closely related to new technology acceptance in different contexts.

Computer literacy is the individual's judgment of his or her capacity to use the computer confidently, which is not only concerned with the skills one has, but with the judgments of what one can do with whatever skills one possesses [43], [44], [46].

Computer literacy has a significant effect on users' performance expectancy [44], [47]-[50] and effort expectancy [44], [49], [51], [52]. Due to lack of access to technology, lack of training and lack of time, the teachers in Saudi Arabia find themselves poorly skilled in their use of ICT in teaching [39]. It is reasonable to anticipate, however, that if primary school teachers were more computer literate and confident in their use of the technology, then they would find ICT easy and useful.

System quality indicates the quality of the ICT systems available in primary schools for teaching and learning activities. The quality of the ICT system significantly influences perceived usefulness [44], [47], [53], users' attitudes toward using the technology [44], [47], [49], [54], and users' behavioural intentions to use technologies [44], [49], [50], [55]. Unfortunately, in Saudi Arabia, teachers suffer from limited knowledge of the use and maintenance of ICT, as well as the basic technical and pedagogical skills for using technology in teaching, which negatively influences their current use of ICT [39], [40]. If, however, the ICT system in a primary school possessed all the expected characteristics, then the teachers would find the system useful; and would develop a positive intention to use the system.

Islamic *culture* is dominant in Saudi Arabia; it is embedded in political, public and private life for the majority of Saudi citizens and therefore has an impact on education and the institutions that provide education. As a result, cultural factors, such as power exercise (how people operate using their influence over different matters), social collectiveness, uncertainty avoidance (societies' tolerance of uncertainty), and gender, influence the behavior of the teachers, as they are a major part of the social system [56]-[58].

Given Islamic culture and social organisation, the Saudi context is completely different from that of the Western nations considered by most ICT research [56]. Saudi versions of cultural factors, such as power exercise, social collectiveness, uncertainty avoidance, and gender, directly affect how teachers behave in the schools and how they like to use ICT in the classroom. Considering the social structure and cultural norms, teachers' use of ICT in classes would reflect the Saudi context.

External barriers are also a general condition faced by the teachers. Lack of professional training, lack of access to the internet, and not having enough time to use ICT are common complaints among the teachers [59]. They have to manage the students and also prepare for the lectures in the classes. Without proper external support, it would be difficult to use ICT on a regular basis.

Considering the importance and relevance of the additional constructs, they were incorporated into the model with corresponding hypotheses.

H5: Primary school teachers' computer literacy in ICT has a significant positive effect on primary school teachers' performance expectancy of ICT use.

H6: Primary school teachers' computer literacy has a significant positive effect on their effort expectancy of ICT.

H7: System quality and flexibility has significant and direct influence on behavioural intention to use ICT in primary schools by the teachers.

H8: There is a direct and positive relationship between culture and behavioural intention to use ICT in classes.

H9: There is a significant relationship between culture and external barriers to use ICT in class by the teachers.

H10: External barriers have a negative and direct effect on behavioural intention to use ICT in primary schools by the teachers.

E. Behavioural Intention to use ICT and Actual use

In Saudi Arabia, teachers are currently limited in their use of ICT facilities in their classroom for any purpose, and technology is rarely used in teaching [39], [40], [59]. However, if primary school teachers develop a positive intention to use ICT facilities, then they will use them to teach the students, given the opportunity. Therefore, the following hypothesis was formulated:

H11: Teachers' behavioural intention to use ICT has significant and direct relation with their actual use of ICT in their classes and teaching.

Considering all these hypotheses and constructs, a combined model of ICT adoption for the teachers was proposed, as shown in Fig. 1. The figure shows all the constructs used in modeling ICT behavioural intentions and actual use of ICT by the primary school teachers in the study sample. In this case, except for behavioural intention and actual use, all the constructs are exogenous constructs, meaning independent constructs that influence the use of ICT. Behavioural intention and actual use are the endogenous constructs (dependent constructs of the model). However, behavioural intention can also act as an exogenous construct, when the relation between behavioural intention and actual use are evaluated.

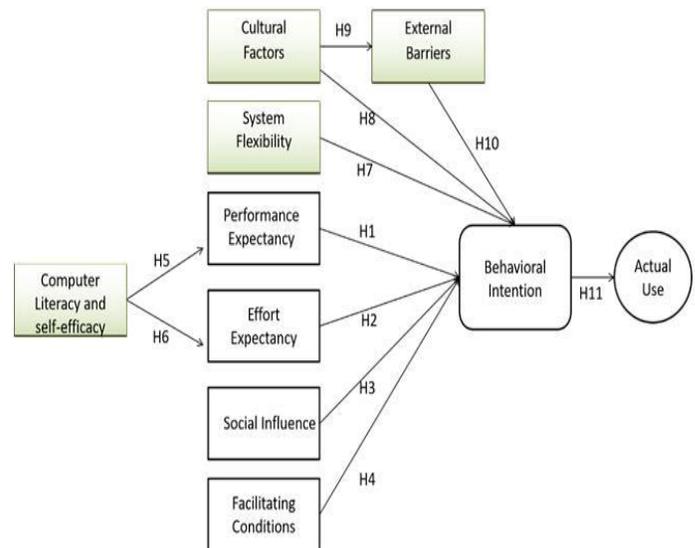


Fig. 1. Proposed ICT behavior model for the teachers of primary schools in Saudi Arabia, Highlighted boxes indicate additional constructs integrated with base UTAUT model constructs.

F. Methods and Materials

In this study, a mixed methods approach, combining both inductive and deductive methods, was used in order to collect the most comprehensive data regarding the study aim, including both qualitative and quantitative analysis [60], [61]. The quantitative analysis was complementary to the

qualitative, helping to develop insight and a detailed understanding of teachers' attitudes toward ICT in primary education in Saudi Arabia.

1) Sampling for data collection

The target populations consisted of teachers of primary schools in the Kingdom of Saudi Arabia. The sampling process was random, and ensured a statistically acceptable size. For qualitative analysis, interviews were conducted to provide a comparison with quantitative surveys and add depth to the responses to the survey questionnaire [60]. Like the schools, the 200 interviewees were selected randomly from the list of all the primary schools in the three targeted cities (Jeddah, Riyadh and Dammam).

A PLS-SEM (partial least squares-structural equation modelling) [63] technique was used for modeling the adoption of ICT in primary schools by teachers in Saudi Arabia. Teachers were targeted from the selected schools randomly, and contacted to conduct the intensive survey. After receiving all responses, the data were cleaned and processed. From this process, 170 valid responses from teachers were collected.

2) Data collection

Interviews with selected primary school teachers were conducted for qualitative data collection to explore the behaviour, mindset, perceptions and general acceptability of ICT in primary education. In this research, semi-structured interviews were used to obtain the teachers' in-depth ideas.

Based on the understanding developed from the qualitative data, quantitative data were collected from primary school teachers in Saudi Arabia using different sets of questions to test the developed hypotheses in this study. The details of each construct-related item/question can be found in Table I. Most of the questions/items were based on the basic questions formulated for the UTAUT model [28].

3) Data analysis

In order to achieve the desired goals and answer the research questions effectively, to determine the validity of the conceptual model, and most importantly to guarantee the best and most relevant results, efficient analysis of the qualitative and quantitative data was essential.

a) Qualitative data analysis

The qualitative data (interviews) analysis strategies were grounded in the inductive approach [60], [62]. For analysis and interpretation of the interview data, a 'hermeneutical' analysis process was used in this research [64]-[67]. Hermeneutics is known as the 'art of interpretation', which is concerned with the creation of interpretive understanding of participants' experiences [64]-[70]. It involves the interpretation of text based on iterations of the researcher's own experience and existing literature and research, as well as one's own contextual ideas [65].

b) Quantitative data analysis

Quantitative data analysis followed the deductive approach [62], [71]. At the beginning of these the analyses, general descriptive statistics were conducted to understand the data type, frequency and percentages for different general questions asked of the teachers, such as their age, education, and use of

ICT facilities. PLS-SEM was used to consider the suitability of the hypothetical model and its relationships with respect to the research problems. PLS-SEM is an iterative approach that maximizes the explained variance of endogenous constructs. Linear composites of observed variables are employed as proxies for latent variables, in order to estimate model relationships, given that construct validity has been established [72], [73]. In this study, *SmartPLS* software (a standalone software specialized for PLS path models) developed by Ringle, Wende & Will [74] was utilized [75], [76].

c) Conformity factor analysis (CFA)

Conformity factor analysis (CFA) was conducted to test how well an adequate a priori factor structure and its relevant model of loadings matched the actual data [77]-[81]. CFA requires both the number of factors and the specific pattern of loadings of each of the measured variables on the underlying set of factors. Each measured variable is hypothesized to load on only one factor, and positive, negative, or zero (orthogonal) correlations are specified between the factors [82]. CFA was undertaken to ensure that all the items and constructs proposed in the model influenced convergent legitimacy, construct cogency, discriminant authority and factorial validity [82], [83]. The proposed factors (Table I) of the models were entered for CFA, where it was assumed that the factors or items having outer factor loading greater than 0.5 predict the corresponding constructs effectively, and vice-versa [84]. This analysis helped us assess the structural stability of data collected through the questionnaire in order to develop a better understanding of the model, and pave the way for developing the PLS-SEM model.

d) Path analysis

At the first step of PLS-SEM, the path models of the proposed model connecting the variables and constructs were considered for running the PLS-SEM algorithm in *SmartPLS* software (Version 3). The estimation of path model parameters involved four steps: i) determination of an iterative algorithm that determined the composite scores for each construct; ii) correction for the attenuation of those constructs that were modelled as factors; iii) parameter estimation; iv) bootstrapping for inference testing [73].

The significance of each parameter and the strength of the relationships between the predictor (exogenous) and the dependent (endogenous) constructs were determined using critical ratio or t-values. Based on the weights of the indicators, the relevance of the indicators was assessed to determine their relative contribution to forming the construct [72], [76]. After the analysis, the model was evaluated using the co-efficient of determination (R²), estimation of path coefficients (β), and prediction relevance (Q²) [72]. Finally, the model relationship analysis was carried out through alternative hypothesis testing using the p-values [85], [86].

III. ANALYSIS AND RESULTS

A. Characteristics and Actual use of ICT in Primary Education by Teachers in Saudi Arabia

81.73% of the primary school teachers surveyed were male. In Saudi Arabia most schools for females are not easily accessible because of social norms and culture [87], [88], and communication with female teachers was difficult to arrange.

The teachers surveyed in this study were aged between 23 and 49, with an average age of 30. The majority of the teachers surveyed held a Bachelors degree (82.35%). Primary schools in Saudi Arabia have a minimum requirement of a Bachelors degree before teachers are employed. The teachers were generally comfortable with computers and technologies and were increasing the frequency with which they used them in their professional and private lives day to day [89], [90].

Most of the teachers surveyed had been using personal computers in their homes for more than five years (76%). Many of them used a computer for six hours or more per week (77%). The data indicated that computer use increased with the increase of experience with the computer. Most of the teachers were using computers at home for internet browsing (100%), word processing (82%) and e-mail (56%). Thus, the teachers used computers for professional as well as personal purposes showing their familiarity with and capacity to use ICT facilities.

This result contradicts the findings from a study by Al Mulhim [39], who found that teachers in Saudi primary schools suffer from a great gap in their knowledge and in even the basic technical and pedagogical skills of using technology in teaching due to lack of access to technology, lack of training, and lack of time, which discourage them from using technology in their teaching.

The majority of the teachers did not have access to computers or the internet in the classroom for education purposes (75%). However, some teachers did have access to a projector in the classroom. Lack of access to computers in their workplace indicated that a vast majority of the teachers were not able to use ICT for their teaching, despite the fact that they were capable of using computers at home. This finding concurs with studies of Alwani, and Soomro [38], [39] and Albugami and Ahmed [91] who found that despite having sufficient funding, there is still a real gap between the availability of ICT in Saudi schools and methods of implementation, that is, lack of access to technology, lack of hardware and unavailability of internet access.

B. Confirmatory Factor Analysis (CFA)

The items which actually define the constructs or are related to the constructs needed to be investigated before running the PLS-SEM model to identify the factors most eligible for analysis. Based on the factor analysis of the items (Table I) for the constructs, it was possible to ascertain which factors would best explain the constructs in the model and predict ICT usage by teachers in Saudi primary schools.

Not all of the items predicted the constructs with acceptable factor loadings (greater than 0.5). The CFA determined the factors/items that really reflected the constructs. Table I shows that for each construct the average loadings of the corresponding items were above 0.7, which is widely accepted for a measurement model [92]. Thus, it was confirmed that the constructs with these items could proceed to a PLS-SEM model. In this case, the CFA also confirmed the validity and reliability of the constructs. All the constructs proposed in modelling had acceptable validity and reliability for the items found from CFA.

TABLE I. CFA RESULTS FOR ITEMS WITH ACCEPTABLE FACTOR LOADINGS FOR THE CONSTRUCTS CONSIDERED IN THE MODEL

Construct	Code	Measurement item description (5-point Likert Scale)	Factor Loadings
Effort expectancy (EE)	EE1	My interaction with the ICT system (i.e. Class room software, projector) would be clear and understandable	0.74
	EE3	I would find the ICT easy to use in school administration	0.76
	EE4	Learning how to use ICT system does not require a lot of effort	0.82
	EE5	Using ICT systems in school does not involve too much time doing mechanical operations (e.g. school management works, admission works)	0.68
Performance expectancy (PE)	PE2	ICT technology enables me to accomplish my tasks more quickly	0.79
	PE3	Using the ICT increases my productivity (i.e. communication, processing school activities)	0.79
	PE4	If I use and encourage the system, I will increase my chances of getting a raise (i.e. Would give better salary)	0.82
Social Influence (SI)	SI3	In general, the school authority has supported the use of ICT	0.93
	SI4	My colleagues are frequently using ICT for the classes and school related activities	0.62
	SI5	Educational authorities (i.e. Ministry of education) encouraged me to use ICT in school	0.81
Facilitating Conditions (FC)	FC1	The school has enough ICT resources including hardware and software for officials and teachers	0.62
	FC4	I get trainings to use ICT in primary school teaching purpose as per requirement	0.81
	FC5	A specific person/group is available for assistance with any difficulties related with ICT use	0.79
	FC6	In general, I am satisfied with the facilitating conditions	0.77
Computer literacy and self-sufficiency (CS)	CS1	I feel confident that I can evaluate appropriately students' activities and tasks using ICT systems	0.86
	CS2	I feel confident that I can select and use educational software for a defined task	0.79

Construct	Code	Measurement item description (5-point Likert Scale)	Factor Loadings
	CS3	I feel confident that I can teach students how to locate, retrieve, and retain content-related information from different sources	0.84
System Flexibility (SQ)	SQ2	The ICT system of the school is reliable	0.80
	SQ3	The ICT system of the school is adaptable	0.80
	SQ4	Response time of ICT system of the school is acceptable due to the functions, speed, features, contents, interaction capability of the technology	0.75
	SQ5	In general, I am satisfied with the system quality of ICT of this school	0.75
Culture Factor (CUL)	Cul7	Working within a team is better than working alone	0.73
	Cul8	Men usually solve problems with logical analysis	0.80
	Cul12	It is important to have job requirements and instructions spelt out in detail so that people always know what they are expected to do	0.75
	Cul13	Rules and regulation are important because they inform workers what the organisation expects of them	0.63
External Barriers (Obs)	LA2	There is not enough time in class to implement technology-based lessons	0.89
	LA3	Lack of access to the Internet	0.80
	LA4	Lack of professional development opportunities on using ICT in teaching	0.61
Behavioral Intention to Use (BIU)	BI2	I intend to use ICT in teaching as often as possible	0.75
	BI3	I intend to use ICT in teaching on a regular basis in upcoming time	0.78
	BI4	I intend to recommend strongly to others to use ICT in teaching	0.71
Actual Use (AU)	AU1	How many lessons did you use ICT in your teaching in the week 1&2 of the last month?	0.92
	AU2	How many lessons did you use ICT in your teaching in the week 3&4 of the last month?	0.87
	AU3	On an average how many lessons did you use ICT in your teaching in a month?	0.87

1) Test of validity and reliability

In order to determine the reliability of the constructs, both Cronbach’s alpha and composite reliability statistics were measured for the teachers’ responses. A value for Cronbach’s alpha greater than 0.7 shows high reliability, while a value greater than or equal to 0.6 shows moderate reliability. If the value is less than 0.5, reliability is lacking [93], [94]. Analysis of the teachers’ results indicated that all constructs had a Cronbach’s alpha of 0.7 or greater, showing high reliability, indicating that the test items were highly correlated. It must be recognised, however, that Cronbach’s alpha is sensitive to the actual number of items in a test and may over- or underestimate reliability [95], [96]. Thus, in addition to Cronbach’s alpha, composite reliability was also measured, and it was found that all the factors showed a high composite reliability value (greater than 0.7). It was confirmed, therefore, that the model items and constructs had acceptable reliability (Table II).

Using the average variance extracted (AVE) and the Fornell-Larcker criterion, the convergent and discriminant validity for the constructs of the measurement model for the teachers were determined. Convergent validity shows how well the latent constructs are explained by the observed variables, and for that the AVE needs to be > 0.50 [78]. As presented in Table III, all the constructs had an AVE greater than 0.5. Thus all had convergent validity; that is, the responses to the survey questions/statements were sufficiently correlated with the respective latent variables.

Discriminant validity confirmed that measures of a latent construct that were not supposed to be related were not related. Using the data from an AVE, according to the Fornell-Larcker criterion, if the diagonal values of the matrix are greater than other correlation values, discriminant validity has been established between two reflective constructs [97], [98]. This would ensure the model constructs have discriminant validity and would be useful for structural equation modelling (Table III).

TABLE II. RELIABILITY FOR THE FACTORS OF TEACHERS’ MODEL

Constructs	Cronbach’s alpha	Composite reliability
EE	0.753	0.844
PE	0.734	0.849
SI	0.727	0.839
FC	0.753	0.842
CS	0.78	0.872
CUL	0.714	0.823
Obs	0.713	0.818
SQ	0.784	0.861
BI	0.611	0.794
AU	0.874	0.922

TABLE III. CONVERGENT AND DISCRIMINANT VALIDITY EVALUATION OF CFA

	AVE	AU	BI	CS	CUL	EE	FC	Obs	PE	SI	SQ
AU	0.79	0.89									
BI	0.56	0.31	0.75								
CS	0.69	0.43	0.29	0.83							
CUL	0.53	0.41	0.69	0.40	0.73						
EE	0.57	0.44	0.62	0.41	0.72	0.75					
FC	0.57	0.58	0.21	0.26	0.28	0.28	0.75				
Obs	0.60	0.51	0.12	0.16	0.17	0.30	0.70	0.777			
PE	0.65	0.14	0.53	0.02	0.55	0.48	0.04	-0.009	0.80		
SI	0.64	0.53	0.19	0.65	0.33	0.31	0.43	0.273	0.07	0.8	
SQ	0.60	0.61	0.23	0.40	0.22	0.29	0.73	0.622	-0.05	0.51	0.78

2) Path analysis results

PLS-SEM modelling for the teachers’ use of ICT in primary school tested estimated path coefficients, t-values (critical ratio) and standard deviation. The path coefficient and the critical ratio reflect the strength of the relationship between the predictor (exogenous) and the dependent (endogenous) construct. The path coefficient and their statistical significance are presented in Fig. 2.

As illustrated in Fig. 2, effort expectancy has a moderately positive relationship with the behavioural intention of the teachers to use ICT in primary schools ($\beta = 0.206$, $t=2.379$, $p<0.05$). In addition, performance expectancy also has a moderately positive relationship with behavioural intention ($\beta = 0.214$, $t=2.036$, $p<0.05$). Therefore, there is a significant relationship between performance expectancy and behavioural intention to use ICT in class. The results indicate that both effort and performance expectancy increase the behavioural intention of the teachers to use ICT for teaching in primary schools, and hypotheses H1 and H2 are accepted.

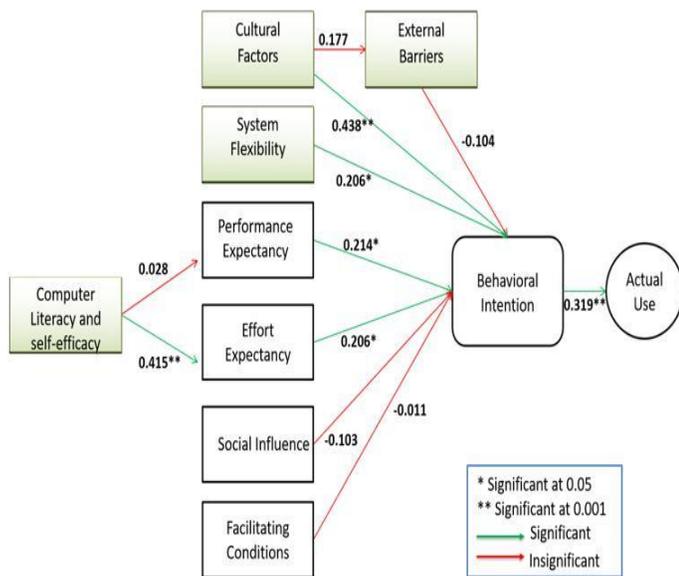


Fig. 2. Structural equation path analysis of conceptual model for teachers’ use of ICT in primary schools in Saudi Arabia. Red arrows depict the relation is insignificant, green arrows show significant relation.

Facilitating condition has a weak negative, yet insignificant ($\beta = -0.011$, $t= 0.109$, $p>0.05$) relationship with behavioural intention; implying facilities in the schools do not influence the

intention to use ICT in classes, and there is no relationship with behavioural intention. Hypothesis H4 is therefore rejected. Furthermore, social influence also shows no significant ($\beta = -0.103$, $t= 1.687$, $p>0.05$) relationship with behavioural intention to use ICT in schools by the teachers; therefore H3 is also rejected. The analysis indicates that there is no positive social influence or that there is actually social hindrance in Saudi schools in terms of intention to use ICT in class by the teachers. In contrast to facilitating conditions and social influence, system quality and flexibility demonstrate a moderately significant ($\beta = 0.206$, $t= 2.141$, $p<0.05$) positive relationship with behavioural intention, which indicates that if system quality were better, the teachers would be more willing to use ICT in class. Therefore, H7 is accepted.

Fig. 2 also shows computer literacy has a very strong positive relationship with effort expectancy ($\beta = 0.415$, $t= 4.988$, $p <0.05$). However, computer literacy has a weak and insignificant ($\beta = 0.028$, $t= 0.292$, $p> 0.05$) positive relationship with performance expectancy, indicating computer literacy has no significant influence on performance expectancy. Therefore, H5 is rejected but H6 (for effort expectancy), is accepted according to the model.

The model found a strong significant ($\beta = 0.043$, $t= 4.937$, $p<0.05$) positive relationship between culture and behavioural intention (H8 accepted) to use ICT in class. This indicates that Saudi cultural factors can positively influence the use of ICT in class for Saudi primary schools. However, culture has no significant relationship with obstacles to use ICT ($\beta = 0.177$, $t= 1.16$, $p <0.05$), and obstacles to use ICT have a negative yet insignificant relationship with behavioural intention ($\beta = -0.104$, $t= 1.06$, $p>0.05$). H9 and H10 are therefore rejected for this study. This indicates that obstacles can affect the use intention, but in the case of Saudi schools, this is not significant.

Finally, the model shows a moderately positive relationship with behavioural intention and actual use ($\beta = 0.319$, $t=3.733$, $p<0.05$) of ICT by the teachers in class, thus H11 is accepted. Importantly, the R-square value for the actual use is only 0.102, indicating behavioural intention to use ICT in class only explains 10.2% of actual use of ICT in class. This is very low, indicating behavioural intention does not explain the existing actual use. This is because actual use of communications technology for teaching is not high. Therefore, behavioural intention cannot predict actual use. The implication from this result is that the teachers are willing to use ICT, but there are factors preventing its adoption.

Analysis of the data to estimate the relationship among the variables overall revealed that the R-square value for behavioural intention was 0.561, meaning that about 56% of the variance in the dependent variable behavioural intention was predictable by the independent variables.

To further test the model, a blindfolding analysis of the model was conducted to measure the Q² values. In the structural model, a Q² value larger than zero for a reflective endogenous latent variable indicates the path model's predictive relevance for a particular construct [72]. In this case, for behavioural intention, the Q-square value is 0.277, and for actual use, the Q-square value is 0.072, indicating the model achieved statistically acceptable predictive relevance to mimic the real world conditions of ICT use behavioural intention and the actual use by the primary teachers.

IV. DISCUSSION

The supported constructs for primary school teachers in Saudi Arabia were:

- performance expectancy,
- effort expectancy,
- cultural factors,
- computer literacy,
- system quality,
- behavioural intention, and
- actual use.

Thus, primary school teachers' performance expectancy, effort expectancy, cultural factors, and system quality had a significant positive effect on their behavioural intention to use ICT. Their computer literacy had a significant positive effect on their effort expectancy of ICT, and their behavioural intention to use ICT had a significant and direct relationship with their actual use of ICT in their classes and teaching.

A. Performance Expectancy and Behavioural Intention

Performance expectancy has a significant effect on behavioural intention towards the use of technology [44], [49]. Qualitative analysis demonstrated that the teachers think that,

Use of ICT in classrooms improves primary school teachers teaching performance and increases learning productivity of primary school students. Additionally it is effective to make the students understand about difficult topics though use of photos and videos. This also increases the attention of the students (Interviewee #3).

It can be argued that if the teachers were provided with proper facilities, they would use ICT in their school activities to experiment with new approved ways of teaching. This finding is consistent with the basic idea of the UTAUT model, which suggested that performance expectancy would have a significant relationship with behavioural intention. The position is consistent with Al Mulhim [39] and Albugami and Ahmed [91], who suggested that perceived improvement in performance could motivate teachers to use ICT facilities more frequently. Therefore, it can be concluded that, the stronger the

performance expectancy of the teacher, the greater their intention to use ICT.

B. Effort Expectancy and Behavioural Intention of the Teachers

The teachers' SEM model found that effort expectancy had a moderately strong positive relationship with behavioural intention to use ICT in Saudi Arabian primary schools ($p < 0.05$). The qualitative interviews aligned with this result. In regard to effort expectancy, one of the teachers said that,

Using the computer for preparing lessons does not require a lot effort, but to use ICT in classrooms at advanced level requires some efforts for which trainings are required. (Interviewee #7)

The results indicated that if ICT proved easy to use, the teachers would be more likely to adopt the technology. However, Alenezi, [25], Al Mulhim [39] and Alhawiti [40] have previously pointed out that lack of access to technology, lack of training and lack of time made the use of ICT in teaching much more difficult, which concurs with the findings captured in this study.

C. Cultural Factors and Behavioural Intention to use ICT by the Teachers

Analysis of the data indicated that many of the teachers' behaviour in the school and their desire to use ICT in class tended to relate to the cultural context. The analysis found that there was a strong significant positive relationship between culture and behavioural intention to use ICT in classes among the primary school teachers who participated in the study ($p < 0.05$). This indicated that Saudi cultural factors could positively influence the use of ICT by teachers in classes in Saudi primary schools.

This finding proved quite interesting and somewhat surprising. Several studies have indicated that Islamic culture and the Saudi Arabian social system do not welcome ICT usage. Nearly 2000 internet sites are blocked by the government, including anti-Islamic content, demonstrating a desire to control the ICT sector and the viewer's [91].

However, the government of Saudi Arabia is attempting to change its social and economic structure in an effort to modernise, that is, to become part of the developed world. Saudi Vision 2030, for example, encourages greater engagement with ICT and education for young people as part of an effort to reduce dependency on an oil-based economy [99]. Most of the teachers in the research sample were relatively young adults, and it is possible that they considered ICT in their schools and classrooms from the point of view of the changing social and economic mood that is shaping Saudi Arabia currently.

The interviews revealed a range of opinions among the teachers about the efficacy of ICT, but many were very positive about the introduction of ICT and the positive changes the technology could bring. One of the teachers explained,

ICT is not suitable for their culture as it contains some bad things. So they do not prefer using ICT. (Interviewee #2)

While another teacher indicated:

In our social context, and following Islamic culture, it often look like ICT is not having favourable environment. But things are changing, and Islam does to hinder progressive ideas or tools, rather help use them in proper ways. (Interviewee#3)

D. System Quality and Behavioural Intention of the Teachers

The teachers' SEM model found that system quality had a moderate significant ($p < 0.05$) positive relationship with behavioural intention. That is, if the system quality were better; the teachers would be more willing to use ICT in classes. This finding differs from other studies at higher levels of Saudi education. The secondary and tertiary sectors have engaged with digital teaching technologies much more strategically than the primary sector, and progress has been rightly noted. However, on the whole, the quality of the current ICT system lags behind many other countries [25], which was made evident by our study.

Primary schools, particularly, continue to lack proper staffing for ICT system support, and even if an ICT system exists in a school, it is often outdated [39], [40]. Upon analysis, the data offered little evidence that the teachers understood what a quality system was, although it was clear that they understood that their systems were not high quality. In most cases, ICT facilities were actually non-existent, but the teachers expressed the belief that system quality would encourage them to use ICT. Thus, there existed a strong, positive relationship between system quality and behavioural intention. It has been argued by several studies that perceived system quality, as well as actual system quality, can both influence the behavioural intention to use ICT [47], [49], [50], [55].

E. Computer Literacy with Effort Expectancy of the Teachers

The model suggested that there was a very strong positive relation between computer literacy, and the effort expectancy of the primary school teachers in the sample ($p < 0.05$). This finding was supported by the qualitative interviews, where the teachers expressed the idea that with the help of ICT they might be better able to express their ideas to students in ways that would require less effort. Their comments showed, however, that they realised that they would need more time when initially working with ICT [100].

Most of them, however, did have a basic idea about how to operate computers, and run Microsoft *Office* products, so it was possible that their existing computer literacy would enable them to learn the use of ICT for teaching purposes quite quickly. They seemed confident that with basic training to improve their computer literacy, they would master the skills required to use ICT as a learning and teaching tool.

That was the optimistic view. However, the real and persistent lack of access to technology, lack of training and lack of time resulted in most of the teachers in Saudi Arabia being inexperienced in using ICT for teaching [39], [91].

It can be argued that, as more and more teachers gain the appropriate skills, computer literacy and confidence will increase until the system develops a critical mass that enables all teachers to ICT and implement it in their daily school activities.

F. Behavioural Intention and Actual use Of ICT by the Teachers

In Saudi Arabia, the teachers currently face several structural issues that reduce their actual use of ICT in teaching in spite of their intentions [39], [40]. Our study demonstrated, however, that they are very positive about using ICT. The model showed a moderate positive relationship between behavioural intention and actual use ($p < 0.05$) of ICT by the primary school teachers.

However, as noted previously, primary school teachers' behavioural intention to use ICT did not sufficiently explain their actual use (R-square value for the actual use is only 0.102), with only 10.2% of actual use of ICT in classes. This is very low, indicating that they are not actually using ICT in class despite their intention to use.

As a whole, the model predicted the behavioural intention of the teachers with greater accuracy than actual use (R-square value for the behavioural intention is 0.561), indicating that the factors that influenced the desire to use ICT (56.1% of behavioural intention) were different from those that resulted in its actual use. The interviews complemented these results by adding the insight that most of the teachers were positive about the use of ICT, but that they were not doing it currently due to the absence of facilities and support [91]. This explains why their actual use was lower, despite their intentions.

As per the teachers' SEM model path analysis, the unsupported construct and relations for primary school teachers in Saudi Arabia were:

- social influence–behavioural intention;
- facilitating conditions–behavioural intention;
- external barriers–culture and behavioural intention;
- computer literacy–performance expectancy.

In subsection G the possible explanations for not supporting these relations are discussed.

G. Social Influence and Behavioural Intention to use ICT of the Teachers

It was found from the model that social influence had no significant ($p > 0.05$) relation with behavioural intention to use ICT in schools by primary school teachers. This finding seemed curious on the face of it, as social surroundings often play a vital role in ICT adoption.

When looking at the cumulative data, it appeared that intention to use ICT was more personal and less socially directed than actual use, perhaps a reflection of the reality of adopting a new technology if given the opportunity at this level of schooling. In this regard, one of the teachers mentioned during the interviews that

It is general view of the society that, ICT is more useful for secondary or mostly for higher education; the children do not need ICT to learn. My friends and wife think ICT is not needed for children's education, as the lessons are quite easy. (Interviewee #6, Teacher)

The relation between social influence and intention to use ICT was thus a complex one. It is possible that the participants were not more active in pursuing the use of technology because of negative social influence, while being able to appreciate the benefits of the technology if they were assisted in using it. Thus, it can be argued that social influence has a more intense relation with actual use than with intention to use the facilities.

Pynoo et al. [101] did a cross-sectional study and found that the relation between social influence and behavioural intention to use ICT by the teachers did not remain the same all the time (not always significant, or insignificant). It varies based on the context of the teachers. The social surroundings of Saudi teachers may not predict their intention, but may influence their actual use (further explored in the interactive model for the teachers).

H. Facilitating Conditions and Behavioural Intention to use ICT of the Teachers

The teachers' model found that facilitating conditions had a weak negative and insignificant ($p > 0.05$) relationship with the behavioural intention of the primary school teachers. This result indicated that facilities existing in the schools did not influence the intention to use ICT in classes.

Several previous studies have mixed views regarding this, Teo [42], Teo, Lee, & Chai [37], Panda, & Mishra [102] indicated that facilitating conditions might have influence on the adoption of new technologies, while Pynoo et al. [101] showed that facilitating conditions had no impact on intention to use ICT by teachers, rather it affected the actual use. As found in the qualitative interviews, the facilitating conditions for the schools in this study were poor. On the whole, teachers in Saudi Arabia do not have appropriate or reliable technical facilities to use in their daily activities. As one teacher mentioned,

I prefer not to use the computer available in the class rather than using it because within the limited class time this loses some time due to the outdated system. Moreover we are not provided with projector in every class room. For the class of moderate to large number of students single computer is not enough. So it complicates the process rather than making it easy and simple. (Interviewee #2, Teacher)

Some of these statements explain that the facilitating conditions might be responsible for lower actual use of ICT by the teachers, while not influencing the intention to use ICT under the right circumstances. Thus, in general, it can be argued that poor facilitating conditions do not actually influence intention to use, but that they are responsible for lower actual use of ICT.

I. External Barriers, Culture and Behavioural Intention to Use ICT

The study found that external barriers to the use of ICT by primary school teachers in Saudi Arabia had a negative yet insignificant relationship with behavioural intention ($p > 0.05$). Additionally, culture had no significant relation with external barriers to the use of ICT by primary school teachers ($p > 0.05$). The result indicates that even though there are obstacles to the

use of ICT, the intention to use the technology is not influenced by external obstacles. One of the teachers explained,

I have taken the initiative to use ICT in my classrooms for teaching from my personal interest. I use lecture notes using computer to make them more interesting to the students. But for this I have not received any special training from the school. (Interviewee #4, Teacher)

This respondent offered the insight that some of the primary school teachers were willing to use communications technology in difficult circumstances and without support. These teachers showed initiative, always intend to use ICT when they can, but currently face obstacles that hamper actual use. External barriers and culture did not relate to behavioural intention.

J. Computer Literacy with Performance Expectancy of the Teachers

The teachers' SEM model found there was a weak and insignificant ($p > 0.05$) relation between computer literacy and performance expectancy, indicating computer literacy had no significant influence on performance expectancy.

It is possible that the teachers in the sample felt that computer literacy would mean that they could achieve their goals with less effort, once they had had some training, although some of the teachers observed that regardless of knowing how to use a computer as a teaching tool, their performance actually depended on classroom conditions and personal credibility and knowledge of subjects, not on just operating ICT facilities.

V. CONCLUSION

ICT has become part of everyday life for many people in both business and education. Technological literacy ensures modern technology can be used purposefully and strategically, and will enable Saudi development. Integration of ICT into Saudi education would provide a fillip to the traditional education system, extending students' and teachers' experience and knowledge.

ICT was introduced into education in Saudi Arabia after numerous calls for the development and reform of the sector, and was officially implemented throughout secondary schools less than a decade ago, but has been largely ignored in primary education. The interactive model developed for this study was able to identify reasons for this, which are more complex than can be perceived superficially, as the evidence shows.

While, by some, ICT is already perceived as a tool for improving teaching performance, collaboration, learning experience and learning outcomes, the nation has a relatively short experience with ICT use in education, and disinterest or opposition to its use are also evident.

Data analysis for this study showed that effort expectancy, performance expectancy, computer literacy, and system quality all had a positive influence on the majority of the teachers' intentions to use ICT if given the opportunity. Computer literacy had a significant positive effect on their effort expectancy, which in turn positively influenced their

behavioural intention. In contrast, Saudi social and cultural conditions and the quality of their ICT systems were clearly obstacles that restricted actual use.

The findings of this study will help guide the Saudi government as it seeks to ensure successful adoption of ICT in education by teachers. Policy makers in Saudi Arabia will have to take the initiative in encouraging primary level teachers and training them. System quality must be improved, and the community made more aware of the usefulness of ICT in education. Such initiatives will improve the effort expectancy and performance expectancy of the teachers; and reduce the negative effects of cultural and social factors, along with other obstacles. Ideally this will help the teachers develop positive behavioural intentions related to the use of ICT in primary education, which will in turn increase their actual use of ICT for teaching in the primary schools of Saudi Arabia.

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