Advances in Intelligent Systems and Computing 1171

Suresh Chandra Satapathy
Vikrant Bhateja
B. Janakiramaiah
Yen-Wei Chen *Editors*

Intelligent System Design

Proceedings of Intelligent System Design: INDIA 2019

Springer

Advances in Intelligent Systems and Computing

Volume 1171

The series "Advances in Intelligent Systems and Computing" contains publications on theory, applications, and design methods of Intelligent Systems and Intelligent Computing. Virtually all disciplines such as engineering, natural sciences, computer and information science, ICT, economics, business, e-commerce, environment, healthcare, life science are covered. The list of topics spans all the areas of modern intelligent systems and computing such as: computational intelligence, soft computing including neural networks, fuzzy systems, evolutionary computing and the fusion of these paradigms, social intelligence, ambient intelligence, computational neuroscience, artificial life, virtual worlds and society, cognitive science and systems, Perception and Vision, DNA and immune based systems, self-organizing and adaptive systems, e-Learning and teaching, human-centered and human-centric computing, recommender systems, intelligent control, robotics and mechatronics including human-machine teaming, knowledge-based paradigms, learning paradigms, machine ethics, intelligent data analysis, knowledge management, intelligent agents, intelligent decision making and support, intelligent network security, trust management, interactive entertainment, Web intelligence and multimedia.

The publications within "Advances in Intelligent Systems and Computing" are primarily proceedings of important conferences, symposia and congresses. They cover significant recent developments in the field, both of a foundational and applicable character. An important characteristic feature of the series is the short publication time and world-wide distribution. This permits a rapid and broad dissemination of research results.

**** Indexing: The books of this series are submitted to ISI Proceedings, EI-Compendex, DBLP, SCOPUS, Google Scholar and Springerlink ****

More information about this series at http://www.springer.com/series/11156

Suresh Chandra Satapathy · Vikrant Bhateja ·
B. Janakiramaiah · Yen-Wei Chen
Editors

Intelligent System Design

Proceedings of Intelligent System Design: INDIA 2019

Springer

Editors
Suresh Chandra Satapathy
School of Computer Engineering
KIIT Demmed to be University
Bhubaneswar, Odisha, India

B. Janakiramaiah
Department of Computer Science
and Engineering
PVP Siddhartha Institute of Technology
Vijayawada, Andhra Pradesh, India

Vikrant Bhateja
Department of Electronics
and Communication Engineering
Shri Ramswaroop Memorial Group
of Professional Colleges (SRMGPC)
Lucknow, Uttar Pradesh, India

Dr. A.P.J. Abdul Kalam Technical
University
Lucknow, Uttar Pradesh, India

Yen-Wei Chen
College of Information Science
and Engineering
Ritsumeikan University
Kyoto, Japan

ISSN 2194-5357 ISSN 2194-5365 (electronic)
Advances in Intelligent Systems and Computing
ISBN 978-981-15-5399-8 ISBN 978-981-15-5400-1 (eBook)
https://doi.org/10.1007/978-981-15-5400-1

Preface

This volume contains the papers that were presented at the 6th International Conference on Information System Design and Intelligent Applications (INDIA) organized by the Department of Computer Science and Engineering, LIET, Visakhapatnam, India, during November 1–2, 2019. It provided a great platform for researchers from across the world to report, deliberate, and review the latest progress in the cutting-edge research pertaining to smart computing and its applications to various engineering fields.

The response to INDIA was overwhelming with a good number of submissions from different areas relating to machine learning, intelligent system designing, deep learning, evolutionary computation, etc. After a rigorous peer review process, with the help of program committee members and external reviewers, only quality papers were accepted for publication in this volume of Springer.

Our thanks are due to Dr Neeraj Gupta, India, and Dr Naeem Hannon, Malaysia, for keynote address during these two days. We are thankful to Dr PVGD Prasad Reddy, Hon. VC, Andhra University, Visakhapatnam, for his inaugural address being the Chief Guest. We would like to express our appreciation to the members of the Program Committee for their support and cooperation in this publication. We are also thankful to the Team from Springer for providing a meticulous service for the timely production of this volume.

Our heartfelt thanks to management committee members of LIET for their support for hosting the conference. We place our appreciation to the Principal of LIET and HOD of the Department of CSE for continuous support and motivation. Special thanks to all Guests who have honored us in their presence in the inaugural day of the conference. Our thanks are due to all special session chairs, track managers, and reviewers for their excellent support. Support of all faculty members and student volunteers of LIET is praise worthy. Last but certainly not least, our

special thanks go to all the authors who submitted papers and all the attendees for their contributions and fruitful discussions that made this conference a great success.

Bhubaneswar, India — Suresh Chandra Satapathy
Lucknow, India — Vikrant Bhateja
Vijayawada, India — B. Janakiramaiah
Kyoto, Japan — Yen-Wei Chen

Editorial Board of INDIA

Dr. P. Satish, Dean, R&D, LIET
Dr. R. Rajender, Professor, CSE, LIET
Dr. K. Narasimha Raju, Professor, CSE, LIET

Springer Corresponding Editors INDIA2019

Dr. M. RamaKrishna Murthy, ANITS, Visakhapatnam, India
Dr. B. Janakiramaia, PVPSIT, Vijayawada, India

Publicity Committee

Mr. G. Sateesh
Mr. P. Jagannadha Varma
Mrs. K. Sadhana

Web Masters

Mr. U. Kartheek. Ch. Patnaik

Organizing Committee Members

Dr. G. A. V. Ramchandra Rao
Dr. G. Sitharatnam
Mr. D. Madhu Babu
Mr. A. Yugandhara Rao
Mr. B. Nageswara Rao
Mr. A. Rama Krishna
Mr. M. S. Uma Sankar
Mr. V. Anji Reddy
Mr. B. Sstish Kumar
Mr. D. Satish
Mr. S. K. Nagul
Mrs. B. Sailaja
Ms. P. Srinivasa Rao
Mrs. G. Yosada Devi
Mrs. G. Hymavathi
Mr. P. Ganesh
Mr. D. Sunil
Mrs. A. Subhalaxmi
Mr. J. Tulasi Ram
Mr. M. Sriramulu
Ms. B. Padmaja
Ms. M. V. Bhuvaneswari

Ms. M. Pallavi
Mr. S. Rambabu
Mr. Vinod Manikanta
Mr. G. Ravindranath
Mrs. M. Swetha

Supporting Staff

Mr. V. Satya Prasad, System Admin
Mr. M. Srikanth, Programmer
Mr. V. Pramodh, Programmer
Mr. B. Chinna Rao, Programmer

Contents

About the Editors

Suresh Chandra Satapathy is a Professor, School of Computer Engg, KIIT Deemed to be University, Bhubaneswar, India. His research interest includes machine learning, data mining, swarm intelligence studies and their applications to engineering. He has more than 140 publications to his credit in various reputed international journals and conference Proceedings. He has edited many volumes from Springer AISC, LNEE, SIST etc. He is a senior member of IEEE and Life Member of Computer society of India.

Vikrant Bhateja is Associate Professor, Department of ECE in SRMGPC, Lucknow. His areas of research include digital image and video processing, computer vision, medical imaging, machine learning, pattern analysis and recognition. He has around 150 quality publications in various international journals and conference proceedings. He is associate editor of IJSE and IJACI. He has edited more than 22 volumes of conference proceedings with Springer Nature and is presently EiC of IGI Global: IJNCR journal.

B. Janakiramaiah is a Prof in the Dept of CSE, PVPSIT, Vijayawada, India. He obtained his PhD in Computer Science from JNTU Hyderabad. He has ample experience being in Editorial board of Spinger AISC and LNNs of IC3T 2016 and also acted as reviewer for various international journals from Elsevier, springer, IOS press etc. His research domain is Intelligent system with Soft Computing. He has quality publications in international journals and also many publications in conf proceedings. He is a member of CSI, IEEE etc.

Yen-Wei Chen received the B.E. degree in 1985 from Kobe Univ., Kobe, Japan, the M.E. degree in 1987, and the D.E. degree in 1990, both from Osaka Univ., Osaka, Japan. He was a research fellow with the Institute for Laser Technology, Osaka, from 1991 to 1994. From Oct. 1994 to Mar. 2004, he was an associate Professor and a professor with the Department of Electrical and Electronic Engineering, Univ. of the Ryukyus, Okinawa, Japan. He is currently a professor with the college of Information Science and Engineering, Ritsumeikan University, Japan. He is also a visiting professor with the

College of Computer Science, Zhejiang University, China. He was a visiting professor with the Oxford University, Oxford, UK in 2003 and a visiting professor with Pennsylvania State University, USA in 2010.

His research interests include medical image analysis, computer vision and computational intelligence. He has published more than 300 research papers in a number of leading journals and leading conferences including IEEE Trans. Image Processing, IEEE Trans. SMC, Pattern Recognition. He has received many distinguished awards including ICPR2012 Best Scientific Paper Award, 2014 JAMIT Best Paper Award, Outstanding Chinese Oversea Scholar Fund of Chinese Academy of Science. He is/was a leader of numerous national and industrial research projects.

Acceptance of Technology in the Classroom: A Qualitative Analysis of Mathematics Teachers' Perceptions

Perienen Appavoo

Abstract The degree of integration of ICT in education varies within contexts. Accordingly, teachers have different opinions and beliefs on the practicability and educational worth of the integration. This research was carried out to collect the views of Mathematics teachers after a blended model, combining the traditional approach with ICT-based lessons, was used to teach the topic fractions to junior secondary school students. These class teachers were thus able to give an informed opinion of the process. Data collected led to the construction of a Technology Implementation Model. The four emerging themes of the interviews were 'learner empowerment', 'effective teaching', 'inhibiting factors' and 'teacher support'. Generally, teachers were positive about the pedagogical worth of ICT and expressed their willingness to see technology as part of the teaching/learning process. However, apprehension and concerns were also voiced out and one key element highlighted was the systemic and systematic professional development of teachers.

Keywords Teacher professional development · Integration of technology · Mathematics · ICT-based lessons

1 Introduction

Today, we are witnessing a major shift in the way we conduct business and do our activities because of the tremendous influence of technological affordances. The education sector has not escaped this wave of technology integration and teaching and learning are taking new turns to bring learning content in innovative ways. Many of those who are called to embrace this new paradigm have never used any technology in their learning. What is required of them is a novel way of teaching, to which they have scantly been exposed. It is, therefore, appropriate to investigate to what extent teachers are ready to accept computing tools in the classroom. Closely linked to that is the readiness of teachers to operate these tools. As mentioned by Tondeur et al. [1]

P. Appavoo (✉)
Open University of Mauritius, Moka, Mauritius
e-mail: p.appavoo@open.ac.mu

S. C. Satapathy et al. (eds.), *Intelligent System Design*, Advances in Intelligent Systems and Computing 1171, https://doi.org/10.1007/978-981-15-5400-1_1

'merely providing ICT does not inevitably improve learning, but beyond access, it is how teachers use ICT that makes a difference, and Teacher professional development (TPD) is critical to achieving valued outcomes'. Moreover, teachers' opinions and beliefs count, and helping them to develop their knowledge and attitudes can promote a culture that supports ICT as an integral part of the learning and teaching process. By now, every teacher in Mauritius has been exposed to educational technology to some extent and every school is equipped with computers [2]. But there is scant information about what is happening in the classroom and what teachers as key players feel about this integrative process. This paper seeks to analyze the opinions and beliefs of practicing Mathematics teachers who have been exposed to a real classroom situation whereby both traditional practices and ICT-based lessons were used to teach the Mathematics topic, fractions.

2 Literature Review

Today, there is mounting pressure from all quarters to use innovative tools to meet the emerging learning styles of students. Great challenges are thus awaiting teachers in this new era of technological transformation. Teachers in Israel have positive perceptions of their competence in technology and have embraced technology in the teaching of Mathematics [3]. It was found that teachers with routine access to computers tend to employ teaching practices that put students at the centre of learning [4, p. 1]. Teachers, being an integral part of the teaching and learning process, will play a major role in the adoption and implementation of ICT in education [5]. Lim et al. [6] purported that teachers' personal ICT conceptions affected how they used ICT in their teaching, and teachers' belief in the potential of ICT was an important factor that contributed to the high frequencies of ICT usage. The overall conclusion from the works of Uluyol and Sahin [7] is that more concrete encouragement, support and opportunities must be developed to increase teachers' motivation, and thus improve the level and quality of ICT use in classrooms. Gul [8] investigated technology integration and reported that teachers' attitude to technology and willingness to use technology were significant factors. Teachers need ICT-pedagogical skills to be able to integrate technology-enhanced lessons in their teaching.

Unfortunately, many teachers are grappling with ICT tools to channel them towards sound pedagogical gains and meet the emerging demand for education [9]. In an educational process still constrained by the traditions and practices of the past, the integration of technology is not an automatic process and encompasses a number of factors, with the teacher as the lead agent of change. It is known that in the history of new technologies in education, many teachers have in varying ways resisted, through fear and anxiety, lack of competence, poor leadership from senior staff and inadequate technical support [10]. How are teachers supposed to integrate what they know with technology? Koehler et al. [11] contend that there is no 'one best way' to integrate technology with curriculum. Following a survey carried out by Blackwell et al. [12] with early childhood educators, it was found that more than

anything else, attitudes toward the value of technology to aid children's learning have the strongest effect on technology use, followed by confidence and support in using technology. It was argued that apart from the knowledge, skills and attitudes, teachers' need, beliefs about teaching and learning with technology also mattered for adequate teaching in the knowledge society [13]. Ertmer [14] purported that any new knowledge base will remain unused unless teachers make sense of its application within their prevalent pedagogical understandings. Whether through choice or necessity, there is an increasing number of teachers using both ICT-mediated and face-to-face teaching and learning [15].

When it comes to the teaching of Mathematics, teachers have to be trained in the innovative use of technological tools [16]. As highlighted by Tondeur et al. [1], systemic (stakeholders, local factors) and systematic (gradual and evolving) teacher professional development (TPD) is one of the five challenges to effective teacher empowerment. Despite the panoply of academic works already documented in this field, Aris and Orcos [17] believe that it is crucial to continue research on the teacher educational experiment for future implementation of ICT. This study will investigate the teachers' perception/beliefs regarding the pedagogical worth of technology in the teaching of Mathematics.

2.1 TAM and UTAUT

Successful uptake of technology in the teaching/learning process starts with technology acceptance and one framework that has been widely adopted and researched is the technology acceptance model (TAM), based on the theory of reasoned action (TRA) by Fishbein and Ajzen [18]. TRA examines the relationship between beliefs, intentions, attitudes and the behaviour of individuals. According to this model, a person's behaviour is determined by its behavioural intention to perform it. Bandura [19] also highlighted the importance of perceived usefulness and perceived ease of use in predicting behaviour. Perceived Usefulness (PU) measures the efficacy identified by the user while perceived ease of use (PEOU) identifies the difficulty level of the technology perceived by the user [20]. PEOU and PU form the two major components of TAM which is a theoretical framework that provides a systematic way to make predictions about technology acceptance and computer usage behaviours. This technology acceptance model rests upon the fact that the way a person perceives the usefulness (PU) of technology and its ease of use (PEOU) will determine the way that person makes use of that particular technology. The first proponent of TAM [21] based the model on the assumption that user motivation can be explained by three factors: (1) perceived ease of use, (2) perceived usefulness and (3) attitude toward usage. Davis [21] hypothesized that the attitude of a person towards a system was a major factor that influenced whether he/she would use or reject the system. In turn, the person's attitude seems to be influenced by two major beliefs: perceived usefulness and perceived ease of use, where perceived ease of use has a direct influence on perceived usefulness.

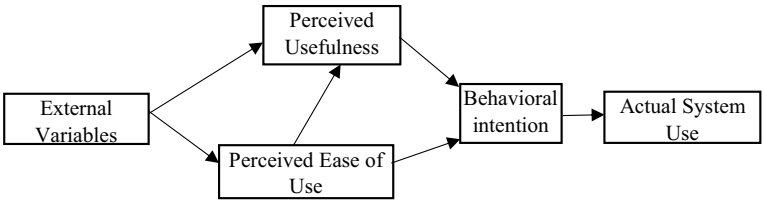

Fig. 1 Final version of TAM by Venkatesh and Davis [23] (*Source* Lala [20])

Davis et al. [22] later found that perceived usefulness was a major significant determinant of peoples' intention to use computers while perceived ease of use was only a significant secondary determinant. In 1996, Venkatesh and Davis [23] proposed a new refined model of TAM (Fig. 1).

However, according to Lala [20], there is a need for future research that can focus on developing new models that exploit the strengths of TAM because though it is a very popular model for explaining and predicting the use of a system, it does have some uncertainty among some researchers about its application and accuracy. This model has been largely reviewed by many researchers and additional factors and variables identified to include extrinsic and intrinsic motivation, self-efficacy [19], behavioural intention [21] and opinion of others [23], all of which were found to influence the adoption and usage of new technologies. Ensminger [24] proposed that examining teachers' perceptions of these variables can help those in charge of planning for technology gain a deeper insight into what might affect the final use of technology in the classroom.

2.2 Aim and Objectives of the Study

The aim of this study is to draw a theoretical framework that depicts teachers' opinions and beliefs about the integrative process of ICT in the classroom. This was achieved through the following research questions:

1. Which elements of ICT-based lessons did teachers find beneficial?
2. Which elements of ICT-based lessons were challenging to teachers?
3. What kind of support must be given to teachers for the integration of technology?

3 Methodology

The topic fractions was taught in five different schools during a period of two weeks in each school. Teaching was done using a digital learning software comprising interactive powerpoints, instructional videos and apps, e-exercises and worksheets, all loaded on tablets. Students worked in pairs using the tablets and class teachers

were present throughout the experiment to witness how technology, blended with the traditional practices, was used to teach Mathematics. The researcher conducted the experiment in each school, hence guaranteeing consistency. Once the experiment was over, semi-structured interviews, guided by questions based on literature review, were conducted with the class teachers. Subsequent interviews were slightly modified based on emerging findings in view of seeking further clarification. Five teachers were interviewed, two female and three males. Each interview lasted around one hour. Beliefs, attitudes and opinions of teachers regarding the experiment were recorded and codified around central themes addressing the pedagogy, learning conditions, performance gains and apprehensions.

4 Data Analysis

Once the five interviews had been transcribed verbatim, the Word documents were then uploaded on the computer-assisted qualitative data analysis software Atlas.ti. During the experiment, informal chats were held with the class teachers to collect views and opinions of the process of technology integration in the teaching/learning of fractions.

This qualitative method resulted in a vast amount of richly detailed data that was contextually laden and subjective, hence revealing the perception and beliefs of those teachers exposed to the experiment. The process of thematic content analysis was adopted to identify themes and categories that 'emerge from the data'. Particular care was given to deviant or contrary cases—i.e. findings that were different or contradictory to the main ones, or were simply unique to some or even just one respondent.

One hundred and thirteen quotations were highlighted from the five Word documents to generate 32 codes. These codes were later reduced to 14 with appropriate renaming, and then these were finally grouped under four main themes namely, *learner empowerment*, *effective teaching*, *inhibiting factors* and *teacher support* (Fig. 2).

Teachers noted four key elements with regard to *learner empowerment*. They observed that students were motivated and showed great interest in their Mathematics lessons, factors which have been vastly researched and reported upon by Jewitt et al. [25] and Penuel [26]. They discussed the benefits of students taking ownership of their learning, giving them in the same breath independence to learn and progress at their own pace. They also appreciated that peer tutoring evolved as a natural practice of this new learning environment. Tsuei [27] reported that peer tutoring is one of the most well-studied strategies in Mathematics instruction and proved that technology was effective in enhancing the learning of Mathematics for students with learning disabilities.

The second emerging theme related to *effective teaching.* Teachers mentioned that learning content, enhanced with video clips, slides presentation, mathematical games and interactive exercises, could make them more effective in their teaching. They

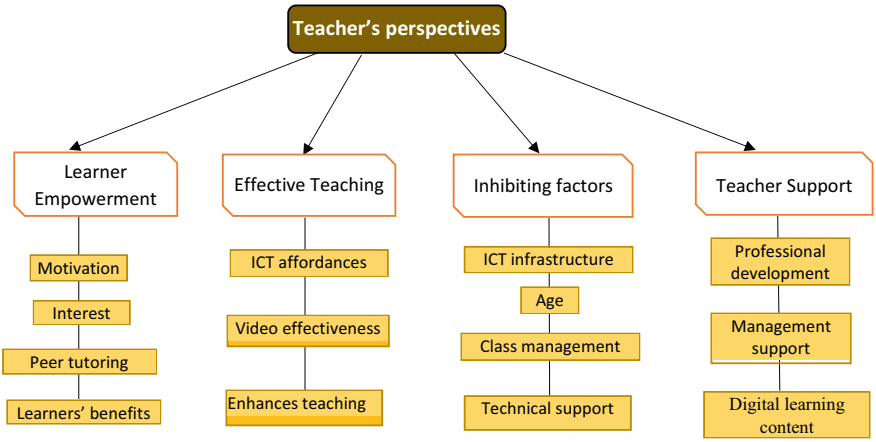

Fig. 2 Technology implementation framework—a teacher's perspective

appreciated the pedagogical worth of the videos which offered greater and enhanced learning experiences to students [28], but were also concerned with the narrator's language and pronunciation.

Teachers valued the interactivity of the learning content and its multimedia components as driving forces that rendered the Mathematics lessons more appealing and engaging. Moreover, they could see technology facilitating effective lesson planning, where future lessons can be easily enhanced, edited and updated. These interviews demonstrated that teachers were able to appreciate the worth of ICT as a teaching tool that could ease the teaching of abstract and difficult concepts.

One teacher considered the computer as a convenient tool for managing student's personal data, marks and grades. In general, teachers opined that this mode of instruction provided more class time to attend to needy students while high performers proceeded with further work. This was seen as convenient to work with mixed-ability students, offering teachers the ability to transform the quality of instruction and promote a more student-centered learning environment as proposed by Penuel [26].

The third theme related to factors that they considered as inhibiting the successful uptake of technology in their teaching. If teachers were positive about the benefits of technology integration, yet they drew attention to the poor and inappropriate technological infrastructure and restricted access in schools. They voiced out the unpreparedness in terms of skills required to channel the affordances of technology in their teaching, especially by the elder teachers who were the most resistant to change. As described by Archambault et al. [29], there is a need to provide teachers training in progressing technologies that can help them transform their pedagogy to leverage the affordances provided by ICT integration. For two teachers, managing digitally enhanced classrooms can have its own challenges, in terms of discipline, class management and ensuring that computer activities were really geared towards learning, and attending to technical failures especially where technical support was

scarce. Penuel [26] reported that in addition to teacher professional development and positive teacher attitudes, access to technical support is a key factor directing the effective implementation of ICT in schools. One teacher also proposed to reduce the class size to make the class more manageable.

A fourth theme emerged from the interviews and focused on teacher's support. Professional development to master the skills of working with digital content was commonly mentioned by the teachers as a non-negotiable prerequisite for the successful uptake of ICT by teachers. Such findings have been reported by Penuel [26] and Minshew and Anderson [30] where attention was drawn to the fact that the lack of adequate professional development can become a source of frustration.

Teachers said it would be appropriate if the digital learning content could be made readily available, but also wished they could have the expertise to amend and contextualize the latter to fit the level of their students. Lim [31] proposed to develop a framework for teachers within the same department to collaboratively design ICT-mediated lessons, and share ICT resources, and lesson plans. Teachers also requested the sustained support of management as reported by Solar et al. [32]. One teacher suggested that school's management should encourage collaboration and discussions among colleagues to foster confidence and beliefs in ICT integration. Moreover, the role of parents was raised and comments were geared towards making them aware of the potential of ICT to impact learning and to encourage them take responsibility for the proper use of technology at home. Zhang and Zhu [33] found that in order to improve students' digital media literacy, cooperation between school and home is necessary.

5 Limitations

This experiment was very time consuming, lasting two weeks in each of the five schools. Hence data was collected from only five class teachers. Moreover, only one topic, namely fractions was taught using this approach. In the future, more teachers could be exposed to technology-enhanced teaching. For example, three to four teachers could be present while the experiment is carried out in one class. Other topics could be taught using this approach. Opinions and views would then be collected from a greater number of teachers, and the findings would then be more generalizable.

6 Conclusion and Recommendations

Despite the restricted number of participants in this study, there was a good representation of male and female teachers, working in both high and low performing schools. Interviews were intense and a rich array of data collected to form an opinion of what teachers perceived of the integration of technology in schools and hence

their acceptance thereof. Teachers' feedback focused on four themes namely, *learner empowerment*, *effective teaching*, *inhibiting factors* and *teacher support.* They saw both sides of the coin, one side showing all the benefits teachers and students could derive from ICT-enhanced lessons and the other one showing the hindrances and hence measures to be taken to facilitate the integration of technology in schools.

The major concerns of teachers evolving from observations, discussions and interviews can be summarized as follows:

- Fear of losing control of the class as students might demonstrate greater mastery of the tool than the teacher.
- Inability to attend to hardware malfunctioning during classes.
- Lack of specific teaching skills and strategies to integrate ICT in the curriculum.
- Restricted access to the latest technology and appropriate logistics.
- Belief that planning and conducting ICT-based lessons is more time consuming, hence the fear of not completing the syllabus on time.
- Challenges of managing a digital classroom, with IT equipment and students working more independently.
- Some were apprehensive that the uptake of ICT will discard prevailing teaching methods completely and recommended rather a blended approach that would support and enhance existing teaching practices. Teachers maintained the importance of the explanation copybook for revision.
- Lack of traceability of work done by students. Contrary to exercise books, the tablet left no trace of work accomplished by the student.

This study did reveal though a significant acceptance of technology in the classroom by teachers. However, readiness to maximize on the affordability of ICT to revamp teaching and learning remains a grey area. Teachers need to be reassured through ongoing professional development, and they must also be accompanied in the integrative process. More ICT-enhanced model lessons should be made available to teachers and they must be provided with the appropriate guidelines. Most teachers have studied in the traditional way while they were students, and today shifting to the use of technology poses problems. The lessons learnt from this study are numerous and should add academic discourse to the uptake of technology in education.

References

1. Tondeur, J., Forkosh-Baruch, A., Prestridge, S., Albion, P., & Edirisinghe, S. (2016). Responding to challenges in teacher professional development for ICT integration in education. *Educational Technology & Society, 19*(3), 110–120.
2. Central Statistics Office. (2016). http://statsmauritius.govmu.org/English/Publications/Pages/all_esi.aspx#2017.
3. Baya'a, N., & Daher, W. (2012). Mathematics teachers' readiness to integrate ICT in the classroom: The case of elementary and middle school Arab teachers in Israel. In *Interactive Mobile and Computer Aided Learning (IMCL) International, Conference*, IEEE. https://doi.org/10.1109/imcl.2012.6396470.

4. Office of technology assessment: Teachers and technology: Making the connection. U.S. Government Printing Office (1995).
5. Liu, R. (2010). Psychological research in educational technology in China. *British Journal of Educational Technology, 41*(4), 593–606.
6. Lim, L. Y. T. S. K., Lim, C. P., & Koh, J. H. L. (2012). Pedagogical approaches for ICT integration into primary school English and Mathematics: A Singapore case study. *Australian Journal of Educational Technology, 28*(4), 740–754.
7. Uluyol, C., & Sahin, S. (2016). Elementary school teachers' ICT use in the classroom and their motivators for using ICT. *British Journal of Educational Technology, 47*(1), 65–75.
8. Gul, K. Y. (2015). The views of Mathematics teachers on the factors affecting the integration of technology in Mathematics courses. *Australian Journal of Teacher Education, 40*(8), 32–148.
9. Virginia, E. (2016). Transforming the classroom. Technology counts. *Education Week, 35*, 35. https://eric.ed.gov/?id=ED566602.
10. Nagel, D. 6 technology challenges facing education. Ed Tech Trends, https://thejournal.com/articles/2013/06/04/6-technology-challenges-facing-education.aspx.
11. Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education, 193*(3), 13–21.
12. Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education, 77,* 82–90.
13. Sim, J., & Theng, L. B. (2007). Teachers' perceptions of the use of ICT as an instructional tool in Mathematics and Science.
14. Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *Educational Technology Research and Development, 53*(4), 25–39.
15. Latchem, C. (2017). Using ICTs and blended learning in transforming TVET. United Nations Educational, Scientific and Cultural Organization and Commonwealth of Learning.
16. Clarke, T., Ayres, P., & Sweller, J. (2005). the impact of sequencing and prior knowledge on learning Mathematics through spreadsheet applications. *Educational Technology Research and Development, 53*(3), 15–24.
17. Aris, N., & Orcos, L. (2015). ICTs and school education. Special issue on teaching Mathematics using new and classic tools. *International Journal of Interactive Multimedia and Artificial Intelligence, 3*(4), 13–18.
18. Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behaviour: An introduction to theory and research, Reading, MA.
19. Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122–147.
20. Lala, G. (2014). The emergence and development of the technology acceptance model (TAM). *Proceedings of the International Conference Marketing- from Information to decision, 7,* 149–160.
21. Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35,* 8.
22. Venkatesh, V., & Davis, F. D. (1996). A model of antecedents of perceived ease of use: Development and test. *Decision Science, 27*(3), 451—481.
23. Svendsen, G. B., Johnsen, J. K., Almas-Sorensen, L., & Vitterso, J. (2013). Personality and technology acceptance: The influence of personality factors on the core constructs of the technology acceptance model. *Behaviour & Information Technology, 32*(4), 323–334.
24. Ensminger, D.(2016). Technology planning in schools. In N. Rushby & D. Surry (Eds.), *The Wiley handbook of learning technology* (p. 461). Wiley: New Jersey.
25. Jewitt, C., Hadjithoma-Garstka, C., Clark, W., Banaji, S., & Selwyn, N. (2010). *School use of learning platforms and associated technologies*. Becta: University of London.
26. Penuel, W. C. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*(3), 329–348.
27. Tsuei, M. (2014). Mathematics synchronous peer tutoring system for students with learning disabilities. *Educational Technology & Society, 17*(1), 115–127.

28. Willmot, P., Bramhall, M., & Radley, K. (2012). Using digital video reporting to inspire and engage students. http://www.raeng.org.uk/education.
29. Archambault, L. M., Wetzel, K., Foulger, T. S., & Williams, M. K. (2010). Professional development 2.0: Transforming teacher education pedagogy with 21st century tools. *Journal of Digital Learning in Teacher Education, 27*(1), 4–11.
30. Minshew, L., & Anderson, J. Teacher self-efficacy in 1:1 iPad integration in middle school science and math classrooms. *Contemporary Issues in Technology and Teacher Education, 15*(3). http://www.citejournal.org/volume-15/issue-3–15/science/teacher-self-efficacy-in-11-ipad-integration-in-middle-school-science-and-math-classrooms.
31. Lim, C. (2007). Effective integration of ICT in Singapore schools: Pedagogical and policy implications. *Educational Technology Research and Development, 55*(1), 83–116.
32. Solar, M., Sabattin, J., & Parada, V. (2013). A maturity model for assessing the use of ICT in school education. *Journal of Educational Technology & Society, 16*(1), 206–218.
33. Zhang, H., & Zhu, C. (2016). A study of digital media literacy of the 5th and 6th grade primary students in Beijing. *The Asia-Pacific Education Researcher, 25*(4), 579–592.

Smart Agriculture Using IOT

Bammidi Deepa, Chukka Anusha, and P. Chaya Devi

Abstract An automated agriculture system is developed to monitor and maintain the important aspects of farming like temperature, humidity, soil moisture content and sunlight using IoT technology. The sensors must be placed at appropriate places and positions to sense and communicate the details using cloud computing to the mobile phones of farmers, to optimize the agriculture yield by automating the field maintenance system. Improved water supply process, brightness maintenance, temperature conditions adjustments can be achieved in the automated system using the proposed idea. Single board Node MCU microcontroller is used as the decision making and controlling device between various sensors and the farm maintenance equipment. The proposed system is expected to be helpful to the farmers in controlling an irrigation system in a better and accurate way.

Keywords Farm automation · Node MCU · Sensors · Cloud computing · Smart agriculture · Monitoring

1 Introduction

Agriculture and cultivating plants is a science and art. The food and livestock development through agriculture have facilitated the human population to progress many times larger than that could be achieved by hunting and collecting food. Due to the enormous increase in population and changes in climatic conditions, the application of IoT has become necessary for the sustainable growth of food for living beings. IoT is a shared network that can interact with objects through an internet connection. IoT systems help farmers in getting information and making decisions throughout

B. Deepa (✉) · C. Anusha · P. Chaya Devi
Anil Neerukonda Institute of Technology and Sciences, Visakhapatnam, India
e-mail: deepa.ece@anits.edu.in

C. Anusha
e-mail: anoosha.ece@anits.edu.in

P. Chaya Devi
e-mail: chayadevi.ece@anits.edu.in

S. C. Satapathy et al. (eds.), *Intelligent System Design*, Advances in Intelligent Systems and Computing 1171, https://doi.org/10.1007/978-981-15-5400-1_2