

FORECASTING SKILL NEEDS FOR TEACHERS BASED ON SELECT PATENTS

Prajakta Shivaji Mane
RIT CSE Dept. Islampur, Maharashtra, India
prajakta6mane@gmail.com

Prof. S. U. Mane
RIT CSE Dept. Islampur, Maharashtra, India sandip.mane@ritindia.edu

Abstract— In recent years, technology has entered into the classrooms in a big way, making teaching intensely technology driven. With this, for teachers the scope of enhancing the experiential learning and integrating it in classes has increased tremendously, hitherto limited to classrooms or at best the laboratories. From use of computers for programming to use of devices for online experiments, the incursion of technology has, in fact, expanded and pushed educational frontiers into the infinite cyberspace. In other words, technology has created competition between teachers and virtual teaching/learning, a pointer to change of role of teachers in future.

Technologies for which patents have been filed or granted in recent past can well serve as precursors to the upcoming innovations in educational spaces, which in turn can pose need of acquisition of newer skills by teachers. This study is on forecasting such (future) skills that would become important for teachers. For this patent database of select technologies have been examined and skills needed to handle them have been identified. Results on skills for Communication Technologies are presented.

Keywords— future technologies, patents, forecasting, future skills

I. INTRODUCTION

In recent years, technology has entered into the classrooms in a big way, making teaching intensely technology driven. With this, for teachers the scope of enhancing the experiential learning and integrating it in classes has increased tremendously, hitherto limited to classrooms or at best the laboratories. From use of computers for programming to use of devices for online experiments, the incursion of technology has, in fact, expanded and pushed educational frontiers into the infinite cyberspace. In other words, technology has created competition between teachers and virtual teaching/learning, a pointer to change of role of teachers in future.

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Evidently, there is need to focus on the future

teaching skills. More so, because teacher has to generate manpower equipped with a skills that are changing with technology. Future teachers must be prepared an existing one re-skilled or trained for being able to teach effectively by adopting emerging technologies. To forecast future skills for teachers it is necessary to study future technologies that will have impact on teaching. Towards this the present work delves into patents that have been filed or granted in recent past.

Patent is a legal right granted by the government to the owner of invention (inventors or their assignee) to exclude others from making, using, selling and invention for a specified number of years and generally has validity up to 20 years. The databases of patents are the most reliable source of the technical information on inventions which can be referred for research work. Patent information gives us idea about the future products (technological products, process, hardwares, software) etc. that may hit the market.

The technologies impacting future education will require skills when deployed in the classrooms or adopted by the teachers for discharging their duties. The technologies that are emerging and have a potential to impact education can be classified into six broad categories [1] - ICT (Information and Communication Technologies), AI (Artificial Intelligence) Technologies, Display and User Interface Technologies, Internet Technologies, Computational Technologies and Simulation Modeling. Due to ICT Technologies, data transfer and data communication has become easy and efficient, making the delivery of educational content and instructions much better and appealing. AI is reducing the work of assessment carried out by teachers and setting them free for more interactions with students. Newer Display and User Interface Technologies are transforming the way students receive information and convert it into learning for themselves. Due to Internet Technologies, access to sources of learning whether teacher, books, video or learning material in any format, has democratized. Computational Technologies have helped in solving complex problem with less efforts and time.

Emergence of these technologies and their combinations (like Digital text-books, Flipped classrooms, Game-based learning, MOOCs, Immersive Virtual Reality) by themselves, and emergence of new models of content creation, delivery, assessment and management of student work are triggering changes in the educational landscape. These changes are usually much slower than technologies themselves and need to be managed with appropriate skills which could even be altogether new. Thus, keeping an eye on emerging technologies and skills they may demand from teachers who are at the core of education system becomes important. Skills for communication

technologies by Patent Analytics have been identified in this study, which has represented by infographics for better understanding.

II. LITERATURE REVIEW

The ingress and adoption of technologies in education has been there for centuries, starting with printing press. This has continued with technologies like, radio, cinema, tape recorder, television, videos, CDs, DVDs etc. However, internet and mobile telephony have accelerated and democratized the education completely for the first time in human history. For all practical reasons technology and education have been impacting each other and their various advances, interplay and newer concepts emerging in the education domain. These aspects and also to some extent the skills required to handle the technology induced changes have been studied. A review of such work is presented below in subsequent paragraphs.

Noted futurist Thomas Frey [2] has predicted that by 2030 over 2 billion jobs will disappear. He has forecast jobs along with new skills required to do these jobs efficiently and pointed out the need to be focused on the catalytic innovations that will be responsible for the creation of future jobs. Among other things, he gives the vision to forecast appropriate future skills for particular educational technology. Campo et al. [3] have given a comprehensive account of educational technologies as they have found adoption in university education. The range covers educational technologies from the traditional blackboard to the internet (networking devices) in chronological order along with advantages and limitations. The study discusses impacts of these teaching resources on teachers and students: for e.g. flip-charts that have been very useful in small classes or seminars, since the teacher had to be close to the holder and had little space to write, but this technique could be not used in classes with a large number of attendees. More specifically, Čestmír Serafin et al. [4] have contributed to the evaluation of technology (resources) including effects of using technology on teaching. This contribution analyses teacher's approaches to evaluating educational technologies resources, with two main perspectives; first is that of teacher's and educational goals and tasks, while the second is of student's perspective.

Spector [5] has reviewed emerging technologies (educational) from the US NSF (National Science Foundation) and from other sources. He has recommended for changes in the curriculum to adjust for the changes that advanced learning technologies will usher in. After examining MOOCs, Personalized learning and Game-based learning in this study, it has been reported that MOOCs will have a more significant impact compared to the other two. Roy Damary et al. [6] have critically studied the online distance education system of Robert Kennedy College (RKC). In online distance education at international level, students and instructors from different culture and background have to interact with each other and it tends to create new challenges for

students and instructors (new expectations from teaching staff i.e. adopting new desired skills). This work looks at culture as a new aspect which can affect the working of technology in the education system.

Introducing technology into the real educational setting, Ford and Hirst [7] have developed Mobile Learning Laboratory. A traditional 4-walled laboratory has more limitations of time and place etc and their mobile lab overcomes them and provides advanced features. This to an extent that there will not be need of a teacher, a person with no computer knowledge can use this mobile lab with ease, the lab can be moved easily (greater mobility) etc. This mobile lab uses many devices that make it work more efficiently and with minimum limitations like interactive devices, experimental devices, consumable items, electrical apparatus etc. Strikingly enough, there will no need of skills for teachers for this teacher independent system; but there will be need of lower order skills to operate, maintain and repair and also upgrade them. has some skills, like facilitative management, consultation skill etc. which can be useful to forecast skills for educational technologies, particularly because of polar-shift in learning from teacher-centric to learner-centric. The report [9] maps intersection between science and 21st-century skills and as an example suggests, media literacy as one of them in the study, skills along with their outcomes and examples have been given.

Hwang Gyu-hee [10] has discussed how patent data can be useful to predict future skills along with the development of a methodology that forecasts the future skills needs by using patent analysis. The focus of this study is on the needs for new skills required in the future according to the evolution of technological innovation with the reference to Network Information Security. This work provides a direction to undertake the present study in an important area like education; rest of the work reviewed earlier gives different perspectives to understand and study educational technologies and identifying future teaching skills. No attempt to forecast skills needed by teachers in future, based on Patent Analytics has been found and hence, this work is a notable attempt in forecasting skills.

This above literatures gives the different perspectives to understand and study educational technologies and identifying future teaching skills. Literature survey helped to take, history of educational technologies, some existing teaching skills, multicultural environment of distance education in which instructor plays crucial role, impacts of emerging technologies on teaching, types of skills into consideration. Also, list of skills get increased. The gap found by literature survey is no one has attempted Patent Analytics for forecasting future needs for teachers yet. There is need of clever use of technical resources like patents for research purpose.

A document from SkillScan [8] lists out 18 skill-sets with suggested career options for that particular skill set. Nine skill-sets are of relevance to education or teaching and the list

METHODOLOGY AND METHOD OF STUDY

This study is focused on skills which impart the ability to carry out a task with pre-determined results often within a given amount of time, energy, or both. For teaching, which is a complex activity, the job functions involve ideas (cognitive skills), things (technical skills), and/or people (interpersonal skills) to be dealt by the teacher. Any exercise to forecast a skill due to the incursion of new technology that a teacher would need would be of qualitative nature.

Therefore, in this study, Patent Analytics a qualitative forecasting method has been used to identify future skills for teachers. In order to keep it focused educational technologies have been classified in 6 broad categories: Communication, Display & User Interface, Internet, Simulation & modeling, Artificial Intelligence and computational technology and data of 2012-2017 have been examined.

Skills related to cognitive domain (Knowledge-based) that are categorized in 6 levels: Remembering (level 1), Comprehending (level 2), Applying (level 3), Analyzing (level 4), Synthesizing (level 5) and Evaluating (level 6) have been examined vis-à-vis future technologies (software/hardware).

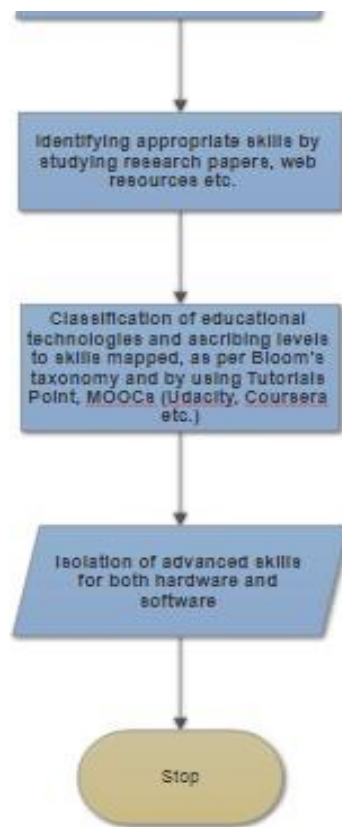


Fig. 1 working methodology

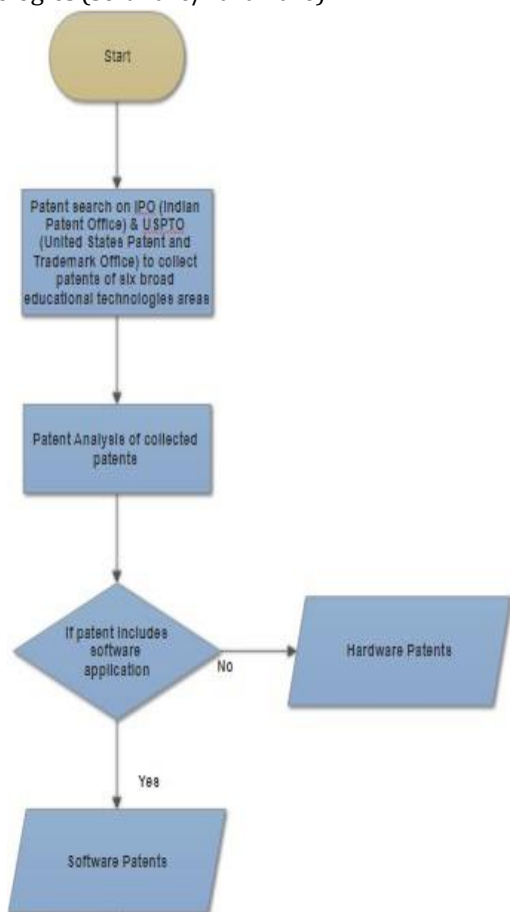
With the approach discussed above, the entire study has been carried out following the steps given below:

- Step 1-** Patent search on IPO (Indian Patent Office) & USPTO (United States Patent and Trademark Office) to collect patents of six broad educational technologies areas
- Step 2-** Study and analysis of patents to identify future technologies (software & hardware)
- Step 3-** Identifying appropriate skills by studying research papers, web resources etc.
- Step 4-** Classification of educational technologies and ascribing levels to skills mapped, as per Bloom's taxonomy & following criteria given in the table below:

Web Resources/MOOCs	URL
1. Tutorials Point	https://www.tutorialspoint.com/
2. Coursera	https://www.coursera.org/
3. Udacity	https://www.udacity.com/

Step 5- Isolation of advanced skills for both hardware and software

These steps were applied for 13 patents related to communication technologies, as preliminary investigation to test the approach. These patents of IPO and USPTO were filed during 2012-2017 only.



III. RESULT & DISCUSSION

Patents analyzed for communication technology has categorized as software (process) and hardware (product) patents. There are 3 patents are of software and 10 are of hardware patents. There are 13-15 basic skills identified for communication technology and more than 15 skills identified for both software as well as for hardware patents. Near about 15 future skills identified in this study as shown in Fig. 2

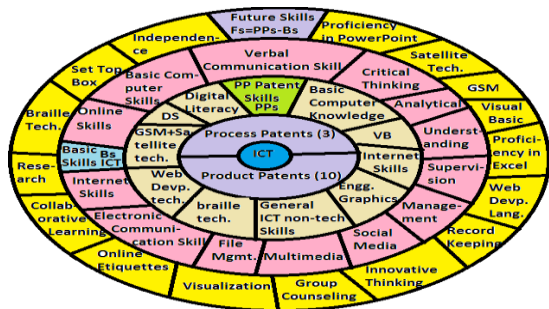


Fig. 2 Future skills for communication technology by Patent Analytics

IV. CONCLUSION & FUTURE WORK

Education is a field, getting intensely impacted by newer technologies. The present work is based on 13 patents filed in recent years and communication technologies which are expected to emerge in future. In all, 16-20 skills of different levels have been identified for both software and hardware aspects of educational technologies covered in above patents. The Fig. 2 gives the complete picture of findings for communication technologies with set of skills required. This work will be extended further to cover different educational technologies and subjected to validation.

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