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A Fundamental Study of an Alternative Learning Framework Utilizing Natural User Interface (NUI) for Physically Disabled Students

Marianne Too* and Roy Chang

Abstract - An alternative learning framework utilizing a natural user interface (NUI) can be applied in the context of education for students whose needs are not catered for in the current learning environment in Malaysia. The alternative learning program would still follow the current subject syllabus, but with differences in how the lessons are delivered, learned and executed. A conceptual framework that enables the adoption of the alternative learning program using Microsoft Kinect in Malaysian education system was then proposed to minimize the gaps found in the current learning setting to accommodate for Malaysia's physically disabled children's special needs primary school children, using the National Curriculum as a guide. Since this is a new framework, the reliability and the validity of the proposed framework will be analyzed. A usability test would also be conducted to gauge the acceptance of the proposed framework amongst the children.

Keywords: *Alternative Learning, Kinect, User Acceptance*

I. INTRODUCTION

Alternative learning programs are defined as "methods of adapting educational programs to meet the individual needs of students and at the same time providing a vehicle for examining new ways of learning in a changing society" [1]. The alternative learning program would still follow the current subject syllabus, but with differences in how the lessons are delivered,

learned and executed. A study conducted in Philippines showed that alternative learning programs have a positive relationship towards the students' academic performance [2]. The plus side of alternative learning programs is that it can always be improved with the advent of new technology. With the emergence of new interactive technology like Kinect, alternative learning programs can evolve once again. An alternative learning program utilizing Kinect as a natural user interface can be applied in the context of education for disabled children whose needs are not catered for in the current learning environment in Malaysia. Children with substantial problems in communication, comprehension, vision, hearing, or physical movements are considered disabled [3]. Under Malaysia's Education Regulation (Special Education) 2013, education services are provided for children with hearing and visual impairments, mild intellectually challenged, and physically disabled children with normal cognitive abilities [4]. In Malaysia, the pencil-and-paper method is still the learning method used [5]. This traditional method requires the children to constantly use their hands in jotting down notes or during exams. This arrangement is a hassle, especially for those who are physically disabled and are not able to hold or even grip a pencil or pen properly. In light of this, there is a need to provide an alternative method of learning for these children to help them cope with the demand of learning. As mentioned

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previously, with emergence of Kinect, alternative learning programs can move into a touch-free learning environment. In the current inclusive programs, traditional methods of teaching and learning are applied. This leaves little scope for addressing diverse learning needs of children which could hinder their academic development. The inclusive programs also are lacking in assistive devices and learning materials suitable for these children. In majority of the situation, the disabled children feel neglected when it comes to group activities which involves children without any disabilities [6]. An alternative learning program could be designed to incorporate group learning amongst those disabled to enhance peer-to-peer learning. Parents should be involved hands-on with the development of their children. However, sometimes parents with disabled children may not know the best way to cater for their children, especially when it comes to academic matters. Parents are not sure how to teach their children with the current teaching method. Parents involvement in their studies play a critical part in their children's success [7]. If an alternative learning program is designed that is user-friendly and allows parents to learn and at the same time interact and educate their children, this would be a win-win situation for all parties – children, parents, and teachers likewise. The alternative learning program could also be used as a home tutor for disabled children. This objective of this research will therefore focus on developing, validating, and determining the user acceptance of an alternative learning program in Malaysia to accommodate the physically disabled children's special needs.

II. LITERATURE REVIEW

A. Disabilities and Education

In Malaysia alone, in year 2012, there are 85,803 new registrations of persons with disabilities were recorded; 38% of whom were children [8]. According to Issue Brief [9], a legal framework for education for physically disabled children is provided under the Education Regulations (Special Education) of 2013 and the Education Act of 1996; is applicable to all schools with special needs education, whether government or government-aided. Disabled children's education in Malaysia is parked under the Ministry of Woman, Family and Community Development, and the Ministry of Education. In the current system, there are three programs available for disabled children under the Ministry of Education [9] Special Education Schools: These schools cater for unique curriculum and learning methods for children that are blind and deaf. Integration Program: The "Special Education Integrated Programme (SEIP)" provides special classes for children with learning impairments within normal schools. Inclusion-Focused Efforts: The "Inclusive Education Programme" aims to mix special needs children into normal classes so they will not feel left out. Teaching aids and additional assistance are provided.

B. Alternative Learning Method and its Effectiveness

The Education Rules (Special Education) 1997 mentioned "teachers are allowed to modify method and

approaches in teaching and learning, time provisions in daily scheduled activities, subjects matter, and the teaching aids that are more appropriate and suited the individual needs of these special needs students for more quality education." Teaching children with disabilities in normal classes requires customization in terms of delivering the lessons. The traditional methods of teaching and learning, learning aids, and the evaluation systems leave little scope for addressing diverse learning needs of children. Research has shown that one of the factors that affect performance is specific to physical disability [10], [11]. When their performances are affected, this would allow little opportunity for disabled people to continue with their education. Teachers' perceptions and methods of teaching will also influence the performance of students [12]. To aid in processing and understanding the lessons taught, assistive technology or other learning tools can be applied [13]. For example, children with speech and physical disabilities can use computers with assistive software, voice activated software and wireless mouse that are mobile and interactive with the computer which allows for a more inclusive learning environment. Teaching the curriculum to disabled children using technologies had shown to improve performance in the children's academics [14]. Despite the benefits of alternative learning and other learning tools, traditional methods are still used although it is ineffective.

III. PROPOSED CONCEPTUAL FRAMEWORK

The proposed conceptual framework (refer to Figure 1) was adapted from several models - Unified Theory of Acceptance and Use of Technology (UTAUT) model by Venkatesh et al. [15]; Family Involvement Questionnaire (FIQ) by Fantuzzo et al. [16]; Family-School Relationships Survey by Gehlbach, H. [17]; and Intrinsic Motivation Inventory (IMI), developed by Deci and Ryan [18]. UTAUT was created by Venkatesh et al. [15] to merge previous technology acceptance model (TAM) related studies. According to UTAUT, the key factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions can help with prediction of the behavioral intention of using the technology and the actual usage of said technology. Many studies in recent years have been conducted utilizing UTAUT, including in the educational context and showed that three of the four key factors (excluding facilitating conditions) do predict behavioral intention [19], [20].

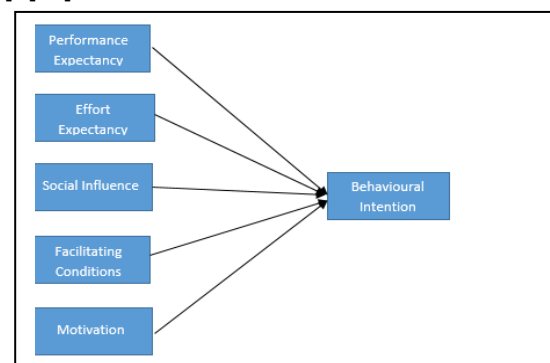
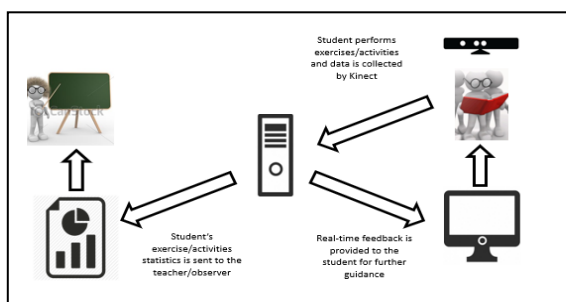


FIGURE 1. Proposed conceptual framework.

According to Venkatesh et al. [15] social influence “contains the external social environments related to an individual's behavior intention such as the reflection of peers, instructors and subjective social conditions”. For the purpose of this research, social influence is considered as the level that the students think are significant role models, such as their parents and guardians, were influential in their use of technology. Childrens whose parents are actively involved in their learning has shown to have higher academic motivation, achievement, and self-esteem [20]. As this study is on parental support in a home setting, the Family Involvement Questionnaire (FIQ) and the Family-School Relationships Survey were selected to be included in this study. The FIQ was applied to gauge parents' use of learning activities and habits to support their children's education at home [16]. The Family-School Relationships Survey was created to provide schools with guidance on family attitudes, specifically parent support and efficacy [17]. Research has shown that motivation plays a vital role in children's learning effectiveness [22], thus this variable is added into the framework. In measuring the intrinsic motivation of students, we are adopting the Intrinsic Motivation Inventory (IMI) instrument [18]. The instrument evaluates participants' “interest/enjoyment”, “perceived competence”, “effort/importance”, “pressure/tension”, “perceived choice”, “value/usefulness”, and “relatedness”, thus yielding seven subscale scores.

IV. METHODOLOGY

A total of 32 students and their parent/guardian participated in this study. The students were from primary schools (ranging from ages 8-9 years old), in Melaka Tengah. They were selected based on their physical disability. The proposed alternative learning framework utilizing natural user interface is developed by using Microsoft Kinect to assist teachers in teaching students with physical disability by gauging the accuracy of their movements during learning. The interactive interface with audio and video feedback is used to reinforce an individual's motivation to engage in learning activities. The activities will make use of the hand joints, for example moving objects, choosing objects, and raising hands or arms. The implementation of the study is visually diagramed in Figure 2.

**FIGURE 2. Implementation setup of study.**

The intention to adopt the alternative learning method will be tested using questionnaires that were developed based on UTAUT [15], FIQ [16], Family-School Relationships Survey [17], and Intrinsic Motivation Inventory (IMI) [18]. Each of the questions in their original forms were reviewed and modified to suit the targeted respondents. Some of the modifications made for UTAUT, FIQ and Family-School Relationship Survey include changing some words used in the original version (e.g., system to Kinect), and simplifying the words. As for IMI, we used the condensed version which has been validated [18]. The pool of items created had 3 items for PE, 3 items for EE, 12 items for parental involvement, 2 items for FC, 9 items for Motivation, and 3 items for BI. Responses were measured using a Likert scale from 1 - strongly disagree to 7 - strongly agree.

V. RESULTS AND DISCUSSION

As the proposed framework of this study is a new framework, there is a need to evaluate on the validity and reliability of the questionnaire used to ensure the feasibility and consistency of the questionnaire in measuring the intended outcome of this study [23]. The definition of validity can be “the accuracy of an instrument in measuring the anticipated constructs within research” [24]. Validity can be tested in four forms – face, content, construct, and criterion. In our study, only face and content validity will be tested as our sample size is deemed too small for the remainder two validity tests, and thus may lead to inaccurate analyses [25]. As mentioned by Wong and Yamat [24], face validity “measures the degree of the instrument at a surface level in relation to its appropriateness and suitability in relation to the purpose of the study; whilst content validity focuses on the capacity of data collection items to gather, reflect, and portray the variables that are measured”. For face validity, the questionnaire was analysed by a Primary 3 teacher who teaches physically disabled students to determine the feasibility and practicality of the questions for physically disabled students in Primary 2 and 3. The teacher reported that the questions were clear and not confusing. As for the content validity, the teacher analyzed and confirmed the questions consist of UTAUT, parents' support, and motivation levels. Based on the evaluation, the questions were found to be valid. A reliability test was then conducted on the proposed variables. Reliability is “the stability and consistency of scores from an instrument” [26]. In our study, the Cronbach's Alpha test will be used to test the reliability of the instrument. The Cronbach's Alpha values for all the constructs in this study are above 0.7, showing at the very least a good reliability [27]. Table 1 shows the constructs and Cronbach's Alpha values. In general, the results of the tests indicated that the questionnaire that was deployed is valid and reliable.

TABLE 1. Results for validity and reliability tests.

Construct	Cronbach 's Alpha
Performance Expectancy	0.749
Effort Expectancy	0.745
Social influence	0.733
Facilitating Condition	0.746
Motivation	0.829

The Multiple Linear Regression (MLR) test was then conducted to assess the relationship between the quantitative dependent variable (user acceptance) and independent variables (performance expectancy, effort expectancy, social influence (parents' support), facilitating condition, and motivation) using a straight line. Results are depicted in Tables 2. Referring to Table 2, the ANOVA significant p-value showed less than 0.05, indicating that overall, the regression model is statistically significant to predict the outcome variable (i.e., it is a good fit for the data). The R Square of 0.423 is acceptable in social science research [28]. The value indicates 42.3% of the total variation in behavioural intention can be explained by the 5 independent variables. Based on the coefficient's summary significant values, all factors, except performance expectancy and social influence show a significant value. This indicates that behavioural intention of the students can be predicted by effort expectancy, facilitating condition, and motivation. Results obtained are in support of the findings of user acceptance based on effort expectancy [29], [30]; on facilitating condition [18], [19]; and on motivation [31], [32]. The non-significant relationship between performance expectancy towards behavioural intention echoes the results by Mensah [33], Jacob and Darmawan [34], and Naranjo-Zolotov, Oliveira, and Casteleyn [35], and social influence towards behavioural intention with [18], Mensah [33], Jacob and Darmawan [33], and Naranjo-Zolotov et al. [35].

TABLE 2. MLR results.

Test Results	Value
ANOVA Significant Value	.000
R square	.423
Coefficients Summary	
Performance Expectancy	.940
Effort Expectancy	.001
Social Influence	.234
Facilitating Condition	.012
Motivation	.004

User acceptance of a technology has been researched by Abbad [19], Kim and Lee [20], and Donmez-Turan's [29]. All studies indicated a positive relationship between the UTAUT variables and the intention to use the system. This is in line with our results.

VI. CONCLUSION

In conclusion this research has presented a fundamental study on a proposed conceptual framework for an alternative learning method for the education system in Malaysia. The proposed framework was analyzed for its validity and reliability before the user acceptance analysis can be done. The outcome of the tests showed the instrument is valid and reliable. To determine the user acceptance of the proposed

alternative program (i.e., proposed framework), the MLR test was conducted. Results indicate 42.3% of the total variation in behavioural intention can be explained by effort expectancy, facilitating condition, and motivation factor. Since this value is acceptable in social science research, it can be concluded that the students in general accept the proposed alternative learning program. In hindsight, the fundamental study has paved the way to enable physically disabled students to learn using a new method which uses a hassle-free equipment, thus requires minimal movements of the limb, but still following the National Curriculum.

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AUTHOR CONTRIBUTIONS

Marianne Too: Conceptualization, Data Curation, Methodology, Validation, Writing – Original Draft Preparation;

Roy Chang: Project Administration, Writing – Review & Editing;

CONFLICT OF INTERESTS

No conflict of interests were disclosed.

ETHICS STATEMENTS

Our publication ethics follow The Committee of Publication Ethics (COPE) guideline. <https://publicationethics.org/>

REFERENCES

- [1] UNICEF, "Alternative learning pathway: Children's education dreams," *UNICEF Sudan*, Nov. 30, 2023. [Online]. Available: <https://www.unicef.org/sudan/stories/alternative-learning-pathway-childrens-education-dreams>. (Accessed: 10 Feb 2023)
- [2] T. Igarashi, P. Acosta, and N. Tenazas, "Second-Chance Education Should Not Be Second-Class: The Philippines' Alternative Learning System," 2020. URL: <https://blogs.worldbank.org/en/eastasiapacific/second-chance-education-should-not-be-second-class-philippines-alternative-learning> (accessed: 10 Feb 2023)
- [3] Bristol Safeguarding Partnership Procedures, "Disabled Children," URL: <https://swcpp-bristol.trixonline.co.uk/chapter/disabled-children> (Accessed: 10 Feb 2023)
- [4] K.Y. Teng, K.J. Yeo, and H. Jaffri, "Implementation of Inclusive Education Programme in Malaysia," *1st International Education Postgraduate Seminar*, 2014. URL: https://www.researchgate.net/publication/313525402_Implementation_of_Inclusive_Education_Programme_in_Malaysia (accessed: 10 Feb 2023)
- [5] Z.A.A. Talib, N.S. Zakaria, R.W.O. Rahmat, W.A.W. Adnan, and S.L. Wong, "PrAise: Putra Alternative Assessment," 2019. URL: <http://psasir.upm.edu.my/id/eprint/78615> (Accessed: 10 Feb 2023)
- [6] Child Welfare Information Gateway, "The Risk and Prevention of Maltreatment of Children with Disabilities," 2018.

- URL: <https://www.childwelfare.gov/resources/risk-and-prevention-maltreatment-children-disabilities/> (Accessed: 10 Feb 2023)
- [7] White Lodge News, "Early Childhood Education Blog and News," 2020. URL: <https://www.cceonline.com/blog/> (Accessed: 10 Feb 2023)
- [8] Issue Brief, "Inclusive Education Malaysia," 2014. . URL: <https://www.unicef.org/malaysia/media/926/file/Issue%20Brief%20Inclusive%20Education%20in%20Malaysia%202014.pdf> (Accessed: 10 Feb 2023)
- [9] K. Couture, "The Evolution of Special Education in Malaysia," *BORGEN Magazine*, 2021. . URL: <https://www.borgenmagazine.com/special-education-in-malaysia/> (Accessed: 10 Feb 2023)
- [10] I. Babik and E.S. Gardner, "Factors Affecting the Perception of Disability: A Developmental Perspective," *Frontiers in Psychology*, vol. 12, 2021. URL: <https://pmc.ncbi.nlm.nih.gov/articles/PMC8255380/> (Accessed: 10 Feb 2023)
- [11] P. Bakhshi, G.M. Babulal, and J. Trani, "Education and Disability in a Conflict Affected Context: Are Children with Disabilities Less Likely to Learn and be Protected in Darfur? *World Development*, vol. 106, pp. 248–259, 2018. DOI: <https://doi.org/10.1016/J.WORLDDEV.2018.01.019>
- [12] J.D. Davis, A.R. McDuffie, C. Drake, and A.L. Seiwel, "Teachers' Perceptions of the Official Curriculum: Problem Solving and Rigor," *International Journal of Educational Research*, vol. 93, pp. 91–100, 2019. DOI: <https://doi.org/10.1016/J.IJER.2018.10.002>
- [13] T. Lersilp, "Assistive Technology and Educational Services for Undergraduate Students with Disabilities at Universities in the Northern Thailand," *Procedia Environmental Sciences*, vol. 36, pp. 61–64, 2016. DOI: <https://doi.org/10.1016/J.PROENV.2016.09.012>
- [14] No Limits Academy, "Welcome to No Limits Academy," . . URL: <http://www.nolimitsacademy.com/> (Accessed: 10 Feb 2023)
- [15] V. Venkatesh, J.Y. Thong, and X. Xu, "Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead," *Journal of the Association for Information Systems*, vol. 17, no. 5, pp. 328–376, 2016. DOI: <https://doi.org/10.17705/1jais.00428>
- [16] J. Fantuzzo, E. Tighe, and S. Childs, "Family Involvement Questionnaire: A Multivariate Assessment of Family Participation in Early Childhood Education," *Journal of Educational Psychology*, vol. 92, no. 2, pp. 367–376, 2000. DOI: <https://doi.org/10.1037/0022-0663.92.2.367>
- [17] H. Gehlback, "Family-School Relationships Survey," URL: <https://www.lincnet.org/site/handlers/filedownload.ashx?moduleinstanceid=6827&dataid=13774&FileName=5.5.Panorama%20Family%20Survey%20User-Guide.pdf> (Accessed: 10 Feb 2023)
- [18] E.L. Deci, and R.M. Ryan, "SDT: Questionnaires: Intrinsic Motivation Inventory (IMI)," 2015 URL: <http://www.selfdeterminationtheory.org/intrinsic-motivation-inventory> (accessed: 10 Feb 2023)
- [19] M.M.M. Abbad, "Using the UTAUT Model to Understand Students' Usage of E-Learning Systems in Developing Countries," *Education and Information Technologies*, 2021. DOI: <https://doi.org/10.1007/s10639-021-10573-5>
- [20] J. Kim, and K.S.-S. Lee, "Conceptual Model to Predict Filipino Teachers' Adoption of ICT-Based Instruction in Class: Using the UTAUT Model," *Asia Pacific Journal of Education*, 2020. URL: <https://eric.ed.gov/?id=EJ1370578> (Accessed: 10 Feb 2023)
- [21] L. Lara, and M. Saracostti, "Effect of Parental Involvement on Children's Academic Achievement in Chile," *Front. Psychol.*, vol. 10, pp. 1464, 2019. DOI: <https://doi.org/10.3389/fpsyg.2019.01464>
- [22] A.A. Hayat, K. Shateri, M. Amini, and N. Shokrpour, "Relationships between Academic Self-Efficacy, Learning-Related Emotions, and Metacognitive Learning Strategies with Academic Performance in Medical Students: A Structural Equation Model," *BMC Med Educ*, vol. 20, no. 76, 2020. DOI: <https://doi.org/10.1186/s12909-020-01995-9>
- [23] G. Kinchin, N. Ismail, and J.-A. Edwards, "Pilot Study: Does It Really Matter? Learning Lessons from Conducting a Pilot Study for a Qualitative PhD Thesis," *International Journal of Social Science Research*, vol. 6, no. 1, pp. 1–17, 2018. . URL: <https://eprints.soton.ac.uk/416716/> (Accessed: 10 Feb 2023)
- [24] A. Wong, and H. Yamat, "Testing the Validity and Reliability of the "Learn, Pick, Flip, Check, Reward" (LPFCR) Card Game in Homophone Comprehension," *International Journal of Academic Research in Business and Social Sciences*, vol. 10, no. 1, pp. 22–32, 2020. DOI: <https://doi.org/10.6007/ijarbs%2Fv10-i1%2F6803>
- [25] A. Aithal, and P.S. Aithal, "Development and Validation of Survey Questionnaire Experimental Data – A Systematical Review-Based Statistical Approach," *Munich Personal RePEc Archive*, 2020. URL: <https://mpra.ub.uni-muenchen.de/103996/> (Accessed: 10 Feb 2023)
- [26] V. Braun, V. Clarke, N. Hayfield, and G. Terry, "Thematic Analysis," in *Handbook of Research Methods in Health Social Sciences*, P. Liampittong, Ed. Singapore: Springer Singapore, pp. 843–860, 2019. DOI: https://doi.org/10.1007/978-981-10-5251-4_103
- [27] K.S. Taber, "The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education," *Research in Science Education*, vol. 48, no. 6, pp. 1273–1296, 2018. DOI: <https://doi.org/10.1007/s11665-016-9602-2>
- [28] C.J. Ferguson, "Is Psychological Research Really as Good as Medical Research? Effect Size Comparisons between Psychology and Medicine," *Review of General Psychology*, vol. 13, no. 2, pp. 130–136, 2009. DOI: <https://doi.org/10.1037/a0015103>
- [29] A. Dönmez-Turan, and M. Kir, "User Anxiety as an External Variable of Technology Acceptance Model: A Meta-Analytic Study," *Procedia Computer Science*, 158, pp. 715–724, 2019. DOI: <https://doi.org/10.1016/j.procs.2019.09.107>
- [30] P.Y. Chen, and G.J. Hwang, "An Empirical Examination of the Effect of Self-Regulation and the Unified Theory of Acceptance and Use of Technology (UTAUT) Factors on the Online Learning Behavioural Intention of College Students," *Asia Pacific Journal of Education*, vol. 39, no. 1, pp. 79–95, 2019. DOI: <https://doi.org/10.1080/02188791.2019.1575184>
- [31] R. Steinmayr, A.F. Weidinger, M. Schwingler, and B. Spinath, "The Importance of Students' Motivation for Their Academic Achievement–Replicating and Extending Previous Findings," *Frontiers in Psychology*, vol. 10, pp. 1730, 2019. URL: https://www.researchgate.net/publication/334813490_The_Importance_of_Students'_Motivation_for_Their_Academic_Achievement_-_Replicating_and_Extending_Previous_Findings (Accessed: 10 Feb 2023)
- [32] M.C. Zaccane, and M. Pedrini, "The Effects of Intrinsic and Extrinsic Motivation on Students Learning Effectiveness. Exploring the Moderating Role of Gender," *International Journal of Educational Management*, vol. 33, no. 6, pp. 1381–1394, 2019. DOI: <https://doi.org/10.1108/IJEM-03-2019-0099>
- [33] I.K. Mensah, "Factors Influencing the Intention of University Students to Adopt and Use E-Government's Services: An Empirical Evidence in China. *SAGE Open*, 2019. . URL: <https://journals.sagepub.com/doi/abs/10.1177/2158244019855823> (Accessed: 10 Feb 2023)
- [34] D.W. Jacob, and I. Darmawan, "Extending the UTAUT Model to Understand the Citizens' Acceptance and Use of Electronic Government in Developing Country: A Structural Equation Modeling Approach," *International Conference on Industrial Enterprise and System Engineering (IcoIASE 2018)*, Yogyakarta, Indonesia, 2019. DOI: <https://doi.org/10.2991/ICOIASE-18.2019.17>
- [35] M. Naranjo-Zolotov, T. Oliveira and S. Casteleyn, "Citizens' intention to use and recommend e-participation," *Information Technology & People*, vol. 32, no. 2, pp. 364–386, 2019. URL: <https://www.emerald.com/insight/content/doi/10.1108/itp-08-2017-0257/full/html>