Revisiting the Knowledge Gap Theory: Dynamism and Risks of AI in Adaptive Learning

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Scholars have argued that the digital means of providing inter-disciplinary professional programs can not only help in aiding the demographic dividend in India but can also help in proper monitoring and motivation of the learners to complete the programs which they have enrolled in digitally thereby, reducing the knowledge gap within society. Despite the possibilities of a high dropout rate, adaptive learning methods on digital platforms can be seen as potential game-changers due to their ability to personalize learning. For a digital sound platform to promote adaptive learning in India, there is a need to adopt a sound digital learning model that can help the learners by providing academic aid and also motivating them to develop an inter-disciplinary aptitude for greater industrial integration. Adaptive learning with the integration of artificial intelligence can be seen as a necessary and crucial step towards effective learning. The paper focuses on analyzing some of the key e-content and e-learning platforms such as e-PG *Pathshala*, UGC-SWAYAM, mooKIT (Open-source MOOC Management Software), IITBX, ApnaCourse, etc. to understand their e-learning model and to identify the parameters which are indicative of adaptive learning and what more can be integrated to ensure that the learners are equipped with complete understanding of inductive, deductive and discovery-based learning. The idea of integrating AI in the learning model is a positive step towards adaptive forms of learning. However, the challenge of noise in the information can create extreme situations of incorrect assessment of student's performance, followed by the challenges of dealing with the emotional reactions during the student's progress. It is also imperative to understand as to how the AI-driven model can be integrated to the discussion forum of such platforms where a dynamic form of continuous communication can be achieved with the students through AI and how it can help in better assisting them and guiding them in the course of their performance.

Keywords: Artificial intelligence, adaptive learning, Knowledge Gap theory, e-PG *Pathshala*, UGC-SWAYAM MOOCs.

The Knowledge Gap theory is a communication theory that was proposed in the 1970s by Philip J. Tichenor, George A. Donohue, and Clarice N. Olien (Donohue, Olien, and Tichenor, 1970, pp. 159-170). This theory primarily focused on the information gap that existed within society. The theory proposed that "as the infusion of mass media information into a social system increases, the higher socio-economic status segments tend to acquire this information faster than lower socio-economic status population segments. Hence the gap in knowledge between the two tends to increase rather than decrease." (Communication Theory, 2019). The theory was seen as pivotal in the context of any society because media gradually began to be identified as an information source that had the power to influence knowledge creation and opinion formation. Unfortunately, the demerit of media as a form of technology was that it was, to a greater extent, determined by the socio-economic capital of an individual.

Historically, it was the stratum of the population well off in terms of socio-economic capital that had access to media technologies first. It would come later on trickle down to the rest of the sections of the society. As a result, the early adopters had a comparative advantage over others in terms of access to information. This gap within society was expected to expand with time as with the advancement in media technologies, the access being costly would become concentrated to the creamy layer, and the rest of the population will have to wait till the time the technology became competitive in terms of cost. Also, at the same time, in this gestation period of waiting, the state of technology would not remain constant and evolve into a newer and more advanced form. As a result, it was observed that the gap would continue to grow within society. Even in terms of information services, there would be an economic challenge as the technology would remain to be inaccessible to everyone within society, and providing cost-effective information services on the available technological platforms would not prove fruitful in the long run (Atkin, Fu, & Jeffers, 2017).

This theory was seen relevant for most of the developing societies such as India because, in India, there is a wide disparity between the rich and the poor, which has also affected the domain of media technology and its access. The Knowledge Gap theory is considered to be crucial because there is a process of rapid digitization of information that has taken place in India in the 21st century. This process has resulted in providing different degrees of choices for knowledge creation among the population. However, the demerit of this process is the fact that due to the rapidly growing freedom of choice in the contemporary information environment, there may emerge an increasingly differential distribution of knowledge between various socio-economic groups. This may create adverse societal implications in the long-run. The primary focus of the policy-makers then comes down to ensuring that the levels of knowledge formation amongst the demographic dividend of the country remain fair. However, in the case of India, with the already existing structural imbalances and unequal distribution of media technologies, it has contributed to the rising gap of knowledge amongst the different strata of the population (Sheikh, 2017).

For instance, in the case of levels of literacy in India, the Census Data of 2011 indicated that the total levels of literacy in India were 778,454,120[1] (approximately 74% of the total population). Despite the rise in the levels of literacy, the numbers did not show significant development in the domain of girl-child literacy, which was relatively low in comparison with boys. The census data supports the above argument that the levels of literacy amongst the women population increased by only 43% in comparison to men, which was approximately 60% (Census of India, 2011).

Even the male-female gap in terms of effective literacy rate did not come down drastically. It was 17% in 2011 in comparison with 22% in 2001. The decline was not very considerable despite the growth in the overall economy in India. Even by looking at the state-wise increase in the levels of literacy, states like Kerala, Lakshadweep, Mizoram, Goa, Daman, and Diu, etc., had a remarkable growth rate (Census of India, 2011). However, states identified as socio-economically backward such as Bihar, Chattisgarh, Jharkhand, Madhya Pradesh, etc. witnessed a minor rise in the levels of literacy. Still, comparing the statistics in terms of their decadal difference, the figures were not very promising (Census of India, 2011).

Comparing these figures with the growth in the levels of per-capita income, it can be seen that from the period of 2014 to 2017, per-capita income had increased by a mere percentage of 0.77% (Ministry of Statistics and Programme Implementation, 2017). In addition to that, the growth of higher education in India has been slow. For instance, there are a total of 25,951 colleges[2], out of which only 28% have been recognized (OECD Economic Survey, 2011). The total youth population of India, which accounts for 242 million (2017),

the number of recognized colleges lack the sufficient capacity to absorb them for higher education. There is a major challenge in terms of providing the youth with a basic set of skills essential to overcome the issues of unemployment and poverty (UGC Report, 2017).

The current statistics of the Ministry of Human Resource Development, Govt of India, has pointed out that more than 8,00,000 students (2018-19) have enrolled in higher education. Even the Gross Enrollment Ratio (GER) has increased from 25.8% (2016-17) to 26.3% (2018-19). Despite the increase in the number of colleges to 49,964 (2018-19)[3], the problem of recognized institutions still exists, thereby making the process of absorbing the young population for higher education a challenge (Livemint, 2019).

Apart from that, the major concern in terms of higher education that is present is the lack of proper industry-academia linkage. The courses that are running in most of the institutions have not been upgraded with the changing market requirements. The course curricula are incompatible with the industrial requirements. In addition to that, there is limited scope at the institution level for garnering value-addition skills, which can be industry oriented. There are also major challenges in terms of infrastructure. Most of the universities and institutions operating at central or state levels are dependent upon the University Grants Commission for grants and aids for any form of infrastructure-based development.

On the other hand, the colleges and institutions which are self-funded have an exorbitant fee structure that limits the admission of the students, and at the same time, due to its revenue model being profit-based, the scope for quality education becomes limited in the long run. Also, both at the primary level as well as at the level of higher education, there is a lot of political interference in terms of revising the course curricula either in terms of the subject matter or reference material, etc. This has created frequent imbalances in the system, thereby making the delivery of effective programs a challenge. There also exist challenges in terms of research and innovation at institutional levels. Except for a few engineering and management institutions such as IITs and IIMs, the degree of research and innovation is inadequate and lacks the scope for future utilization. The engagement is highly linear and faces challenges in terms of reliability and validity. Also, due to this issue, there exist challenges in terms of acquiring government-based research grants and fellowships. Most of the Indian institutions and universities lack quality publication of research papers which can help in developing an international recognition. This, too, complements the problem of acquiring funds for research and innovation. Further analysis it is noticed that:

(i)   There are issues regarding the management of resources as in most of the state universities, there exists a financial crunch as the number of grants received by them is not optimal. Almost 65% of the grants provided by the UGC are gone into central universities, whereas state universities and affiliated colleges are only able to get the remaining 35%. Although alternative channels for funds have been explored, still in most of the state universities, they have not shaped up to the desired degree.

(ii)   The other alarming concern in the case of higher education is the fact that the student-teacher ratio in most of the universities and institutions, both central and state are unbalanced. According to UGC, there are more than 16,699 posts vacant[4] in different central and state universities were 5,925 (35%) professor posts; 2,183 (46%) associate professor posts; and 2,459 (26%) assistant professor posts remain to be vacant (UGC Standing Committee Report, 2017). It is further complicated with the issues in accountability in teacher appointments and the performance of the subject matter experts in the long run. At present, there are no proper mechanisms for ensuring the accountability and performance of professors in universities and colleges. The process

of student feedback and improving teaching pedagogy is not taken very seriously rather as a formality.

(iii) In addition to that, most universities also face a challenge in terms of maintaining quality ranking in the long run. With the issues in quality assurance, institutions and universities avoid taking long terms strategies that can ensure quality education. They tend to adopt short term strategies that can help in gaining optimal ranking (Sheikh, 2017).

With the existence of such complex structural problems existing in the higher education system in India, the government has begun to explore alternative venues that can help in leap-frogging the structural imbalances and help in providing a vast array of professional courses which can help in strengthening industry-academia linkages.

Learning to E-Learning

Digital technologies post-globalization have brought about a change in the process of learning through the convergence of time and space. The learner is no longer required to exist in a defined structural space to develop professional learning that gradually translates into knowledge. In India, most of the open and distance form of learning was based on the model of the UK open university system. This process amplified with the emergence of privatization and growth in digital media. This allowed for the development of programs and courses which were diverse, inter-disciplinary, and based on the principle of 4 As (Anyone, Anyway, Anywhere, and Anytime). It was observed that with the growth in the professional sectors, there was a demand for services with distinct specializations, be it technological service, mobile service, visualization, etc. It was further observed that the skill development avenues for value addition could not be expected out of every state or central university and institution. It cannot be provided immediately. There was a need for a model that can help in filling this skill and learning gap (Imran, 2012).

It was also observed that with the development of ICT and its applications, the traditional methods acquisition, organization, and access of information had transformed. It was witnessed in most of the developed societies where the employment market constituted different types of information related activities along with a combination of traditional and technological skills. This led to a greater emphasis on content development and management, which could be delivered through digital media.

The notion of e-learning came into light in India post-1999. It was seen as a means for providing choice based courses to the students for value addition. It initially began at school level in the form of smart classes where standard course curricula of primary education were being complemented with additional information in the form of visuals. It later on, from 2000 onwards began to trickle down to business and professional sectors where e-learning was utilized for cost-effectively training the employees. This approach helped in revolutionizing the process of "learning at the doorstep" (Kawatra, 2006).

The focus on transcending from the paradigm of learning to e-learning was primarily done to ensure that there is a plurality in terms of access and affordability, followed by the provision of quality courses. In 2002, a committee was set up to look into the shaping of UGC-INFONET (2004). It was also focused on introducing the idea of e-learning. UGC-INFONET focussed on providing access to scholarly literature available over the Internet in all areas of learning to the university sector in India. UGC planned to link all Indian universities and research and development institutes together with a strong intranet network, which will ensure smooth and quick dissemination of information and would be a major leap towards educational development in the country (Kawatra, 2006).

In addition to that, another project that took shape in terms of delivery of online programs in the field of sciences and other related professional courses was the National Programme on Technology Enhanced Learning (NPTEL). It was funded by the Ministry of Human Resource Development. The idea was first conceived in 1999. It was focused on linking multimedia and web-based technologies to enhance the learning of basic sciences and engineering concepts. The platform was launched in 2006. The process involved making video lectures and broadcasting it through the *Eklavya* channel and also to develop a repository of online learning material through the NPTEL website. NPTEL has more than 300 courses running digitally and has been undertaken by partner institutions such as IITs, IISC, etc. The primary focus has been in terms of designing and promoting e-learning courses in professional fields and competing with international standards (Kawatra, 2006). Even the Government of India has developed a project on making library access in a digitized format, i.e., "National Digital Library," providing free access to various e-books and reference materials across different disciplines which can be used by professional institutions as reference for open-education courses and programs. However, e-learning in India is still gradually expanding as it is undergoing different degrees of experimentation. In India, there still exists a greater reliance on the traditional forms of teaching. It is changing but slowly. As a result, the shift towards e-learning is slow. The Government of India has begun to explore different avenues through which professional courses can be provided effectively through digital media. There has been the entry of private players as well in the form of Udemy, Unacademy, etc. which are providing professional courses in the form of e-learning. There are, however, certain design and structural challenges that can be seen to slow the process of transcendence from the traditional form of teaching to digital form of teaching. As a result, the degree of expansion in India in comparison with the global figures is not very significant (Imran, 2012).

E-Learning Platforms and Engagement: Contrast and Comparison

There is a slow growth towards the adoption of different e-learning platforms. However, the central question that remains to be explored is the fact that can such e-learning platforms help in addressing the problem of a knowledge gap in Indian society? The answer to this question is yes, but it is not linear. The approach to addressing this concern has to be dynamic. In India, in terms of digital engagement, there are certain parameters such as access to smartphones, which has reached a favorable figure of 800 million (2019) (Statista, 2019). Out of this figure, six hundred thirty million users belong to the category of youth. Four hundred fifty million users out of the total figure are utilizing the Internet for information access through smartphones. Post-globalization with the rise in the levels of competition, smartphones have become easily accessible to the different strata of the population. Thus what can be observed here is the fact that if there exist multiple platforms based on e-learning and providing professional courses in a customized manner, then the issue of knowledge gap can be addressed to some extent (Atkin, Fu, & Jeffers, 2017). However, what matters is how the platform has been set up and what all options of customization it is offering, which can provide an easy mode of learning cost-effectively. There exists criticism in terms of how technology may create alternative degrees of knowledge, but also, at the same time, arguments exist that through the exposure to professional information, knowledge can be created, which can provide value addition in different fields. Even the problem of socio-economic capital can be leap-frogged with access to cost-effective media technologies and digital learning platforms (Atkin, Fu, & Jeffers, 2017).

The other central questions regarding e-learning platforms are to understand which type of e-learning model will suit best for Indian conditions and how they can be implemented effectively? It is important to understand that the AI-driven model is where the data through effective storage and efficient processing can provide predictions through neural net algorithms and data-centric techniques to understand the levels of understanding of different students and predict the future course of engagement for them in a far more personalized manner. However, for this to effectively take place, there is a growing reliance on quality data where the AI is initially data-driven in comparison with model-driven as developing a model again is dependent on quality data. As a result, if the existing platforms of e-learning do not provide a sufficient channel to utilize the data through the back-end, the AI-driven model will see a finite set of operations that are minimalistic.

There is no denying in the fact that a complete AI-driven model is a pending future in terms of e-learning, and researchers have already begun to work and employ artificial intelligence technologies to develop more functional web-based learning systems. However, not only do the existing data sets require extensive processing for minimizing the degree of noise, but the technology is also expensive and requires extensive individualization strategies to operate effectively. In addition to that, there is also a need to ensure that the process of learning is adaptive (Hwang & Tsai, 2008).

Most of the e-learning platforms that are based on the principle of open-education resources (OERs) utilizes the Sharable Content Object Reference Model (SCORM). It is the most common occurring model which is based on content sharing and performance assessment, which can be customized. However, the issues emerge when it comes to providing a highly flexible and adaptive mode of learning. SCORM faces certain limitations in terms of providing a dynamic platform. For instance, e-PG *Pathshala* was launched in 2015 by the Ministry of Human Resource Development, Govt of India, and was supervised by UGC-INFLIBNET. It was an e-learning platform that was launched under NME-ICT. The platform provided access to more than 63 subjects, which included both inter-disciplinary and disciplinary courses (UGC, 2019). The platform provided access to learning material both in text and video format, along with self-evaluation assignments. The platform was entirely based on OER and Creative Commons. The only demerit of the platform was that it was not dynamic in terms of providing time-to-time feedback to the learners and nor could it be made adaptive. The programs offered followed a uniform standard and did not have the provision of the certificate of completion. The platform was based on the SCORM model and was very linear in terms of engagement. The platform was designed primarily to provide access to reference material, which was developed by the subject matter experts from all over India in various disciplines and that too free of cost. However, because of the linear engagement and lack of venues for adaptive learning, the platform had limited traffic of users and learners (Hwang & Tsai, 2008).

The other model is the Modular Adaptive Learning System (MALS). This model of learning provides different e-learning programs to be constructed in an individualized and intelligent manner. It is based on an algorithm which enables an object-oriented course framework. Here the learners are subjected to a specific learning object which is supplemented with the course content followed by assessments. Incase if the learning object fails to be achieved, then a new set of learning objects is formed, followed by course material and assessments. This process continues until all the learning objects have been fulfilled. The advantage of having this particular model is that it provides ample scope for an adaptive mode of learning where the programs can be personalized as per the learner's requirements (Hwang & Tsai, 2008).

In addition to that, there are other models, such as the "Wrap Around Model" and "Integrated Model." The former model is linear and involves using existing materials that are available and fixed. It also does not provide a dynamic way of conducting assessments. *e-PG Pathshala* also incorporates elements of this model. The Integrated Model offers a more fluid and dynamic form of engagement. It is largely determined by the individual and group activities in the course.

The challenge that emerges here is that most of the government-run platforms on e-learning are based on open source applications such as Google Course Builder. The application, despite being effective and simple in terms of operations, lacks the dynamic attributes which can enable an adaptive form of learning (Chauhan, 2017). By adaptive, it implies how the process of learning can dynamically change with the change in the learning objectives. This may be seen in terms of language, learning objectives, assessments, etc. UGC-SWAYAM MOOCs is based on Google Course Builder and provides access to more than 100 professional and inter-disciplinary courses spread across different academic sessions. The programs are designed in a standard manner, which includes four quadrants, namely the e-content, video, self-assessment assignments, and learn-more. These quadrants can be accessed as the learner progresses. However, the progression is time-bound and not determined based on learners' achievements and objectives. In addition to that, in case if the learning objective has not been fulfilled, the course designer has to manually calibrate the programs within a given period to provide some degree of adaptive learning. This can be a challenge if the number of learners enrolling for the course is in great numbers. In addition to that, the course does not provide the scope for changing the language at any point in time. It depends entirely on the course designer. Even the format is uniform across every module. Further, the model of evaluation is static. The assessment can be provided through different means such as objective multiple-choice based or subjective writing etc. However, each value has to be defined manually. It cannot be set up automatically in an algorithm, which can make the process of assessment far more effective. As a result, the biggest challenge that can be seen here is in sustaining the learners until the end of the program. The majority of learners tend to leave in the middle of the program. Even NPTEL and CEC follow a similar platform for course delivery (Chauhan, 2017).

In comparison with the above platform, IIMBX provides a far greater engagement when it comes to providing access to professional courses through MOOCs. It is based on the platform, Open edX, which is a similar platform used by MIT for providing MOOCs courses. It offers a range of customization features such as course content, course schedule, and grading policy. The advantage which IIMBx provides in comparison with other government operated open-source e-learning platforms is that there is a progression level that provides the learner to constantly be in touch with his or her levels of progression through the feature of "Insight." This feature, in the case of UGC-MOOCs, is entirely dependent upon the discussion forums, which are again driven by the course designer or coordinator. The nature of engagement on IIMBx is dynamic in the sense that there is an integration of both visuals and text. In addition to that, every unit involves a practical example and assessment methods where the learner can test his/her learnings so far. Even the level of progression for the learner is tuned to his/her pace. The discussion forum is personalized for every course and learner. The discussion posts can also be filtered concerning the topic in discussion to the learner who has raised valuable points during the process. Even the interface for access is simple in terms of engagement (Chauhan, 2017).

The similar is the case of *ApnaCourse*, where more than 100 programs are accessible in the domains of finance and business management to law and designing, etc. The platform is not based on the open-source model yet provides the scope for personalized

learning. The course designed on the platform undergoes different stages of quality checks before it is made accessible to the users. Even this platform provides a simple interface in terms of access to course material, videos, and assessment based assignments, which vary depending upon the learning objectives. The advantage of this platform is that it allows the learner to preview the course curriculum as well as the course structure followed by reviews and feedback from the past learners. This helps in developing a sense of trust and reliability on the platform. The learner can engage in conversation with the subject matter expert, which can be either based on the forum or real-time (Chakravarty & Kaur, 2016).

The advantage that can be seen in all of the e-learning mentioned above platforms is the fact that they provide some degree of cloud-based learning where the learner can access the course anywhere and at any time. However, the challenge that exists in terms of incorporating the process of gamification, which in the case of most of the government-run open-source e-learning platforms lack. On the other hand, private-run e-learning platforms such as Edtech and Next Education, etc. are based on experiential learning techniques and incorporate artificial intelligence for providing personalized learning to the learners. This mode of engagement follows the AI-driven model and is highly dynamic. It enables the learners to engage with the learning problems and constructing meanings. Because of this personalized form of dynamic engagement, the level of dropout rate is less in comparison with government based e-learning platforms (Chakravarty & Kaur, 2016).

Notes

[1] Retrieved from http://censusindia.gov.in/2011-prov-results/data_files/mp/07Literacy.pdf
[2] Retrieved from https://bit.ly/2T3TbjH
[3] Retrieved from https://www.livemint.com/education/news/india-s-higher-education-student-population-grows-by-8-lakh-hrd-ministry-1569081600712.html
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