International Journal of Management, Accounting, Governance and Education
2021, Volume 1, Issue 2

The Application of No-Code/Low-Code Platforms in the Sector of Education

Farhad Khosrojerdi[1], Hamed Motaghi[2], and Mohar Yusof[3]

[1]Université du Québec en Outaouais (UQO), Canada
[2]Associate Professor (UQO), and Visiting Researcher, Universiti Tun Abdul Razak, Malaysia
[3]Mohar Yusof, Universiti Tun Abdul Razak
*khof01@uqo.ca

ABSTRACT

The education sectors have been affected drastically all over the world due to COVID-19. The need for utilizing technologies to deliver online learning has compelled educational entities to accelerate digital transformation. However, the immediate shut down of educational organizations, lack of preparation for such an event caused unprecedented challenges for educational systems to effectively deal with digital learning transformation. In addition, the time-consuming process of developing software applications negatively affected the reasonable solutions. Using low-code/no-code (LCNC) platforms, Citizen Development (CD) offers intuitive and swift tools to users with minimum or no knowledge about coding languages to develop software applications. In this paper, we introduce CD as an effective approach to overcome negative implications of the pandemic providing a framework for delivering an application development project that is suitable for the educational sector. To accomplish this, we present its software development life cycle (SDLC), project delivery guidelines, and required essential processes. Furthermore, requirements of the associated risks including functional and non-functional are defined as well. Reducing administration workloads and efficient operation of the learning system are the additional benefits of applying LCNC platforms.

Keywords: agile processes, citizen development, educational Apps, higher education, low-code platform, no-code platform

6. INTRODUCTION

Implementing digital-oriented solutions for different entities defines the most promising characteristic of digital transformation. It introduces innovative approaches enhancing traditional methods (Bogdanby et al., 2020). It has been applied to several sectors including business (Andal-Ancion et al., 2003), industry (Ustundag & Cevikcan, 2017), healthcare (Agrawal et al., 2010), and education (García-Peñalvo, 2021). Among different segments, the emergence for utilizing advanced technologies and executing digital transformation have even been more crucial for educational systems due to COVID-19. Educational systems negatively were affected by the pandemic and forced to halt face-to-face education. Since then, academic organizations have accelerated their efforts in transferring to digital education. However, the implementation of digital transformation has been a slow process even before this unprecedented event (Bogdanby et al., 2020). Requiring significant adjustments in the institutional model (Voronin et al., 2020) made it difficult to modify various processes of learning models rapidly.

Remote learning and online courses have been employed in private and public education (Bogdanby et al., 2020). Educational organizations have experienced numerous hardware-based and/or software centered technologies to deliver remote schooling before, although they have never been forced to be applied in a short

period of time for the entire educational systems across the world. In fact, digitalizing educational organizations started unwillingly without any initiatives and prior planning. In this case, a significant number of educational organizations and businesses started digital solutions immediately. Therefore, the problem is to provide an effective and efficient solution that can effectively operate predefined technologies. Information technology (IT) based approaches are expected to facilitate these efforts.

Impacts of transferring from the traditional to digital learning systems have been reviewed in numerous studies (Castro Benavides et al., 2020) in addition to the effects of COVID-19. However, there is no practical solution offered in these articles. In this paper, we present Citizen Development (CD) as an effective approach to overcome the barrier of implementing digital transformation in the education sector. Using low-code/no-code (LCNC) platforms, end-users can quickly respond to unprecedented events like the pandemic. Moreover, the software development life cycles (SDLC) for creating applications about administration workloads and online schooling are presented. To accomplish this, we browse the effects of digital transformation in the education sector in section II. The definition of CD and applications of LCNC platforms are described in section III. In section IV, the associated risks are discussed; in addition to the supporting methods and approaches that project management (PM) discipline can offer. In the final section, the conclusion is made, stating the future work and limitations regarding CD.

7. DIGITAL TRANSFORMATION AND ITS IMPLICATION

The fourth industrial revolution (4IR), known as digital revolution, is more than a technology-driven aspect. It provides opportunities to everyone to use technologies for a human-centered future (pombo et al., 2018). Digital transformation is defined as "*the profound transformation of business activities and organizations, processes, competencies and models, for the maximum transformation of the changes and opportunities of a technology mix and its accelerated impact on society, in a strategic and prioritized way*" (Gobble, 2018). Digital transformation has been practiced by higher education institutions in the last decade (Castro Benavides et al., 2020). It can improve the learning outcome of students alongside productivity in teaching and administrative works of faculty members. When COVID-19 hit the world, about 1.8 billion students were affected due to institutional closures in reaction to the pandemic (Ngwacho, 2020). So that its destructive impacts entailed all educational systems and scholar organizations around the world to perform remote learning and consider digital transformation as the only option to continue schooling. Now, the question is how to deliver the remote education and perform digital transformation in a short period of time using resources available in the organization.

Transforming to the digital world has been utilized in different domains including manufacturing, business, education, and research. As an example from the manufacturing industry (Sanchis et al., 2019), the virtual factory open operating system (vf-OS) platform is introduced, managing the overall network of a collaborative manufacturing and logistics environment. The paper claims that it helps Internet of Things (IoT) devices, humans, and software applications to communicate and interoperate without a glitch in the interconnected environment. In another paper (Talesra & Nagaraja, 2021), the use of Oracle APEX low-code platform in developing applications is addressed. The platform allows users to build user access audit and control automation applications. The benefit of the low-code application development is to provide quick responses to constantly changing market requirements that many companies are coping with. In a similar study, the benefits of the application of Aurea BPM for automated businesses in the manufacturing sector are examined (Waszkowski, 2019).

In the education sector LCNC tools have been used by a number of institutions in higher education including Harvard, Georgia Tech, University of Pennsylvania, Bentley University, Boston College, and Florida Gulf University (Totterdale, 2018). Using a low-code platform, the objectives of an undergraduate PM course are supported by students to develop their competencies lined to the course (Mew & Field, 2018). Integrating the Medix platform with the course context encourages students with exposure to a development project while

studying a PM course. In other work, the Medix low-code development technology is used to launch an application for collecting and managing data as well as protecting them in a cost-effective and timely manner (Totterdale, 2018). The implemented approach also presents several options with regards to storing, sharing, reporting, and visualizing the data collections.

8. CITIZEN DEVELOPMENT AND THE USE OF LCNC PLATFORMS

As described in (PMI, 2021), CD is " *a highly cost-effective approach organizations can take to drive innovation and organic change across the business, especially when the economic and political climate makes organizations less inclined to make heavy investments in large-scale transformation*". It has the capability to deal with other change initiatives in an organization delivering the desired digital transformation outcomes (PMI, 2021). In fact, CD is about empowering end-users to develop their own solutions. Citizen developers are non-IT-trained employees in an organization using LCNC platforms (Liptak, 2021) to create applications improving performances of different processes. Without getting involved with IT departments, citizen developers can provide new digital solutions on time with less rework (Mendix, 2021).

The LCNC programming techniques originated from the fourth-generation programming (4GL). The low-code programming, introduced in 2011 (Waszkowski, 2019), and the no-code development are based on: I) model-driven software development approach (Mew & Field, 2018), II) rapid application development (Weiss, 2018), and III) computer aided software engineering (CASE) tools. The low-code and no-code development platforms are graphical user interfaces (GUI) allowing users, herein non-IT-trained programmers, to design and create high performance applications. These platforms aid the end-users to focus on the usability and business aspects of the execution of the developed application instead of taking time on programming and syntax of the codes. Thus, a citizen developer can create and develop an application without spending time on troubleshooting and execution of the created software application. The platforms enable business users with minimum or no knowledge about coding language to quickly generate applications that can be conveniently installed and implemented on computer desktop or cell phones. Utilizing these tools, which are not actively forbidden by IT departments (Gartner, 2021), allows non-IT people in an organization not only to get involved in the process of proposing practical solutions but also to develop software applications.

Today's LCNC platforms are tied with cloud computing featuring web-based mobile apps. Medix, AppSheet, Microsoft PowerApps, Zudy, and Salesforce are the names viewed as the leaders in the category of LCNC platforms. The main characteristics of these tools incorporate a broad range of user-interface, process, data management, reporting, and various app-management (Totterdale, 2018). Furthermore, they support cloud computing, data protection, security permission, and the application code from design components (Rymer, 2017; Vincent et al., 2017).

8.1 The Life Cycle and LCNC Software Development

Although LCNC platforms facilitate the process of design and application development, the project delivery needs to be described. To comply with processes undertaken in the agile software development life cycle (SDLC), we apply the framework drawing the path from ideas to application. In order to develop an application employing LCNC platforms, citizen developers need to apply the agile SDLC processes. As defined in (PMI, 2021), hyper-agile SDLC optimizes the decision-making process, considering characteristics of CD. It introduces real-time development, and less management involvement. The application development life cycle for CD is depicted in Fig. 1 (PMI, 2021). The three different paths in the figure indicate if/when/why an IT department needs to get involved. Citizen developers need techniques and approaches to generate new ideas and gather information and innovative solutions to create effective and efficient applications. The advantage of using LCNC platforms is that the ideation process can be continued throughout the life cycle of building applications.

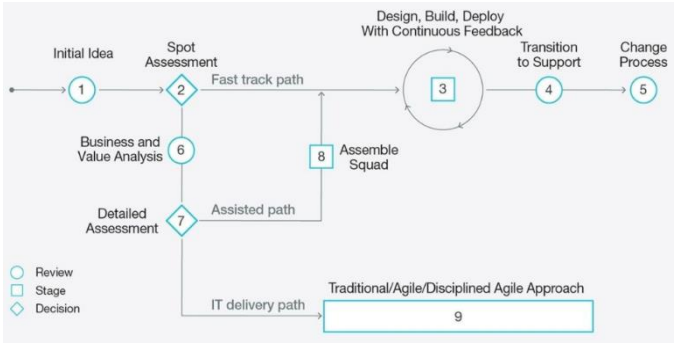

Fig. 1. Citizen Development SDLC (source: (PMI, 2021) Page 33)

The agile methodology allows for iterative development (Mew & Field, 2018) that can be followed by brainstorming sessions. Really Round Robin, hackathon, and ideathon ideation techniques (PMI, 2021) alongside with other methods help the team of citizen developers to collaborate with the employees affected by the implementation of the application.

8.2 Requirements and the Associated Risks

The review and assessment process, after brainstorming rounds, are entailed to ensure that the developing application meets its requirements. Requirements define different technical characteristics of the application including functional and non-functional (PMI, 2021). Functional requirements relate to, in this case, the educational model and describe how the idea of improvement should be delivered through the application. Data management, enterprise environment, and business models performed in the organization are the examples of functional requirements. On the other hand, non-functional requirements deal with the application technicality and representation, for instance different features and the way the application performs (PMI, 2021).

To identify associated risk, we need to assess capabilities of LCNC platforms in producing applications. Limited customization and integration options offered by low-code platforms constrain citizen developers to create specific features or provide high quality services (Talesra & Nagaraja, 2021). In a review paper (Sanchis et al., 2019), limitations linked with the low-code development tools are outlined as: scalability and fragmentation. It is mentioned that these tools have been utilized for creating small-scale applications, and their functionalities for a complex situation in a large enterprise have not been addressed yet. Cloud computing reveals another obstacle related to LCNC platforms. Relying on third-party vendors (Talesra & Nagaraja, 2021) and service providers to take care of security issues and data management are concerned in many cases. Moreover, research protocols (Totterdale, 2018), curriculum, bureaucracy, and existence of different levels of decision-making processes are among risk factors that should be considered for the education sector.

9. DISCUSSIONS

Based on the SDLC defined for CD in the previous section, we present the life cycle processes that practitioners in the education sector can apply for delivering their projects. As discussed earlier in the paper, the most rigorous effect of the pandemic has been sudden shutdown and lack of educational and administration support to students and employees. Identifying appropriate responses to the associated risks, we consider two main streams for application development: I) administration workloads, and II) remote learning. Fig. 2 depicts the SDLC processes when developing an application for the administration purposes. The aim of an administration App is to assist non-academic employees in supporting students as well as scholars. In this case, reviewing requirement assessments and functionality of the application can be approved only by the citizen developers (Fig.2); so that if there is a need for improvement, there would be more brainstorming sessions.

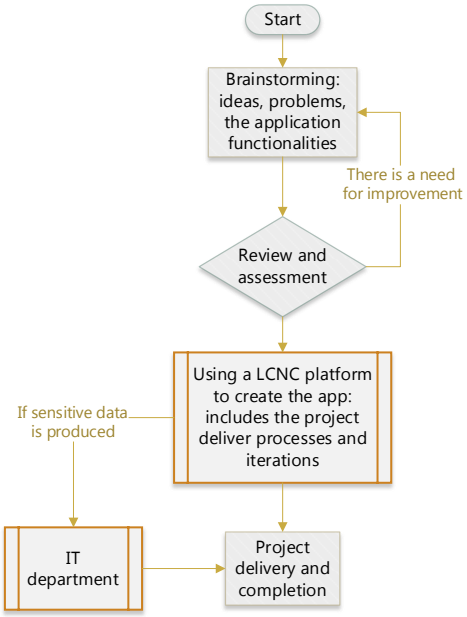

Fig. 2. SDLC for developing applications for improving administration workloads

In contrast, Fig. 3 shows the SDLC processes concerning remote learning. the approval is in the hands of educational teams and departments responsible for the curriculum including teachers and course evaluators (Fig.3), whereas an online App is developed.

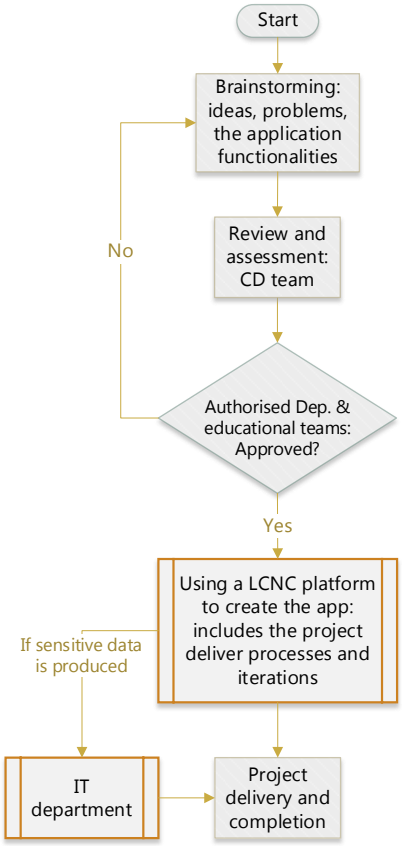

Fig. 3. SDLC for developing applications for providing remote learning

10. CONCLUSION

The purpose of this work is to provide an effective approach to deal with digital transformation in the education sector, especially amidst COVID-19. Citizen development and the application of LCNC platforms are proposed as the digital solutions to mitigate negative consequences of the pandemic. Citizen developers with minimum or no knowledge about coding programs can develop high performance applications. We identified the educational learning and administration workloads as the key domains for the subject of digital transformation responding to the pandemic in the sector. Furthermore, we presentd the processes in their software development life cycles.

Regardless of undeniable benefits encompassing the concept of CD, researchers highlight a few setbacks correlated to building software applications in this manner. Providing a systematic literature review about the subject is considered as the future work focusing on the model-driven methodology, different enterprise architectures, and the processes of the project delivery.

References

Agrawal, R., Gao, G., & DesRoches, C. (2010). Research comentarythe digital transfromation of healthcare: Current status and the road ahead. *Information System Research*, *21*(4), 796-809.

Andal-Ancion, A., Cartwright, P. A., & Yip, G. S. (2003). The digital transfromation of traditional Business. *MIT Sloan Management Review*, *44*(4), 34.

Bogdanby, B., Tamas, j., & Toth, Z. (2020). *Digital Transformation in Education during COVID-19: a Case Study* 11th IEEE International Conference on Cognitive Infocommunications,

Castro Benavides, L. M., Tamayo Arias, J. A., Arango Serna, M. D., Branch Bedoya, J. W., & Burgos, D. (2020). Digital Transformation in Higher Education Institutions: A Systematic Literature Review [Review]. *Sensors (Basel)*, *20*(11). https://doi.org/10.3390/s20113291

García-Peñalvo, F. J. (2021). Avoiding the Dark Side of Digital Transformation in Teaching. An Institutional Reference Framework for eLearning in Higher Education. *Sustainability*, *13*(4). https://doi.org/10.3390/su13042023

Gartner. (2021). *Citizen Developer*. Gartner Inc. https://www.gartner.com/en/information-technology/glossary/citizen-developer

Gobble, M. M. (2018). Digital strategy and Digital Transformation. *Research-Technology Management*. https://doi.org/https://doi.org/10.1080/08956308.2018.1495969

Liptak, J. (2021). *What is citizen development?* SearchSoftwareQuality.com. https://searchsoftwarequality.techtarget.com/definition/citizen-development?vgnextfmt=print

Mendix. (2021). *Citizen Development - Empowering business experts to build high-impact solutions*. Mendix Technology BV 2021. https://www.mendix.com/citizen-developers/

Mew, L., & Field, D. (2018). *A Case Study on Using the Mendix Low Code Platform to support a Project Management Course*. ResearchGate.

Ngwacho, A. G. (2020). COVID-19 Pandemic Impact on Kenyan Education sector: Learner Challenges and Mitigations. *Journal of Research Innovation and Implications in Education*, *4*(2).

PMI. (2021). *Citizen Development - The Handbook for Creators and Change Makers*. Project Management Institute, Inc.

pombo, C., Gupta, R., & Stankovic, M. (2018). *Social Services for Digital Citizens: Opportunities for Latin America and the Carribian*.

Rymer, J. (2017). De-identifying protected health information. *Journal of Health care Compliance*, *19*(6), 51-54.

Sanchis, R., García-Perales, Ó., Fraile, F., & Poler, R. (2019). Low-Code as Enabler of Digital Transformation in Manufacturing Industry. *Applied Sciences*, *10*(1). https://doi.org/10.3390/app10010012

Talesra, K., & Nagaraja, G. S. (2021). Low-Code Platform for application Development. *Int. Journal of Applied Eng. Research*, *16*(5), 346-351.

Totterdale, R. L. (2018). Case Study: The Utilization of Low-Code Development Technology to Support Research Data Collection. *Issues In Information Systems*, *19*(2), 132-139. https://doi.org/10.48009/2_iis_2018_132-139

Ustundag, A., & Cevikcan, E. (2017). *Industry 4.0: managing the digital transfromation*. Springer.

Vincent, P., Baker, V., Natis, Y., Lijima, K., & Driver, M. (2017). *Magic quadrant for enterprise high-productivity application platform as a service* https://www.gartner.com/reviews/market/enterprise-high-productivity-application-paas

Voronin, D. M., Saienko, V. G., & H.V., T. (2020). Digital Transformation of Pedagogical Education at the University. Int. Scientific Conf. "Digitization of Education: History, Trends, and Prospects", Advances in Social Science, Education and Humanities Research.

Waszkowski, R. (2019). Low-code platform for automating business processes in manufacturing. IFAC,

Weiss, T. R. (2018). *No-code, low-code development platforms help organizations meet growing app demand*. https://www.itprotoday.com/mobile-apps/no-code-low-code-development-platforms-help-organizations-meet-growing-app-demand