"BRIDGING SKILL GAPS IN FUTURE WORKSPACES: PROMOTING CREATIVE THINKING IN CLASSROOMS USING DIFFERENTIATED ASSESSMENT METHODS"

Research Paper

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"Abstract"

India has a large population of educated youth, but India ranks 132 out of 191 countries on the World Human Capital Index. This trend can be reversed if educational institutions focus more on skill enhancement than rote memorization. This research aimed to develop creative thinking in graduates by implementing a differentiated assessment pattern based on the ACER creative thinking framework. The age of rapid automation and AI poses a threat to low-skilled labour, therefore educational institutions must focus more on developing skills that machines cannot replicate. The exploratory case study over a longitudinal period of six months concluded that science fiction writing and white paper projects develop higher-order thinking skills in graduate learners. This study was also able to quantify data from the case studies, which could be used in transcripts to indicate skill progress.

Keywords: ACER, Differentiated assessment, skill progress in transcripts, creative thinking.

1   Introduction

Recent developments in the field of AI and smart Automation have led to the rise of machines with intelligence embedded in them. Existing research and surveys by global leaders like McKinsey have concluded that future workspaces will be disrupted by the rise of smart automation. This trend will enable machines and AI to handle low and medium-skilled labor, therefore future workspaces require highly skilled manpower. In this context, it is the need for educational institutions to develop higher-order thinking skills and lay emphasis on pedagogical reforms that bring about innovative changes in teaching, learning, and assessments to attain sustainable development. Standard assessments are used in most colleges and universities to evaluate the rote memorization process, in the current context of rapid automation and AI tools, most of the machines will have intelligence embedded in them and, therefore these assessments have lost their relevance. Thus, educators should revamp the pedagogy to suit the needs of the digital natives and future workspaces. The need for rote memorization is declining as all knowledge is available at the click of a mouse. Each learner is unique in their learning style and, therefore requires a differentiated assessment to check the outcome of the teaching-learning process. Though many studies indicate the importance of analytical thinking, not much research has been done on how higher-order thinking skills can be developed or evaluated in the classroom. Developing higher-order thinking skills in classrooms will make graduates workforce-ready. It is observed that educational reforms do not keep pace with technological revolutions. It is imperative to implement innovative pedagogy in all classrooms to effectively upskill India's vast youth population.

Graduates must be equipped with higher-order thinking skills to become workforce-ready. The time for onboarding at the entry level of jobs will decrease if graduates develop their skills along with knowledge. Educational institutions should focus on workforce-ready graduates so that large-scale unemployment can be reduced. The rise of unemployment and underemployment is due to an education system that is slow to change. Pedagogical practices must be revamped and revised to suit the needs of digital and automated workspaces. This study follows an exploratory case study method with fifty-four graduate learners over a longitudinal study

period of six months. This research aims to establish that educators should move from a knowledge-based assessment system to innovative and differentiated methods that can assess skills required for future workspaces.

2   Literature Review

The reviewed literature indicated the importance of higher-order thinking but not much study was done on how it could be part of pedagogical practices. The current employment trend indicates that machines are replacing low and medium-skilled labor. The chapter's review also indicated that higher education institutes offering three- and four-year degree would lose their relevance if they did not focus on bridging the skill gaps. More learners would prefer to learn short-term skill-based programs rather than invest in three- or four-year undergraduate programs. The rate of graduate hiring in India is 26%, according to Statista Research Department, posing a potential threat to the economy if not addressed Rathore, (2019). The concept of memorizing is irrelevant today, instead, educators should encourage the creation and application of the existing knowledge. The purpose of 21st-century education will be to prepare the learner to meet the demands of society and to make a substantial contribution to the workforce. Awadhya and Kanjilal (2019) emphasized the need for Indian Universities to offer customized skills and this was mentioned years back by Santandreu and Shah (2016).

This study is anchored on the ACER creative thinking framework to measure creative and critical thinking as stated by Ramlinga (2020). The three main themes are knowledge creation, Experimentation, and quality of thoughts. The two main themes and the three subthemes under the quality of thought namely logic, novelty, and elaboration are measured. According to Levy (1999), differentiated learning is a pedagogical strategy that is used to design teaching according to the readiness of the student interests and abilities of each learner. Previous studies by Harbott (2017) and Dupleuis (2019) suggested that educators these days see large student diversity in many aspects such as cultures, learning habits, and academic abilities. ACER creative thinking framework is an approach that enhances creative thinking skills in individuals. It includes a range of principles and strategies to stimulate creative thinking. It draws inspiration from cognitive science and education, creativity involves generating novel and valuable ideas. It emphasizes that creativity is a process that includes problem-solving, testing, and communication.

The first theme of ACER creative thinking framework is Idea generation, this stage focuses on generating a large range of ideas and possibilities. It involves techniques like mind mapping and divergent thinking. The first strand focuses on generating many ideas. The second theme is idea selection and experimentation with the same, this involves shifting perspectives and creating new knowledge. The third theme is the quality of ideas and this enables one to select the best idea. This research is based on the ACER creative thinking framework. This theory provides a structured and systematic approach to cultivating creative thinking skills.

The Guilford (1950) theory of creativity is a pioneering framework for developing creative thinking. This theory is considered the original framework of creativity. It also has shaped our understanding of intelligence. The experiential theory developed by David A. Kolb describes how individuals acquire knowledge and develop skills. This theory indicates that learning is a dynamic process and not a static one. It consists of a process that involves four major steps namely concrete experiences, reflective observations, abstract conceptualization, and active experimentation.

The first step is concrete experience CE it involves the learner's direct engagement in an activity or learning experience and it forms the foundation for the learning experience.

The second step is reflective observation RO after the concrete experience the learner reflects on the experience and observes it from a different perspective.

The third step is abstract conceptualization AO, in this stage, the learner attempts to create meaning from the experience by forming generalization. This is the concept from which a fictitious work can be created by reflection and further can be evaluated for skills. The last step is active experimentation AE which is the basis for generating and applying knowledge gained.

Source	Findings
McKinsey 2021 Survey	90% of all organizations will require reskilling of the existing workforce in the next five years
Lasry et al. 2013 Changing classroom designs: Easy; Changing instructors' pedagogies: Not so easy.	The complexity of imparting 21st-century skills requires an evolution of instructional techniques to ignite the learner's environment
Greenstein (2012) Beyond the Core: Assessing Authentic 21st Century Skills. Principal Leadership	Students need to develop complex skills to prepare for the rigor of college and the demands of the workforce.
Awadhya and Kanjilal (2019) Study on employability skill gaps among IT graduates: exploring employer's views.	Indian Universities to offer skill-based education
World Economic Forum, (2023) Future of Workspaces.	The highest priority for skills training from 2023 to 2027 is analytical thinking
Rosen (2018), Career and Technical Education: Current Policy, Prominent Programs, and Evidence. MDRC.	College students' motivation is increased when they feel secure in their ability to apply what they have learned in the workplace
Misra et al. (2012) A suite of cognitive complexity metrics. In Computational Science and Its Applications	Project-based learning is a novel method that is incorporated into the learning environment so that the learners can offer solutions to real-life problems
Patacsil and S. Tablatin (2017) Exploring the importance of soft and hard skills as perceived by IT internship students and industry:	Improving work skills while at college by providing a compulsory internship program

Table 1   Summary of the Literature Table.

Recent studies have highlighted the urgency to introduce skill-based and competency-based education, which unfortunately is lacking in universities. This research provides a detailed roadmap for imparting skills, domain knowledge, and a robust assessment system to track progress. Ignoring these findings will inevitably lead to a continued decline in India's human capital development, as confirmed by the India Skill Report (2021). The unemployment rate will be around 54% in 2021 and according to them, it could be improved if employees have better behavioral skill sets. According to the Future of Work, Education, and Skills Enterprise Survey, the data collected from 774 companies spread across 14 states indicated about 34% of these companies require new skill sets to handle the rapid automation, and more than 70% of them would up-skill their existing staff. Critical thinking, agility, and a problem-solving approach. The reports by Bessen (2020) provide a useful approach by stating that human capital development is the solution to the current wave of automation, and as studies reveal maximum benefit can be reaped if the skilling happens before employment. Various government surveys indicate that unemployment and underemployment are more common as the educational qualifications increase resulting in youth taking up jobs for which they seem to be over-qualified. This is not in line with the belief that Education will fetch suitable employment. An agile workspace will require creative minds that analyze and put forth strong solutions to adapt to a dynamic work situation. Human beings have almost an unlimited capacity for creativity and their imagination provides them the ability to develop new and innovative ideas.

Craft (2001) argues that by fostering creativity in the classroom, students will be enabled to identify and establish a framework for their lives. Recent studies by Malone et al. (2020) prove that we are many decades away from the day when computers have complete human-like intelligence and therefore there is a lesser possibility of machines replacing humans. The above observations show that new advancements will require agile and advanced skills to cope with these fast and smart machines. The studies carried out by Aniket (2018) indicate a skill gap between the education offered and the requirements of the industry. Bano and Shanmugam (2020) explained that the main reason for the employability gap as well as unemployment among Indian graduates is that the skilling program and education system in India work independently. Most of the studies strongly suggested the development of these skills in the classroom but not many studies are done on how these skills can be developed. Most transcripts around the world emphasize content knowledge; therefore, educators do not focus on skill progress. The best way forward is to have a method to quantify skills and indicate skill progress metrics in university transcripts. The reviewed literature indicated that future workspaces will require analytical and creative thinking as these are skills that machines cannot replicate.

3 Methodology

The study used an exploratory case study method by analysing the written work of the fifty-four students over a longitudinal time frame of six months. According to (Creswell, 2016), the qualitative exploratory case study method is chosen as not much data is available on similar studies. The survey was conducted to understand current trends in education and skill gaps amongst 112 respondents of varied professions, and it concluded that creative and critical thinking will be one of the most in-demand skills for future workspaces. The cohort of fifty-four final-year graduate learners was divided into the control and experimental groups. The learners were all 21 years old except for two of them at 20 years old and all of them belonged to South India. Standard assessment methods were applied to the control group and differentiated assessments were for the experimental group. The experimental group was asked to develop a fictional story or a futuristic product based on the principles taught at the end of each unit of the program. A Flip question paper can be defined as a novel assessment method an alternative to the standardized assessment which gives the learner flexibility. Flip-the-question is a strategy for students to uncover their thinking. It can be used both to raise the cognitive demand of a problem and to provide information to a teacher about the depth of understanding. The knowledge assimilated could be used to create a futuristic product, or they could visualize the knowledge to write a paragraph of science fiction. The answer can be in the form of a white paper project or Science fiction. Though standardized assessments are clear indicators of the route learning done, they lack the space to exhibit creativity, critical thinking, and agility. The more creative people may not have time to engage with route learning and, therefore, might score lesser in standardized assessment methods. This idea will encourage more creativity in the answers and can be used as a source of knowledge creation rather than knowledge repetition.

Figure 1.   Rubric for Assessment of creative thinking.

The above figure is a rubric used to quantify the content of the learners in the experimental group. Each of the five themes explored had a five-point scale to determine the skill progress. The pretest and the post-test values were determined to indicate the development of creative thinking. The presence of each attribute enabled the quantification of each theme and subtheme, thereby generating a metric for skill progress.

4   Results

The below figure shows the results of the eighteen students in the experimental group, with the pretest and post-test scores. Learners 1, 2, 3, 4, 5, 6, 7, 8, 9, 15, and 18 showed marked and steady development in their skills at knowledge creation. Learners 11, 14, and 17 showed almost the same levels at pre and post-test. Interestingly learner numbers 10, 12, 13, and 16 showed a decrease in their ability at the post-test score of knowledge creation. All learners secured a score of 3 indicating that prior knowledge, accuracy, and depth of knowledge were attained, the scores improved if they could play with ideas and generate unique information out of it.

These results also show that ten of the eighteen samples in the experimental group received a score of three on the pre-test, seven received a score of four, and one received a score of five. Students in the experimental group saw a rise in their post-test Knowledge creation scores: four received a score of 3, eight received a score of 4, and six received a score of 5.
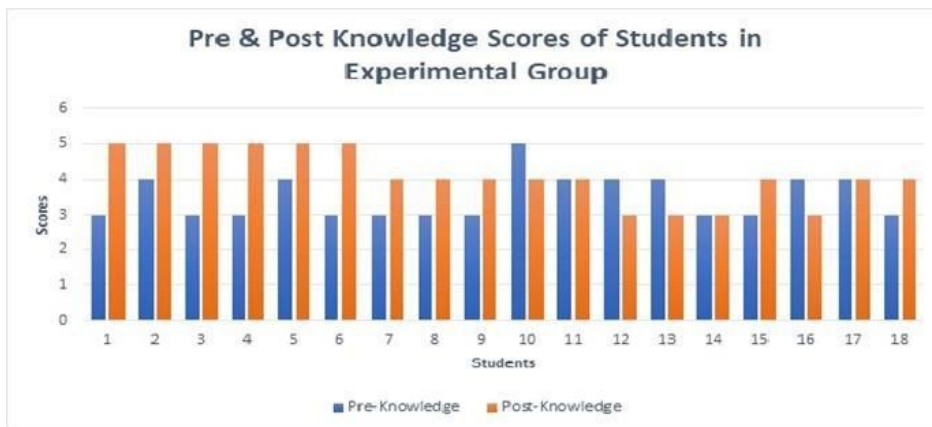
Figure 2.   Pre- and Post-Knowledge Scores of Students in the Experimental Group.

Almost all the learners in the control group retained the same level at the post-test and the pre-test indicating the lack of idea generation, 2 out of the 36 learners i.e., less than about 10% showed a subtle increase in post-test compared to the pre-test.

The learners of the experimental group showed marked progress in all three themes of the ACER creative thinking framework indicating that the results support the hypothesis. The themes and codes of the qualitative data were analysed to generate quantitative metrics to achieve the validity of the hypothesis.

According to Acer, the definition of creative thinking is the capacity to generate many kinds of ideas, manipulate ideas in unusual ways, and make unconventional connections to outline novel possibilities that have the potential to elegantly meet a given purpose. According to Education Scotland (2013), Creativity is at the heart of the philosophy of the Curriculum of Excellence and is fundamental to the definition of a successful Leader.
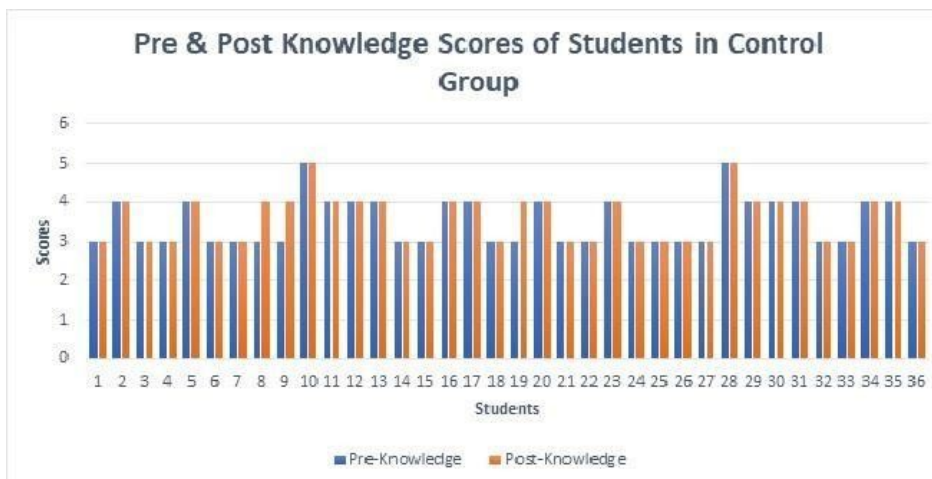

Figure 3   Pre-test and post-test Scores of Knowledge of each Student in the Control Group

According to Mikdashi (1999), creativity is considered a principal term and it can be divided into three types either creating something new or combining things. Houran and Ference (2006) stated that creativity can be seen as a mental process that produces novel and useful concepts or ideas, it could also be seen as a process of introducing innovative relationships between existing ideas or concepts. In the literature reviewed creativity is defined as a principle of problem-finding and problem-solving and therefore requires several skills and talents

and is unconventional (DiLiello and Houghton, 2008). The ability to capture ideas from all around enables learners to take different perspectives.

Theme 1 relates to the knowledge creation of the conceptual framework since creative thinking is a generative process. This is also synchronized with the importance of the production of many different ideas or in other words ideation fluency as mentioned by Guildford (1950). The findings suggest that most learners in the experimental group were able to generate ideas more fluently with time. The inclusion of knowledge creation helped the learners create more ideas and consequently the generation of creative ideas.

The first theme of Acer creative thinking framework is knowledge creation, it throws light on the ability to analyse and sort information to construct new conceptual relationships Fisher and Scriven, (1997). Knowledge creation is possible only if the learner has understood the concepts and can generate multiple solutions to a single problem. The ability to break away from conventional practices is also a form of creative thinking. Future workspaces require innovative thinkers who can generate multiple solutions to complex problems. This is an essential skill that machines cannot replicate fast. The results of theme 1 knowledge creation were quantified by evaluating the content. An interesting study by Smith (2020) stated that engaging with failure is essential for success, and the reluctance to inculcate failure in learning may sabotage the ability of learners to be creative. The rigid and standardized assessment so commonly followed never fosters failure for a student well prepared with memorization of the content. Though flexible assessment methods can seem like a failure regarding the memorization of content they prepare the learners for flexible environments. Another area of concern is that these skills are open-ended in nature and therefore it is difficult to evaluate and assess. The main dichotomies that exist regarding these assessments are psychometric versus behavioral, process versus product finally Individual versus group. The reasons mentioned earlier hinder the assessment of higher-order thinking skills. Therefore, most universities and educators find it difficult to quantify these skills.

These discussions of visionary speculative writing formed the foundation of various student-led assessments over six months. The study was able to support the hypothesis that alternative assignments like flip question papers can improve creative and critical thinking in graduate learners. The embedding of critical and creative thinking throughout the learning and assessment process enables learners to engage in higher-order thinking. The use of logic and imagination makes learners able to select from a range of ideas and strategies. These assignments were challenging and engaging and maintained a fun approach for the learner to develop various alternatives and seek new knowledge. These assignments though flexible and the concept's developed imaginary were evaluated for quality as well as for correctness. Intelligence and creativity should be measured from a multidimensional perspective and intelligence always is composed of different abilities than a single attribute. The hypothesis proves that the learners who engage in this type of assessment were able to integrate their ideas and expand their understanding to develop new insights; the concept of divergent and convergent thinking for the same assignment enables the learners to generate multiple ideas and finally choose the best of these ideas. The fluency of ideas comes forward with the depth of knowledge and it is directly proportional to the growth of knowledge. Integrating ideas enables a generation of new insights. The standard assessments of the control group never allow them to develop their knowledge rather it enables them to memorize and repeat the knowledge.

The existing information of the learner plays a significant role in the learning process. A strong foundation of prior knowledge helps learners build upon existing and new knowledge. This also enhances the success of the learners. Activating prior knowledge helps students establish connections faster. Learners with a strong foundation of prior knowledge can retain and comprehend knowledge faster. Therefore, the motivation of the learners increases leading to new learning outcomes. Learners with strong prior knowledge will have fewer learning gaps. The overall learning experience is thereby enhanced when prior knowledge which is the foundation for building new knowledge helps learners make connections between previous and new information.

The depth of knowledge framework provides a common language for assessing the degree to which cognitive engagement translates into learning opportunities and tasks. The depth of knowledge framework provides student growth and positive academic outcomes. The depth of knowledge assists educators in creating assessments that align with the desired level of cognitive engagement and depth of understanding. deeper understanding at appropriate cognitive levels happens with a higher depth of knowledge. The learners with higher levels of skills were identified by the depth of their knowledge. Though the fluency of ideas indicates the ability to think creatively, not all learners can generate factually correct ideas. Successful outcomes are possible when the data is accurate, this can be achieved when learners have the depth of knowledge to create relevant ideas.

The last attribute to determine knowledge creation was cognitive readiness. The future workspaces will require the agility of thought and people who are quick to adapt to rapidly emerging and unforeseen challenges. This is also a sign of creativity and should be of special relevance. These are the new-age characteristics that educators and educational institutions should be gauging and not the content knowledge memorized by the digital natives.

This case study focused on an assessment system that evaluated competencies rather than knowledge. The key benefit of this assessment is the development of their intrinsic motivation to achieve their best performance. This may be due to the learner competing with her understanding of the lessons taught and not comparing with her peers. In contrast, the learners of the control group were anxious in comparing the grades of their peers. This tendency made them anxious and introduced certain doubts about their abilities. The experimental group enjoyed their assessments as a play method of acquiring knowledge. The rubric for assessment for knowledge creation was the ease with which prior knowledge was intertwined into the product, depth of knowledge, the accuracy of facts stated, and most importantly the expertise and cognitive readiness. The learners in the experimental group demonstrated a higher level of cognitive readiness when compared to their counterparts in the control group; this indicated their readiness to work in agile work environments. The machines of the future will be able to do routine work but adapting to agile and dynamic work situations will be difficult. Therefore, these are the skills that learners should develop more rampantly than memorizing large chunks of data that are available at the click of a mouse.

There is a clear lack of literature that indicates that skill is measured and quantified as a metric in any mark sheet. Most students do not focus on skills as it is not quantified to show progress over the study period. This study was able to provide a transcript that can have skill progress along with content knowledge. Many countries are facing an "invisible underemployment" which refers to a situation where an individual is unable to find a job in line with their educational qualifications and secures a pay much below the expected industry standard. The current lockdown and the technological shift have further escalated this issue. This means that any skill set comprising even a small share of tacit capability will remain the domain of humans because tacit skills cannot be codified. Automation has so far been the most successful in areas where a task can be converted into explicit instructions that a computer understands. This hypothesis is based on the following real-world cases of various science fiction concepts that have now become a reality. Science fiction has often inspired real-world inventions and technological advancements. Here are some well-known examples of science fiction concepts that have become a reality.

Communicators: The concept of handheld communication devices used in "Star Trek" became a reality with the invention of flip phones in the 1990s recorded by the inventor of the handheld phone Martin Hooper (1990). The concept of current-day inventions like driverless cars, hoverboards, blade runners, bionic limbs, teleportation, and universal translators was adapted from several Science fiction movies including Star Trek according to Elizabeth Howell (2018).

There are several examples of individuals who did not perform well in traditional educational settings but went on to become successful inventors and entrepreneurs. Here are a few notable examples that prove the use of standardized assessments is not a good predictor of student achievement.

Thomas Edison: Thomas Edison, the renowned American inventor, struggled academically and was deemed "difficult" by his teachers. However, he went on to invent several groundbreaking technologies, including the practical electric light bulb, the phonograph, and motion picture cameras according to Neil Baldwin (1947). Banesh Hoffman (1973) in the biography stated that Albert Einstein, one of the most influential scientists of all time, faced challenges in school and had difficulty conforming to the traditional educational system. He was even expelled from school at one point. Despite his struggles, Einstein revolutionized the field of physics with his theory of relativity.

The goal of this study was to highlight the importance of providing alternative assessments in the form of white paper projects or Science fiction writing to improve the ability to think creatively and critically. This assessment method also provided the context for learners to navigate an agile environment. The themes of knowledge creation, experimentation, and quality of thought were analyzed for the experimental and control groups over six months. The results proved that there was a positive outcome of the hypothesis, thereby opening new avenues to check the development of creative and critical thinking. The only way to develop skill is to foster an environment where skill can be measured. The dependence on flexible assessments over standard assessments developed creative and critical thinking. The hypothesis was validated as most of the learners in the experimental group showed gradual progress in the development of higher-order thinking skills. The results of the study indicated that the hypothesis was not just a theoretical construct but could be evaluated practically, thereby indicating a positive outcome.

5   Conclusions

In conclusion, it can be stated that differentiated assessment validated the hypothesis with most learners in the experimental group showing gradual progress in developing their critical as well as creative thinking. The study was able to quantify skill progress, thereby allowing transcripts to display skill as well as knowledge gained. The study also highlighted the importance of alternative assessments to align with the dynamic needs of the current workforce. This study's findings enriched the education landscape by providing a differentiated assessment system.

The findings of this study indicate a positive result in the development of 21st-century skills this pedagogical transition is essential for learners to realize the fact that they need to be aware of the evolving skill sets. The assessment though different from the standardized one enabled complete freedom for the learner to explore. The learners found the assessment challenging yet completely flexible. This reduced stress levels considerably and therefore the learners in the experimental group were able to perform better than the experimental group. These flexible assignments allow learners to develop a spirit of inquiry and a quest for knowledge creation. It can be used as a business model to identify the key strengths of the learner, and this will equip the learners to analyze their strengths and weaknesses. This transcript can be used as an objective assessment indicating learner proficiency in a particular skill; it enables learner progress tracking of skills. It also enables goal setting and a means of differentiated assessment for the learners.

This innovative assessment enabled complete freedom for the learner to create his understanding of the knowledge learned. It eliminated the need for route learning and memorization which is a total waste of time for the digital natives. These assessments were able to quantify the progress of the three themes under the ACER creative thinking framework. Diverse students of varied abilities cannot be evaluated on a standard assessment, this study enabled differentiated assessments. This provided for a more holistic and learner-centred method which reduced the anxiety and fear of exams.

A natural progression of this study will be to extend this method to other programs of study like engineering and learners of diverse backgrounds. A limitation of this study is that case studies usually have a small sample size and it might be difficult to generalize in the broader sense. The second limitation is the subjectivity of the researcher's views and bias can influence the data collection, analysis, and interpretation process. These findings will be of interest to educators, administrators, and policymakers as they offer the following three solutions that need urgent attention to bridge skill gaps. This study was able to offer the following three solutions to pedagogical transformations.

A. An Innovation in Pedagogy

Most educational institutes and educators fail to measure the progress of creative and critical thinking skills as these methods are time-consuming and relevant rubrics are not present but this research was able to develop a unique rubric for assessment of these skills. The concept of creative assessments should be taken up more seriously by all educational institutes so that the skill gaps can be bridged.

B Indian assessment system.

Most institutes still depend on the memorization of facts and lesser importance is allotted to the development of higher-order thinking skills. The concept of an open book to enable learners to develop and curate content seems unreliable in the days of rampant AI tools. This research was able to offer a promising solution to this system by suggesting flip questions that enabled a learner-driven unique method of instruction. It also enabled a marking system for creative thinking in transcripts so that skill progress can be measured.

C Promoting student-centred learning and assessment.

No two learners are the same therefore, assessment cannot be standardized for a whole class of students. Each learner must develop their thinking and ability. This research was able to cut the stereotype of assessment that one size fits all. The learners of the experimental group developed versatile skills and were able to create knowledge rather than memorize indicating the growth of creative thinking. Further research is required on diverse groups and programs of study to evaluate the impact of this speculative fictitious scientific writing.

If educators and institutions do not focus on developing skills on a larger scale, most learners would prefer short-term skill-based programs rather than four-year degree programs that have outdated pedagogical practices. The primary focus of educational institutions should be to develop workforce readiness in graduate learners. To ensure that AI can provide sustainable development pedagogical practices must be fine-tuned

rapidly to keep pace with the evolving needs of society. The primary focus should be to develop a highly skilled workforce so that job losses can be mitigated. To attain sustainable development education should evolve and large-scale upskilling should be incorporated both at the workplace and in educational institutions. The rubric is designed to quantify creative thinking and can be used to develop targeted interventions and innovative assessments in graduate learning programs so that educators all over the world can evaluate creative thinking along with domain knowledge. Unlike traditional grading systems, this differentiated assessment showcased not only the acquisition of domain knowledge but also the progress of skills thereby offering a more comprehensive assessment.

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