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Smart Learning Environment (SLE) in the Fourth Industrial Revolution (IR 4.0):
Practical Insights Into Online Learning Resources

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ABSTRACT

This paper examines the explanatory approach in dealing with SLE by advancing online learning sources. The systematic approach of searching for the relevant articles on SLE in IR 4.0 has been widely identified through two electronic databases, Scopus and Web of Sciences. Through adopting such digitally systematic search program, identification was made on the various elements in terms of online learning resources (OLR). This proposes the SLE framework model with an innovative approach in enhancing the learning through incorporating IR 4.0 platform to utilize the variety of information sources together with knowledge attribution in higher education (HE). The contribution provides a theoretical framework with the guideline of well-adapted performance in the educational activities as the new normal trend. In achieving this attainment, the readiness of both instruction facilities and accessibility procedure is significantly the main basis in ensuring the process flow in enlarging digital learning.

KEYWORDS

Industrial Revolution 4.0 (IR 4.0), Online Learning Resources, Smart Learning Environment, Smart Technology Pathway

INTRODUCTION

In the last decades, the emergence of digital transformation is widespread across the rising of link connected into all thing which enabled the connectivity advancement among the multiple lines leading to the new revolution industry age. Such progression is well known as the age of industrial revolution (IR). With growing up such attainment, the advancement has given the valuable insights into providing the way of human life including their business, education, and also social interaction into their peers across an online platform (Agbo & Oyelere, 2019). Moreover, the outstanding impact of artificial intelligent (AI) for instance has led to expand the particular attribution of Industrial Revolution 4.0 (Bagnoli et al., 2019), in enabling the new trends of digital human engagement, and thus both professional and ethical balance should be taken into consideration (Huda, 2019). This is to ensure the main contribution of digitalisation process itself can go further underlying the new style of people live, work and society at large. Attempts to utilise such digital technology are in line with

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expanding the possible engagement to work together with others in a space less basis (Anshari et al., 2017), in that the number of human activities needs to have a sufficient adaptation (Bdiwi et al., 2019).

In the attempts to commit with having adaptive skills in utilising it into the society development, it is necessary to enhance the strategic skills together with knowledge attribution into the platform IR 4.0. As such, the proper management in utilising such technology adoption should bring along with coordinating the technical aspects of growing the recent contributions into the society. In order to manage properly in utilizing it for various aspects such as economic, business, social, cultural, privacy and security within technological basis (Oke & Fernandes, 2020), encouraging the skills development becomes an initial value to transform the adaptation within the technological aspects. As such, providing the research advancement together with the critical engagement to wisely use amidst the society refers to have a clear insight on the wider issues towards various topics. Due to the advancement of digital transformation, the wider contribution could be clearly stated in the utilisation of Internet of Things (IoT) platform linked from online basis to transmit into the digitalisation across various sectors including smart shopping, smart learning, smart interaction, and also deliver the services (Rafiola et al., 2020). In particular, the initiative of digital governance is also constructed across interconnectivity expansion from central data to the customers' outline delivery system, in enabling the real-time access by the government unit agencies. Moreover, the special attention to have a similar pattern to engage into the digital trend points out disseminating the emerging trends of digital process of transferring information from the sources to the receiver at the real-based transaction.

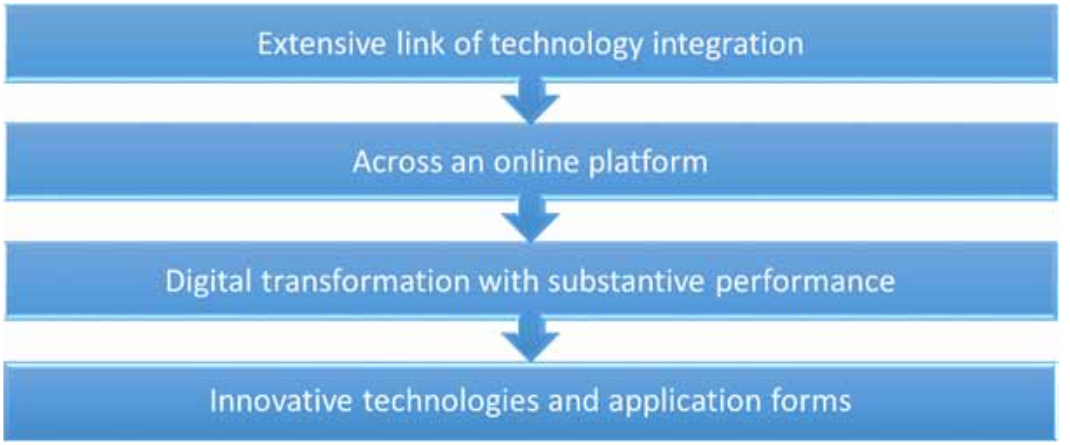
It is true however that not only business and governance engagement progression has been widely transformed but also educational trend in the digital platform is since transformed within the space-less based instruction. The examples of such advancement could be viewed clearly such as innovative teaching technology (Gao et al., 2019), smart learning platform (Anshari et al., 2017), and also modern learning environment (Huda et al., 2018). All such these have been adopted with their unique enlargement towards building the strategy development amidst the IR40. Among such number of contributors applying for the initiatives, there has been a lack of special attention to propose the model of digital pedagogy with the instrumental design on providing the continued support of platform in enabling the teaching and learning performance can go smoothly within the online basis. As such, this article attempts to examine the main features of IR 4.0 in underlying the SLE to ensure the quality of OLR. Referring to the critical assessment of the number of works, the result will be given an opportunity to supply the framework of guideline of well-adapted performance in the learning enhanccement.

LITERATURE REVIEW

Industrial Revolution 4.0 (IR 4.0)

The emergence of industrial revolution (IR) 4.0 was introduced by the German's engineering society as an attempt to transform the interconnectivity for the widespread of adaptive integration of Information and Communication Technology (ICT) for the purpose of manufacturing process (Van Heerden & Goosen, 2020). By taking into account for the extensive link to have a sufficient adaptation, the systematic integration conventionally adopted to bring about the way to work in an appropriate manner could be deployed in addressing the latest technology development connected with the previously existing work system. The particular attribution of having such technology integration across an online platform linked with an adaptive assemblage of innovative technologies and application forms (Rafiola et al., 2020). With a distinct degree of practical development towards the systematic approach on the transition of earlier industrial revolution version, taking into account the IR 4.0 points out making the digital transformation with substantive performance. As such, the elements of having the productive encouragement need to bring into the digital change in all areas of industrial processes together with the production phase through applying for the new paradigm shift

Figure 1. Industrial revolution 4.0 (IR 4.0) (Author compilation)



amidst IR 4.0 (Oke & Fernandes, 2020). In terms of having the production systems well managed, the massive development in organising the technology integration could be combined with the digital interconnection across the modified system version in providing the platform in the ready-use adoption.

As the phase of knowledge expansion in enabling the boundaries across digital elaboration, IR 4.0 is determined to underlie the environment continuance transmitted into the wider connectivity of the human interaction in order to manage their life employment purpose. With the significance of transmitting the knowledge dissemination in the digital platform, IR 4.0 with such distinction could transform the strategic ways of life interaction, job performance and also relationships into the digital basis. Continuing environment in line with following the requirements of digitalization process, the organisation is therefore needed to improve their adaptive skills in getting well prepared into the risk management procedure (Bdiwi et al., 2019). In terms of having a sufficient understanding towards the possibilities on handling the changes in the organisation, it is necessary to have a well proper readiness to adopt the strategy. It is important to commit with a sufficient knowledge understanding towards such risks consequences so that the organisation can compete in managing their direction abilities on changing environment. In short, the sufficient adaptation is required for the organisation to endure their performance in guiding the attitudes, views and also ideas to consider the knowledge management strategy properly to improve the implementation stage (Bdiwi et al., 2019). Moreover, the continued support for the IR 4.0 to give the balance between performance scale of adaptive abilities and risk anticipated execution with the sufficient knowledge should be taken into consideration in a particular approach in enabling the proper strategy in managing the organisation stability.

In line with IR 4.0 digitalisation process, the integration procedure has been transmitted across the organisation stability mainly in terms of information accuracy system. It is important to ensure the systematic approach of having a sufficient contribution to manage the information quality assurance. With the uniquely integrated process, the internal procedures from suppliers to customers are encouraged to provide the entire organisation procedure to lead in enhancing their strategic plan in line with the organisation improvement basis. The engaged strategy here refers to catch up taking the beneficial value in organising the transitions from physical to virtual basis (Voskoglou, 2020). In the attempts to expand the strategic agenda to sustain the organisation leading to commit with having the competitive value in innovating the digital transition, it is necessary to expand the development procedure in commencing the basic form of the strategic roadmap for IR.0 in order to transform into the operation pathway engagement. With this regard, the human consistency on technology adoption should bring the extensive cooperation to transmit into the life facilities by addressing professional and ethical balance (Huda, 2019). The on-going execution of IR 4.0 is definitely being a continued

pathway to facilitate in underlying the people way of running their business enhancement, together with sustaining their peer interaction (Bdiwi et al., 2019), in which their online platform is a necessary point to achieve such attainment. In this view, IR 4.0 might become the main platform digitally connected to achieve such beneficial value in trying to make a competitive advancement through strategic way for enhancing the fundamental transition to the performance better in a time-based decision. The overwhelming procedure should of course be determined to have a better transformation to manufacture the systematic progression in expanding the digitalization process followed with the design principle way of organising the strategic development pathway (Huda and Teh, 2018). In order to have a sufficient design principle linked into the peers, getting an understanding sufficiency refers to manage appropriately within developing the roadmap organisation in ensuring the timely decision to go forward achieving the IR 4.0 main goal plan.

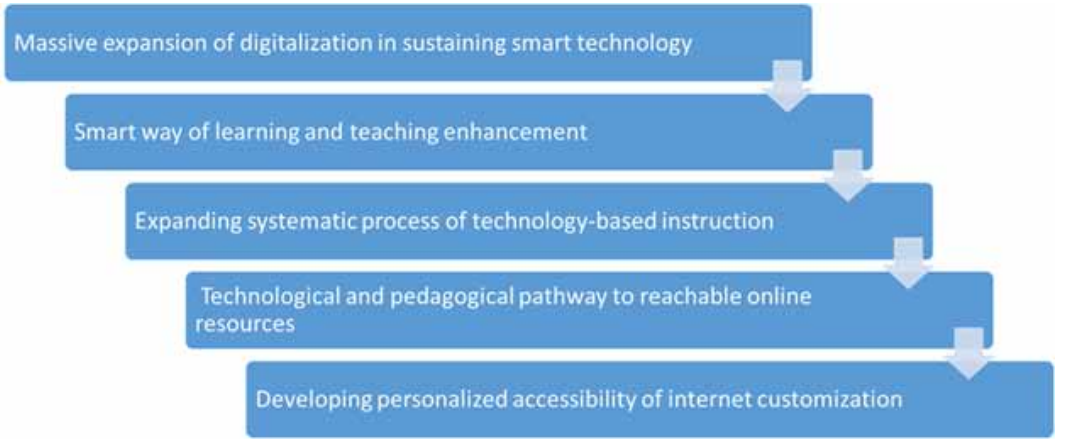
Smart Learning Environment (SLE) in IR 4.0 Context

The emerging trend of smart-learning technology in IR 4.0 refers to the massive expansion of digitalization in human interaction widely engaged into sustaining the continued support with such offered features as the underlying platform of smart technology. The main feature of intelligent systems could promote the smart way of learning and teaching enhancement process to facilitate the distinctive point of trend in IR 4.0 context (Bagnoli et al., 2019; Durnalı et al., 2019). Promoting the smart way for learning refers to expand systematic process on technology-based instruction in order to obtain the resources in an online basis. As an establishment of deploying an intelligent structure in underlying access to wider context of remote platform basis, education 4.0 is being transmitted into the technological and pedagogical pathway in allowing the reachable online resources (Freigang et al., 2018; Huda et al., 2018a). The smart classroom environment platform with its featured distinction of online basis is provided into more dynamic materials on facilitating the resources accessible. As such, the dynamic learning on obtaining the facilitation through internet accessibility played a role in delivering the technology-based instruction procedures on adhering the pathway of guideline to the performance.

In addition, the smart way of teaching and learning basis could promote an instructional design to access the digital platform by enrolling the course through an open online basis. In this view, attempts to adopt the learning materials more dynamic to transmit into the education process would greatly give an opportunity to develop the personalised accessibility of the internet customization (García-Tudela et al., 2020). As such, the practical technologies of obtaining the information across online platform using smartphone application are potentially brought into responding to this technical shift from the traditional basis into a more technology-sophisticated adoption. The potential distinctions in running the teaching and learning practices are widely produced in the educational ecosystem basis. This is in line with developing the technology product for Industry 4.0 by preparing the qualified procedures in expanding professional skills in adopting the smartphone technology into a very global and digital work environment (Hawedi & Abdullah, 2020). As the IR 4.0 requirements in developing the human capital in fulfilling the balance between knowledge and expertise, the advancement of learning culture with an online platform module is sufficiently deployed into providing the smart learning skills assigned to combine the teaching skills. The ultimate point is to empower the strategic way in enabling the development of education trend to adopt the knowledge and skills production process through exchanging the instructional design in giving the direction towards the previous trends (Huda et al., 2018b). In this view, the moving forward from earlier education trends to the new exchange platform with an online direction contemplated the opportunity to advance the practical stage of internet for learning as an attempt to create the change together with growing the sustainable commitment of inquiry process.

In line with expanding the strategic direction of smart learning environment in IR 4.0, the need to transform the production phase through knowledge transmission and inquiry platform should be taken into consideration in providing the smart way of technology and pedagogy integration. In the

Figure 2. Smart Learning Environment (SLE) in IR 4.0 Context

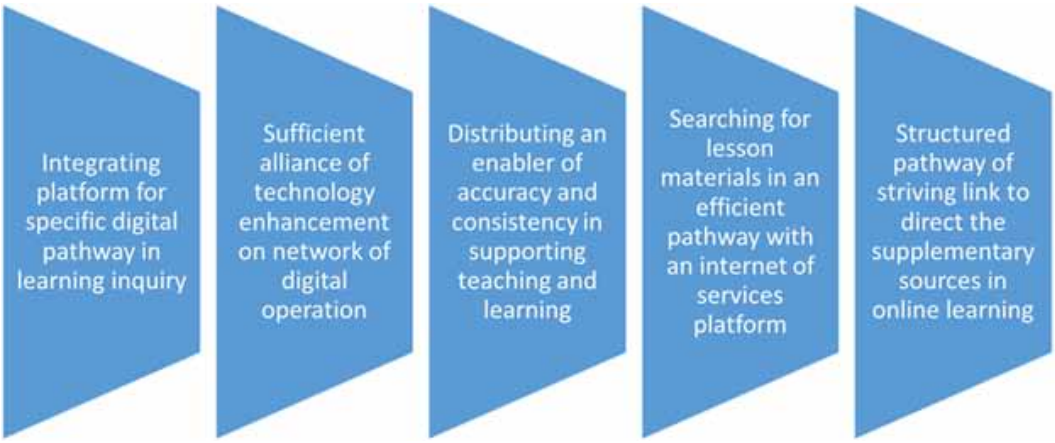


attempts to advance learning inquiry as the new culture, it is necessary to develop the strategic skills towards the new smart platform for innovative teaching initiative (Huda et al., 2016). With such advancement, the knowledge transmission process should do with combining the shift paradigm approach from memorization practice to produce the visionary skills and quality. The education setting should be adjusted to have a sufficient adoption to the technology enhancement mainly in the context of 21st century learning platform (Heinemann & Uskov, 2017). The learning enhancement practice could give the mutual direction in placing the learning culture amongst the students and teachers into being more active involvement together with critical exposure towards the certain lesson subject. Moreover, the potential value of educating the individual personality with such technology adoption is determined to give a point of providing the ready engagement process to achieve the outcome quality within a sufficient experience. As the unique technology platform, IR 4.0 in underlying the smart learning environment could be managed with such digital tools in the attempts in creating an innovative environment with advancing the experiential basis. In making an excellent user in ensuring the educational achievement, the customised empowerment of improving the learning outcome is widely transmitted to build the integrated initiative on an intelligent school management system combined with software basis of learning management in advancing the education inquiry (Hiasat & Pollitt, 2019). In particular, the setting of communication tools for learning aid platform might give a wider chance of personalized learning in a digital learning environment (Hoel & Mason, 2018). In the effort to promote the comprehension efficiency, getting actively in the digital learning should do with enhancing the initiative of professional skill culture together with expanding the better learning outcomes. In this, the achievement plan towards such integrated approach would create the individuals with such sufficient skills and professional development way.

Smart Technology Pathway for Teaching and Learning Enhancement

The pathway of smart technology in underlying the learning inquiry process refers to have a sufficient adoption with the number of latest technology development. Among such technology progression, one of them is Internet of Things (IoT), as an enabler of integrating the platform of communication amongst its all users with their specific digital pathway (Klimova, 2016). The ultimate point of IoT based instructional design lies on forming the decision coordination with further sharing the shape into the new trends of digital interaction way. As an enabler pathway on the physical objects, the specific platform in the way for variety of disciplines including stakeholders, alliance, and business oriented interest is indicated to collaborate in an alliance together with standardizing the mutual line of approach to collaborate in a certain project. IoT enabler in the context of IR 4.0 is approached to

Figure 3. Smart Technology Pathway for Teaching and Learning Enhancement



have a specific concern towards addressing the industrial application by composing the network to the physical objects (Liu et al, 2016, 2017). In communicating with other users, attempts to further share the formation in coordinating with the determination of various interests are contemplated to sustain the paradigm of new online industrial platform. In making a sufficient alliance of approaching such technology enhancement, IoT with addressing the physical network is perceived with a digital-based process in transmitting the infrastructure for instance 3D model of physical machine contemplated into the new human behaviour. In such attainment, standardization of industrial application with IoT addresses the network of digital based shape in representing the process of product by offering the better visibility to support the operation procedure in ensuring the efficiency and effectivity to be well managed (Huda et al., 2017a; Maseleno et al., 2019). Addressing the digital application is sufficiently combined with the industrial application through IoT adoption in enabling the network of the physical matters together with the basis of digital processes of manufacturing infrastructure towards the physical conduct prototypes of technologies.

In line with offering such better quality service in IoT facilities, the operational procedure of firms operations of integrating the machine sensors together with software application might become an overwhelming operation in transmitting the critical visibility to give an insightful point in underlying the smart machines processor (Li et al., 2018; Liao et al., 2019). With such accurate consistency in advancing the data transmission to capture communication approach for instance, the predictive services in deploying the potentials of instructional design would give a beneficial value in distributing an enabler of maintenance procedure (Deng et al., 2019). This is to ensure the stage of accuracy and consistency can go well in line with supporting the teaching and learning enhancement (Huda et al., 2019). Moreover, the number of developed initiatives in the education setting is potentially combined with capturing the learning process through instructional design provided in optimising the systematic approach. Not only data capturing procession but also maintenance services are in line with getting well cooperated into the learning enhancement process (Hussain et al., 2020). The design optimization of looking for the information sources should do with searching for the lesson materials in an efficient pathway in the service development. As such, the encouragement procedure of the way on IoT to deliver the potential information into the learning sources has to bring along with an internet of services platform (IoS). Concerned into the systematically wider usage across the users in valuing their personalised search attempt, IoS is determined to contribute into creating the materialization of product with the service quality. In the context of teaching and learning gateway, establishing such design of information inquiry for the lesson materials is strived to give a right path of convenient platform in strengthening the competitive empowerment.

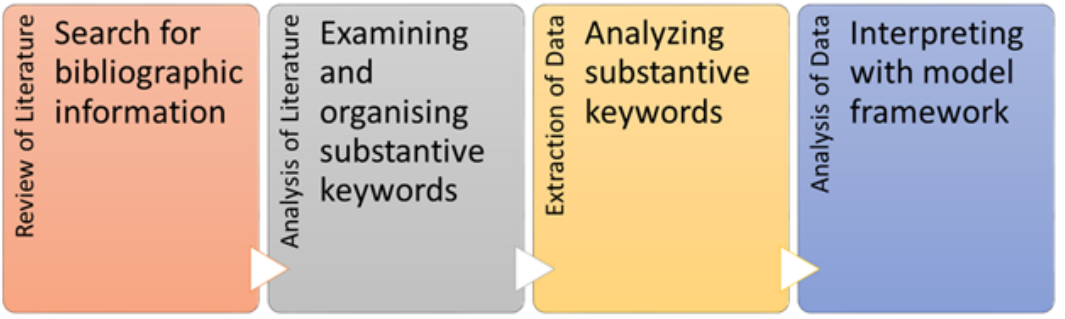
In terms of continuing the value creation of smart technology pathway in teaching and learning inquiry process, the variety of purposes in the internet of people (IoP) to better delivering the information sources together with an active involvement of physical objects related to the internet link is widely conceived into the data transmission technique. Such attainment refers to distribute the structured pathway of striving the established link to direct the service and also the supplementary sources in the online learning (Li et al., 2019). The entire process are prepared with forming the wider direction linked into providing the technological infrastructure in underlying the learning enhancement and competence skills (Huda et al., 2017b). As such, IoP based instructional design would enable the learning inquiry on the information sources searching process might also be contemplated into building the innovative skills of teaching pedagogy consequence. The IoP empowerment is widely sported in enabling IoS infrastructure including sensor-based products in continuing the information of the certain subject lesson (Chen et al., 2017). The wider value of delivering the information as an attempt to uphold the material sources is determined to provide leverage data in the search engine platform (Zhou et al., 2020). In this view, the level of application pathway in adopting the online platform for learning process should do with enhancing the teaching quality skills in transmitting the proactive involvement towards the information materials. Moreover, proactive engagement of supplying the sensors through data transmission delivered into the cloud basis should be properly organised in expanding sustainable information in online platform. Thus, all learners might have a mutual chance to transmit the lesson materials fitted to their needs on demand basis (Peng et al., 2019). In particular, upgrading the elevators with sensors transformed into cloud computing for data service of maintenance refers to underline in delivering the sensor transmission ready to come up with going an upgradeable automobiles via online platform. In terms of gathering information amidst the complex socio-technical system in enabling the personal devices usage, application procedures with an active internet adoption is necessary to form the social device combination involved in the capabilities of reflecting their tasks amidst the online platform.

METHODOLOGY

The main point of this paper is to examine the emerging trends and practices of IR 4.0 presented into the number of platforms in giving the contributions to the SLE with the OLR progression. Assessing the value of such advancements of IR 4.0 would make a progression in providing the smart way of learning environment to give a beneficial value in the teaching and learning enhancement. In this view, the commencement could be employed with building the systematic approach of searching for the relevant articles on SLE in the age of IR 4.0 widely identified through two electronic databases, Scopus and Web of Sciences.

Through adopting such digitally systematic search program, the assessment was conducted into the number of elements including, IR 4.0, SLE, and also OLR. Engaged with IR 4.0 into underlying the trends of smart technology pathway including IoT and Big Data, it is necessary to have a sufficient assessment to the engagement process of strategic design through critical literature reviews from referred articles from Scopus and Web of Sciences-indexed journals, conference and books. The subsequent process is of course deployed through met-synthesis in integrating the interpretation towards such findings from numerous research results. Moreover, evaluation was also made from the latest findings of studies identified from the common structures and features of phenomenological models together with grounded ideas integrated to propose a framework model. Through employing such initiatives, this study was designed to propose the SLE framework model with an innovative approach in enhancing the learning through incorporating IR 4.0 platform by utilizing the variety of information sources together with knowledge attribution in the Higher Education (HE).

Figure 4. Methodology



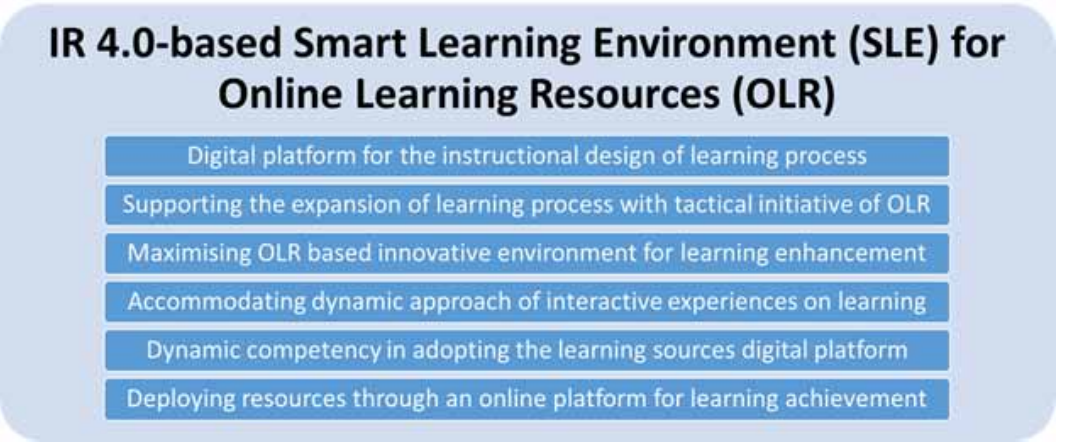
ANALYSIS AND DISCUSSION

IR 4.0-based Smart Learning Environment (SLE) for Online Learning Resources (OLR)

The digital platform for the instructional design of learning process refers to address the basis for an online learning initiative organised from information system associated with smart technology. The strategic performance amongst the users with their performance way refers to expand their extent of capabilities in enhancing the online learning resources (OLR) through the digital basis. With a wider context of supporting the expansion of learning process, the tactical initiative to adopt the OLR is required widely in addressing the phase of supportive engagement in the learning process. Attempts to have a sufficient adoption of such strategic initiative of learning enhancement should be employed with maximising the OLR based innovative environment (Huda et al., 2018; Zhou et al., 2020). The extent of learning material in this view has to be adopted properly through such approaches to be deployed to enable the instructional processes as noted in the plan management. It is necessary to implement the configuration of communication basis together with an administration associated into teaching and learning enhancement (Putro & Rosmansyah, 2018). The running process of learning is linked into the attempts initiated to signify the development achievement through providing the materials towards the certain subject. In this, the pattern of distribution basis of controlling and recovery approach on OLR is suggested to have a multiple sources of information systems in enabling the efficient and efficient teaching (Rafiola et al., 2020). Through such process in convincing this establishment, the initiative of supporting the learning instruction design should do with enhancing the process of accommodating the dynamic approach of interactive experiences on learning. With this regard, the effort on incorporating the extensive configuration of OLR could be generated into the process of providing learning experiences together with a comprehensive basis of knowledge management generated into the social networks and multi-channels.

In addition, the attempts to create the comprehensive learning enhancement through OLR basis should do with aiming at the IR 4.0 smart technology. It refers to have a sufficient contribution of how such wide range of proportions in the teaching and instruction process should bring along with understanding the approach of technology usage properly (Huda, 2019). In obtaining the OLR features, it is necessary to have a sufficient achievement on deploying such framework of cloud computing in big data integration. In this, it is worthwhile to enhance the strategic skills developed through considering the assignment and also to support an adaptive teaching enhancement. Getting an active incorporation between performance and competencies in enhancing the instructional skills refers to the extensive coordination of interpersonal abilities assigned into such experience in the learning process (Ruiz-Calleja et al., 2019). It can be conceived to have an appropriate manner associated

Figure 5. IR 4.0-based Smart Learning Environment (SLE) for Online Learning Resources (OLR)



with teaching competencies through deploying the useful resources myriad as an effort to enable the sustainable culture of instructional design. The dynamic competency has to bring the professional quality together with ethical manners in adopting the learning sources, mainly in the digital platform. Incorporating such systematic coordination on the learning enhancement with ethical manners is actually in line with considering the sufficient comprehension towards the good strategy on the way to how instructional procedure might give the portion of enabling the circumstance condition (Huda et al., 2017c; Sen et al., 2018). The main point of committing with providing the knowledge sharing in enhancing the achievement procedure as the result of entire process of SLE with its distinctive progression needs to carry out determining the actual basis of an online usage as the platform medium. Adopting the extent of SLE incorporated with IR 4.0 yields potentially a distinctive opportunity to engage with deploying the variety of resources through an online platform to underlie the learning achievement. Such achievement refers to give a particular determination of learning quality assigned into the teaching competencies (Nikolopoulou, 2020). The emerging expansion of online resources in achieving educational outcome refers to the digital basis usage through such variety of platforms inevitably into an innovative approach of teaching and learning process. The stability of employing the diverse innovations in the learning environment should be considered to provide the accommodation to take a beneficial value of OLR which both instructors and learners can achieve. The sufficient comprehension of an online adoption in the higher education (HE) context is potentially engaged into an interactive coordination between learning styles and teaching competencies. Such two elements here are widely incorporated into the digital platform assigned into taking an entire opportunity of achievement procedure transformed in underlying the learning culture styles in meeting both demands and needs.

In addition, IR 4.0 based SLE assigned into the extent of OLR should commence with giving a mutual line of focusing on the wide ranges of instructional design in the basis of an online platform. The value of resources through data sets in which the educators might present the video in class should give a tremendous emergence in supplying the access of learning enhancement. With this regard, the extensive points of learning styles should address the range of pointing out the customised online activity in supporting the resources together with technology platforms including smartphones, computers, tablets, in the sense that is transmitted into disseminating it at the social media platforms, etc. (Sharma et al., 2019). The initiative of OLR accessibility might come from integrating the wide range of lesson procedures constructed in the curriculum basis together with suiting into subjects wide-open easily accessible to the readers. In this view, such learning activities would need to make a sufficient readiness of performing a successful transformation of learning activities. As the main

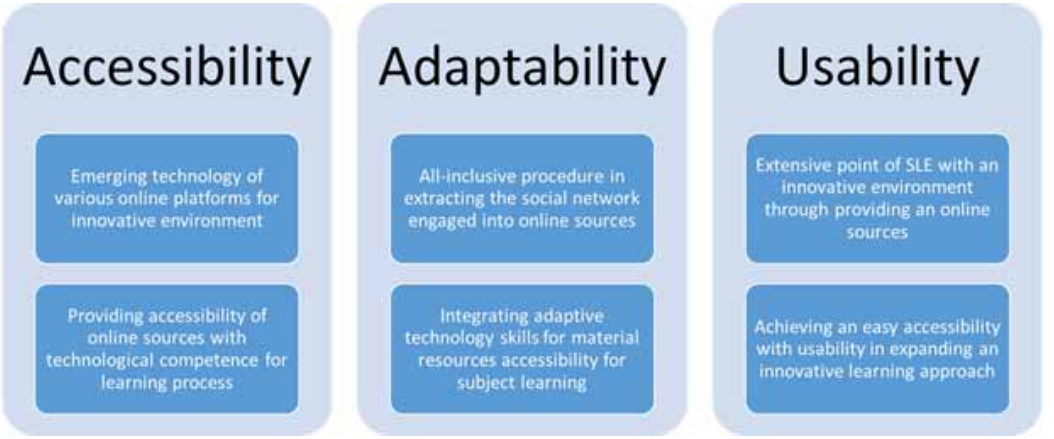
initiative to expand all integrated varieties on daily learning activities, the practical skills development managed in the classroom should refer to accommodate regularly into the OLR for instance online databases including online books and online journals (Oke & Fernandes, 2020). As such, the more manageable platform in benefitting the online resources has to bring the unique approaches accessed with progressing the professional opinions combined into the teaching practices (Huda et al., 2017d; Sumadyo et al., 2018). Such coverage includes the wider management of time, space and frequency in enabling the extensive point of the way to get information data through an electronic platform (Van Heerden & Goosen, 2020). In further, making balance between accessibility and availability of OLR in the attempts to point out the convenient basis refers to the sufficient adoption at anytime and anywhere basis. It is necessary to have a mutual arrangement of constructing the understanding stage incorporated into technology pathway. The knowledge structure in integrating the technology usage for online sources refers to possibly be incorporated into the expertise sufficiency. The wider context of contribution of accommodating the massively pervasive knowledge of online sources is particularly advanced through technology expertise in a professional and ethical engagement procedure basis (Huda, 2019). In this, such advancement would lead to supply he online sources in learning and teaching practices.

IR 4.0-based Smart Learning Environment (SLE) for OLR based Innovative Environment

The emerging technology of the various online platforms such as big data, internet of things (IoT) transmitted into the innovative environment basis is particularly involved in supporting the learning practices mainly in providing an online sources. Such attainment is also linked into transmitting the data value in enhancing the way of adopting the beneficial value into the extensive point of SLE with an innovative environment through providing an online sources. As such, the all-inclusive procedure in extracting the social network engaged into the OLR refers to the wider pattern of both structured and unstructured records (Voskoglou, 2020). The experiential learning through extracting the potential value of subject content aims to advance the adoption of massive data in an open basis in enabling the accessibility amongst the learners freely (Warner, 2019). In the attempts to provide the accessibility of online sources, the initiative of improving the variety of number of facilities together with service quality to lead to the convenience has to be committed into underlying the learning process organised with technological competence. Moreover, the need to point out disseminating the basis of having a mutual line of technology experts in the learning style should be taken into consideration in assisting the learning enhancement. In further, the sufficient knowledge understanding arranged into the strategies of adopting big data analytic process for instance could be better improvement in enhancing the information to effectively achieve the extent of interest and needs basis (Yassine et al., 2016). Deploying the particular online activities can be commenced with integrating the extent of adaptive technology skills in assisting the material resources for learning enhancement process.

Accommodating the learning styles refers to expand the necessary acts of raising the potential improvement to take a beneficial value towards the unlimited data absorbed through online activities. As such, the extent of entirely organised adoption on online sources is directly linked into providing the integrated assistance of the learning performance in the basis of subject alignment. In the attempts to expand the necessary point in underlying the way to run the effective online learning, getting active involvement on achieving the easy accessibility together with the usability extended to the basis of technology skills would lead to drive it appropriately in line with a particular achievement of learning enhancement through an initial requirement on the human awareness (Hawedi & Abdullah, 2020). Moreover, the application guideline here refer to enhance the balance between process and management skills associated into supporting the assessment towards the certain knowledge in the basis of multi sources channels (Heinemann & Uskov, 2017; Huda, 2021). In terms of adopting the achievement of an online platform for learning enhancement, SLE with IR 4.0 might give a prominent assistance to design the beneficial value of big data or IoT application involved in expanding an

Figure 6. IR 4.0-based smart learning environment (SLE) for OLR based innovative environment



innovative approach of the learning style. Obtaining an electronic application design in allowing the potential data transmission to take benefit should do with determining the reflective expansion of OLR accessibility. In this view, transforming the reflective incorporation of practical essence of SLE through IR 4.0 adoption into the environment innovation has to bring the necessary point of innovative design of learning enhancement.

In line with supplying the open accessibility on driving the enlargement of data value potentials, both big data and IoT approach organised to advance the distinctive feature of integrated learning systems yield to expand the pattern of maximizing the data potential value. Through bringing together such approach, attempts to achieve the interactive practice associated with an individual performance sustainability of technology and pedagogy improvement (Gambo & Shakir, 2019). In this view, achieving the particular feature on online learning innovatively in transforming the inquiry achievement is organised to regulate both personalized and customized services into the learning process. Offering the knowledge inquiry through delivering the potential data of customization and personalization is potentially engaged to explore the initiative transformed into the behaviour manners (Hoel & Mason, 2018). In providing the achievement procedure on the learning approach, the capability of performing the particular attempts on managing the resources in an online platform refers to expand supplying the link fitted to the demands and needs. In this view, getting more accuracy on accessing the online sources with having a sufficient management on learning inquiry process needs to bring the integrated transformation of comprehending the quality assurances. With this regard, the materials provided through such system extents needs to take a beneficial value in a particular way in supplying the online resources. The potential data transmission associated with the particular demands and needs could be generated into developing the learning structure course in ensuring the learning quality achievement (Huda and Hashim, 2021; Othman et al., 2016).. Through linking the relevant basis of course into needs basis, developing the learning structure to have a look at understanding the learning quality through wide range of activities yields a potential value of providing the access in an open range towards various webpage available online (Klimova, 2016). Entirely engaged into the essential principle to generate the learning activities should bring along with ensuring the accessibility towards OLR based learning materials.

In terms of carrying out the detailed activities in undertaking an innovative environment for online resources, the entire effort to facilitate the emerging technology of both big data and IoT platform has to bring a sufficient knowledge understanding on content and its coverage inclusion. Moreover, attempts to expand the comprehension distribution of getting an active involvement should be frequently combined with deploying an innovative environment through advancing the OLR basis.

In this view, the extensive initiation in providing the focus on developing the content together with the pattern is necessarily adopted through the wide range of activities to the arrangement linked into the needs of particular instruction properly (Yassine et al., 2016). In assisting the advantage to achieve through such platform, the need to attract a particular attention should bring along with the technology pathway in enabling the effective learning enhancement. As such, the integrated design here refers to expand the strategic approach to give a direction for an essentially particular competence associated with an effective structure scheme. Performing the wide range of technology practice demand through an internet basis is potentially associated with addressing the learning style model implemented particularly in the learning process enhancement (Li, et al., 2019). In the capacity basis, the wider accessibility of OLR transmission might give a particular direction to enhance the structured models of big data or IoT integration in ensuring the online resources transmission. Through adopting an electronic device organised to the paradigm shift from the physically traditional basis to virtually engaged platform, the particular strategy approach in the way to collaborated the necessary point of innovative learning practices is linked into the high-impact instructive skills (Liao et al., 2019). The extent of smart technology with IR 4.0 could give an impactful offer to distribute into the entire dissemination of the data transmission analytics in generating the massive data.

With this regard, the need to have a sufficient coordination of technology pathway designed in the basis of need and demand should be taken into consideration to have an open accessibility of OLR. Such online resources here could be developed in the purpose of teaching and learning enhancement in the sense that is obtained an advantage to advance the learning enhancement process and its accomplishment (Zhou et al., 2019). It is necessary to take a note that an innovative learning approach should do with building the design configuration of pedagogical and technology skills integration. In particular, the extent of having the arranged plan on an innovative knowledge plan is formed to empower the expansion of big data or IoT emerging technology through its analytic process in supporting the teaching and learning procedure. The smart approach of IR 4.0 associated with an online based instructional design should go through expanding the manner in advancing the learning performance. The procedure of giving a direction on utilising the various reference models adopted with big data or IoT emerging technology is necessary to contribute the insightful value in focusing on multi sources data. Moreover, the initial insight of having such idea could give a tremendous recommendation in proposing the typical structure on learning material resources. Delivering such process should do with IR 4.0 smart technology through having a good adoption of an online platform assigned into the data massively from the social media. Enhancing the particularly sufficient devices is entirely extracted from the value absorbed from information like conversation, message, and transaction (Deng et al., 2019). The expansion of data extraction through such process of data complexity from the social network value is potentially determined to give a particular direction in fulfilling the learning enhancement goal by revealing IR 4.0 approach. The way of extracting data value here refers to advance the pattern of data analytics usage related to the certain users, topic and time analytics.

IR 4.0-based Smart Learning Environment (SLE) in Supporting Online Learning Resources

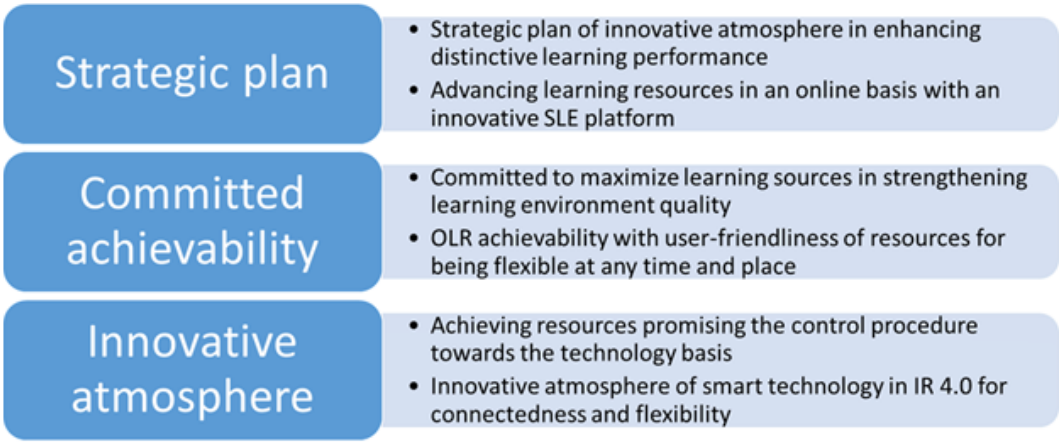
The strategic plan in providing the SLE adopted with IR 4.0 should bring the learning basis through innovative atmosphere by supporting OLR mainly in enhancing the distinctive pattern for learning performance. With its typical arrangement of supplying the learning sources, IR 4.0 based SLE is engaged into rising the advancement of making convenience towards the learning process and also getting active in contributing the learning process support (Chen et l., 2017). The innovative surrounding of making the pattern to have a sufficient assessment procedure is potentially engaged with advancing the learning resources in an online basis. Moreover, the convenient structure assigned into an innovative platform through SLE would be the fundamental approach to result in accepting the personalisation in the way to absorb the massive data sourced from the browser. With this

regard, the pattern basis made from both intervention and customization in the approach to adopt personalisation of online sources refers to enhance the data transformed into the search engine of browser (Yassine et al., 2016). In the attempts in adopting data sources from social network sites (SNS) for instance or event from the electronic newspaper, achieving the useful base in covering both volume and assortment would be transmitted in supporting ORL in the way to arrange the self-regulated inquiry (Maulidiya et al., 2019). In terms of having the wider interactive basis organised into the innovative way, such alignment with an entire element in committing the learning style could be employed through advancing the accessibility of resources for learning materials. In particular, the committed enhancement to maximise the learning sources should be implemented in strengthening the learning environment quality (Putro & Rosmansyah, 2018). IR 4.0 based SLE has to be empowered into contributing the OLR achievability together with considering the user-friendliness of material resources to become more flexible at any time and place. As such, the significant contribution of exploring online resources might expand the rise of an insightful value of IR 4.0 smart technology pathway. As the initiative to give the support of learning enhancement, being responsible to guide the way in achieving the variety of resources could be implemented in enabling the more aids to obtain together with promising the control procedure towards the technology basis.

In line with making the improvement in the way to support the learning instruction, the strategic approach in transforming the basis of learning performance should be taken into consideration of taking the beneficial value into the students' development. In particular, the attempts to advance the achievement of innovative atmosphere in learning enhancement should bring an expansion of strengthening the learning style to be more engaged with the smart technology pathway in IR 4.0 based instructional design (Warner, 2019). The particular way of having the interaction in the effort to accomplish the learning style is widely a potential value to encourage the practice to be more actively involved into the skills of learning enhancement (Ruiz-Calleja et al., 2019). The enhancement here refers to the significant approach of learning process adopted with IR 4.0 smart technology to improve thoughtful abilities consequently in boosting the extent of confidence. Moreover, the raise of having such active involvement in offering the knowledge understanding together with practical skills is determined to give an adaptive technology achievement transformed into both connectedness and flexibility. In particular, the practical skill of smart technology pathway is dedicated to give a transformation into giving insights for the online learning basis. In this view, the significant point of the control basis to integrate a high-quality information should do with an effort which the learners can interact within the learning environment (Sen et al., 2018). The mutual engagement of expanding the learning expertise is significantly contributed into the meaningful strategy in providing the interactional design of attentiveness. In the effort to commit with interacting into both knowledge and skills attributed together with such distinct of assisting the learning process, the innovative design of learning enhancement refers to expand in integrating the approach of IR 4.0 smart technology pathway. In this view, integrated knowledge and skills could be generated adaptively in giving the valuable insights into innovative basis on learning enhancement.

In terms of expanding the way of IR 4.0 smart technology in supporting OLR with its significant essence of strengthening progressively into following the preparation stage together with commencement to implement such online learning basis, it is necessary to manage properly in arranging the learning enhancement process as an effort to improve the approach of usability on smart technology pathway. With this regard, the sufficient understanding and practical skills arranged in the IR 4.0 based SLE should bring along with preparing the consistency of adopting the necessary implementation assigned into the convenient approach of instructional design of teaching and learning design (Sharma et al., 2019). As such, the convenient assurance provided in the SLE might give a prominent contribution into the sustainability of online sources in an online platform in the sense that such procedure managed in an online based instructional plan. Improving the necessary practice of making convenient basis of learning enhancement should do with determining the learning approach to advance the learning style approach (Voskoglou, 2020). The practical stage of enhancing the

Figure 7. IR 4.0-based smart learning environment (SLE) in supporting online learning resources



learning style with IR 4.0 could give an insightful value in providing the online sources upgraded in transmitting the usability and adaptability towards such smart technology pathway. Through this platform, having a sufficient preparation to provide the better assistance might have a look at the context of implementing successfully on the way of learning process together with the provision of pedagogical and technological integration procedure. In this point, the emerging activities of instructional design in the learning process should bring along with determining the usability of smart technology pathway through such tool developed into combining the learning process in the borderless space.

In proposing the learning convenience with such online sources, the utilization of such massive data extraction from each second across social network platform has to bring into an innovative learning performance. As such, this extensive provision determined through actual activities of learning enhancement is consequently planned in providing the entire extent of beneficial values as an attempt to strengthen the ubiquitous understanding together with skills improvement (Sukadari et al., 2021; Sumadyo et al., 2018). In advancing the smart technology pathway of expanding the learning performance, it is worthwhile to take a sufficient procedure of building the learning in the basis of anywhere and anytime context. In this perspective, considering the technological and pedagogical experts needs to arrange the integrated tool of massive data construction in supplying the learning sources in an online platform, so that the accessibility in pointing out the academic skills could be transmitted in influencing the sufficient support for learning effectiveness (Van Heerden & Goosen, 2020). In this view, the significant way to cooperate with collaborating the strategic partnership between teaching style and learning design is attempted to advance the mutual alignment in enhancing the implementation improvement in enabling the easiness to access the learning sources with smart technology pathway in IR 4.0. The integrated engagement between considering the practice and widening the data measurement is potentially configured to emphasise the learning process complemented particularly into smart technology pathway one of which is through the big data analytics process and IoT basis on the voluntary data. The pattern produced through bringing together the wide range of different structured data has to advance the expansion of information worldwide in enhancing the learning enhancement process in the digital era. Expanding the worldwide of information pattern here refers to extract the data extraction from social network basis in offering the multiple sites to enable the users in having the skills particularly thorough the materials collection by the digital devices usability within the good internet connection.

IMPLICATIONS AND RECOMMENDATION

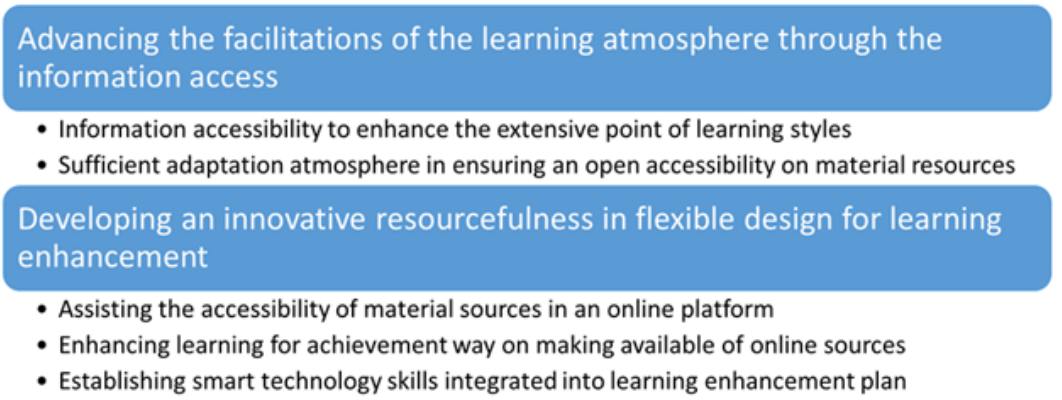
Maximizing Smart Technology Utility for Information Access

Understanding the smart technology in IR 4.0 is widely engaged into forming the digital technology tools together with incorporating the learning skills within the convenient basis. Through advancing the facilitations of the learning atmosphere, the entire sector arranged to have a sufficient plant to support the learning style should do with maximising the smart technology pathway utilised in rising the information access (Nikolopoulou, 2018). Well planned in benefitting the smart technology of IR 4.0, the information accessibility to enhance the extensive point of learning styles could be exactly deployed in creating the way of looking critically at the provision in the instructional design. With such distinctive utility on information access, the adaptability process in providing the assistance for the content transfer desk should be widely performed in advancing the learning sources (Bdiwi et al., 2019). In the attempts to improve the learning practice, aiming to advance the learners' ability to have a sufficient adaptation with the atmosphere should bring along with ensuring an open accessibility towards the material resources. IR 4.0 smart technology integrated with the multi aim space transformed into the spaces of breakout basis together with spaces of technology richness for instance big data analytics and IoT basis might give a prominent assistance in enabling the learners to have a sufficient apprehension towards the knowledge pattern (Çinici & Altun, 2018). In making an easy platform to get access towards such information sources, the wider essence of online sources massively to find out information is potentially transmitted into assisting the effective service in assisting the online practices at the convenient basis (Darshan Singh et al., 2018). As such, the easy way of enhancing the standard point of receiving an accessibility towards online sources incorporated in the learning procedure is fitted into the demand and need-based material subject. Referring to the particular facilitation in advancing the learning practices, an additional assistance to develop an innovative resourcefulness in the basis of flexible design for learning enhancement could make the learning space to be more elaborative procedure together with discovering the large data expansion in building largely on the extent of comprehension stage of data information.

In enhancing to commit with the procedures of having a sufficient knowledge attribution of inquiry for self-regulation principles, the attempts to empower the learning capabilities in advancing the effective online learning has to be deployed in linking to build up the smart technology pathway integration. Moreover, the particular contribution of big data or IoT platform, for instance, integrated with assisting the accessibility of material sources in an online platform is enhanced in the learning enhancement achieved through an easy accessibility of online materials (Durnalı et al., 2019). It means that the availability of access on online sources is necessary to make an insightful value in enhancing the learning enhancement procedure into an easy attainment. The particular contribution of assisting the achievement way on making available of online sources should do with establishing smart technology skills integrated into learning enhancement plan. In this view, enhancing the learning process in achieving the sources availability in an easy accessibility refers to facilitate the competencies in a particular attribution of an adaptive quality in underlying the performance scale (Freigang et al., 2018). Facilitating the instructional design of competencies together with performing the adaptive technology quality requires a usability in learning enhancement gained through making it into the instructional design. The practical stability quality in the learning enhancement, for instance, should bring along with deploying the accessibility of online sources of learning materials. As such, technological skills assigned into pedagogical integration is determined in enhancing the usability of gaining the technical line designed to give an insightful value to possibly sustain the strategic effort in attempting the learning performance.

In line with advancing the technological devices in utilising the information access, IR 4.0 based SLE should do with building the usability of digital based instruction to sustain the learning enhancement. Through enhancing the technical strategies in utilizing the access of materials, IR 4.0 smart technology assigned into the extent of its data analytics could give a beneficial value in

Figure 8. Maximizing smart technology utility for information access



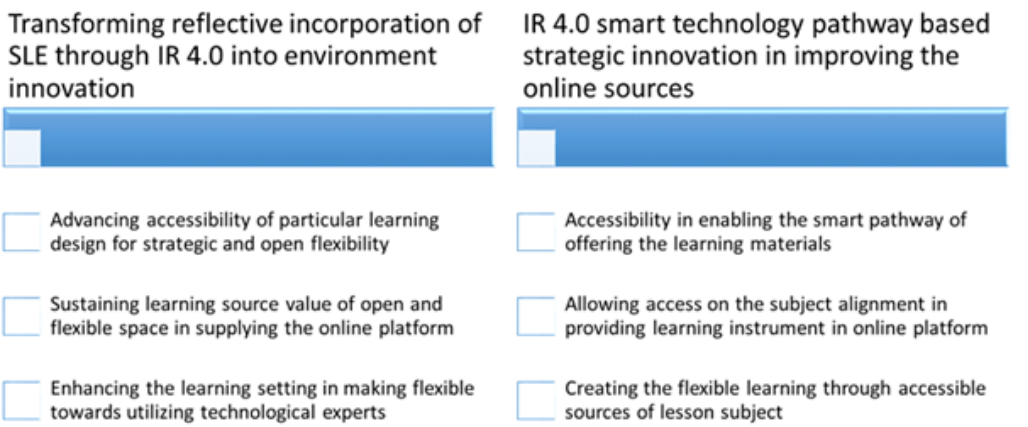
obtaining the distinctive engagement in valuing the performed task innovatively in transforming such information sources together with the capabilities in an online learning platform (Gambo & Shakir, 2019). Both personalization and customization towards the massive data of social network is immediately configured into the information sources in the basis of demand and need referring to the knowledge attribution of learning enhancement. In reaching to enhance the data potential collection, attempts to obtain the customized and personalized facilities would lead to sustain the pathway of generating the instructional design amongst the users in general and each student in particular. The result of online learning distributed from knowledge delivery in an online platform is necessary to expand the sufficient acceptability in terms of smart technology skills together with innovative design of instructional process (García-Tudela et al., 2020). With this regard, the basis of distinctive characteristics of supplying the relevant sources feature in an online setting refers to adapt the learning systems in offering the knowledge distribution along with being more accuracy to sustain the wide range of data exploration. Both knowledge understanding and learning performance could be improved in allowing the online sources ease of access in supporting the learning enhancement (Hawedi & Abdullah, 2020). Supplying the multi-links towards the relevant material sources is sufficiently engaged to provide to the learning procedure being more flexible through enhancing the subject material structure. In the attempts to develop the arrangement of subject material progression, it is necessary to advance the adaptive engagement in obtaining the support into an online learning enhancement as an attempt to enable the learners in achieving the recognizance towards the consistent accessibility of online sources to improve an effective learning. The sufficient practice to support the material sources adjusted into the appropriate content might be developed further into searching for the wide range of various browser engine normally in comprehending the material content (Nikolopoulou, 2020). Such this arrangement could be transmitted to increase the attractive attention in supporting the effective learning in the sense that is enhanced to expand the essential competence generated into the model of instructional strategy (Hiasat & Pollitt, 2019). In particular, the learning process arranged into the planning basis towards smart technology pathway of big data or IoT integration would allow the know-how usage managed especially in forming the learning enhancement procedure. An attempt to transfer the designed principle of technological competence needs to provide the experiential basis of strengthening the smart technology pathway of advancing the strategic innovation in the learning enhancement.

Improving Accessible Resources for Flexible Learning

IR 4.0 smart technology pathway based strategic innovation in improving the online sources arranged into providing the particular design of learning enhancement would lead to advance the accessibility of supplying the strategic description of an open flexibility. In particular, such attainment is assigned to sustain the potential value of learning source in the sense that is enhanced with giving the particular design of an open and flexible space to transform the potential value in supplying the online platform (Hoel & Mason, 2018). In order to provide the learning source, the online transmission to enable the learning inquiry process can run in a wider access easily is gained through supporting the smart technology pathway. Enhancing the learning setting assigned into making flexible towards utilising the technological experts was transformed to sustain the material resources of certain subject. In pointing out the flexible engagement utilised to allow the accessibility of getting the progressive alignment of learning enhancement, both wired and wireless based technology transmission has to bring the necessary points in enabling the smart pathway of offering the learning materials (Liu et al., 2017). In this view, utilizing such technological devices in allowing the access on the subject alignment should be transmitted into providing the learning instrument through an online platform (Van Heerden & Goosen, 2020). Typically viewed as the learning acquisition arranged with referring to the particular contribution of IR 4.0 based SLE, the supplementary assistance on the technology-rich spaces, improving the extent of instructional design to sustain the students' learning outcomes should be taken into consideration in expanding the significant chance to enhance the learning instrument. As such, the knowledge review in supporting learning styles could be deployed with facilitating the digital devices in producing the wider treatment of bringing into the learning design with flexible atmosphere. Accepting the learning acquisition should do with encouraging the atmosphere in enabling the instructional design to be more widely accessible. Moreover, attempts to have a sufficient contribution of getting access to online materials might be linked into obtaining the consequence of making smart technology pathway followed into the current style in online learning (Huda et al., 2018). In order to improve the practical capability of digital transformation consequence, the smart technology's advancement through big data or IoT approach configured with its data analytics endeavours to manage the establishment outline of communication pathway among the users. The sufficient adoption of an online usage through the computer assistance would make an operational structure with its significant contribution into the educational setting (Klimova, 2016). With its significant essence of handling the wide range of concerns in resulting the resources, the information engagement is widely transmitted in the current learning trends.

In further, the wider access on the resources in an online basis should do with performing the significant essence of IR 4.0 smart technology in the sense that is enhanced with analytic data transmission through big data or IoT approach. In this view, such generation transmitted into specialising digital tools and software could be made for the application in enabling the performance of learning assigned into the predictive analytics in ensuring the online sources accessibility (Zhou et al., 2019). In creating the material advancement for learning sources, data mining together with text mining could be accessed in optimising the lesson subject related to assist in the process of creating the data optimization in letting the availability and approachability of any resources (Deng et al., 2019). Appropriate with the learning subject, the sources come from the wide ranges of practices including reading, group work and project space in the attempts to offer the wider accessibility in achieving the online material of learning subject (Chen et al., 2017). As such, the number of sources redirected to present the subject point of learning materials could be configured to assess in an online platform in enabling the flexible based learning with an open accessibility. The environment design here refers to make the involvements promoted in collaboration with reflecting the data compeers in improving the instructional design for the learning enhancement. The number of explorations on smart technology pathway is transformed collaboratively between significant essence of integrated modules and subject segment reflected considerately and efficiently (Peng et al., 2019). Moreover, the particular beneficial value needs to advance in providing the incorporated elements along with

Figure 9. Improving accessible resources for flexible learning



making the structure of topic components to sustain the achievability towards the learning process through considering the value resulting from the number of data transmission related to the focus resources. With such attainment, the chance to drive in a significant contribution to make the period of school education setting in a wider accessibility and open basis could give an insightful value into the learning style. In particular, the sharing information made from working collaboratively could provide the materials of subject to be more accessible in that both teachers and students could have a mutual chance in ensuring the online platform efficiently supporting to the self-regulated learning inquiry basis.

In line with creating the flexible learning through accessible sources of lesson subject, the practical stage assigned into the capability of approaching the significant element aims to give an outstanding value in transmitting the learning outcomes. Moreover, the wide range of flexibility in the learning enhancement could come from the implementation stage of strategic approach in the way to underlie the responsive engagement. With such learning outcomes, the flexible learning is determined to have an achievement access practiced through implementing the responsive approach (Ruiz-Calleja et al., 2019). The particular enhancement of transmitting an online platform for the learning sources refers to make an eventual empowerment configured in supporting the learning flexibility. Moreover, expanding the place together with performing the mode of delivery approach for learning sources could provide the instructional design to be more openly accessible towards the circumstance appropriately into creating the innovative environment. In the attempts to sustain the essence of big data approach or IoT for instance, creating the learning space is engaged with providing the strategy approach of implementing the data transmission to enlarge the online sources in an online platform. Through IR 4.0 smart technology feature, assessing the learning enhancement with such innovative design could offer an effective effort to make the encouraging empowerment towards the knowledge inquiry transmission (Lee et al., 2019). The main point here refers to advance the learning style of enhancing the flexible learning together with accessibility of sources (Sharma et al., 2019). Moreover, the implementation stage of transferring the data accumulation with the credit to facilitate the learning process should enhance giving the insightful value in expanding the learning competence. As such, the space of openness, accessibility and flexibility through an online sources points out disseminating the awareness of performing the planned inquiry together with task based inquiry in achieving the adaptive technology quality (Sumadyo et al., 2018). The aims to obtain the subject lesson of online sources should bring along with improving the learning practice associated with practical principles in ensuring the enhanced optimization of effectiveness on regulating the

smart technology pathway in transferring the data transmission with an analytic process. Since the main point of facilitating the learning process should do with an outcome basis, the sufficient setting of transferring the subject matter of resources is supposed to enable the entire process to be more convenient in line with taking the responsible awareness in making aware of learning enhancement.

CONCLUSION

This paper examined the significant essence of IR 4.0 based SLE in enhancing OLR to see how its process can underlie the learning performance. With the emerging trends of designing such innovative environment, understanding the smart technology pathway through big data or IoT approach is engaged into providing the strategic process in underlying the learning performance. As such, building the tactical initiative in stabilizing an appropriate means in ensuring all activities, particularly in teaching and learning, can run with a plan management. The explanatory approach in dealing with IR.40 based SLE is advanced with the systematic approach to propose the SLE framework model with an innovative approach in enhancing the learning through utilizing the variety of information sources together with knowledge attribution in the higher education (HE). The contribution provides theoretical framework with the guideline of well-adapted performance in the educational activities as the new normal trend. The contribution here refers to enhance learning environment with an innovative and supportive basis for online sources in the sense that is engaged into continuing the sustainability of maximizing the smart technology for information access. In terms of instructional model in enabling the distance learning, the readiness of both instruction facilities and accessibility procedure is significantly the main basis in ensuring the process flow in enlarging the digital learning. Moreover, such attainment could give an insightful value in advancing the improvement of accessible resources for creating the learning atmosphere with being more flexible at anytime and wherever, borderless space of learning enhancement.

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