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Employability Skills in Digital Age: A New Teaching-Learning Organisation Framework for Improved Student Experience and Benefit

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Abstract

Successive Industrial Revolutions have shaped economy due to continuous growth in knowledge contributed in part by Higher Education, with Industry 4.0 giving rise to networked digital enterprises and economy. The digital economy, driven by convergence technologies, is characterized by both exponentially growing information and real-time, high-speed information processing and is causing the nature of jobs to change rapidly and existing jobs to disappear gradually. Teaching-Learning activities in Higher Education must be performed in such an environment where content is changing continuously. Students have to be prepared not only for the workplace of the present but also of the future, that is, the world of work that can be said to come with a 'delay' and is unknown and hence unobservable. It is increasingly difficult to meet the needs of digital economy with incumbent Higher Education teaching-learning processes that view content as relatively static and predetermined that can be delivered through guided instruction and practice and uses technology as a means to replicate existing modes of teaching-learning. This paper describes the design and development life cycle of a new model of teaching learning organization, called the Additive Curriculum model that integrates realistic teaching-learning processes with realistic business processes through horizontal and vertical integration of instruction in courses spanning semesters using realistic value-creating project-based experiential learning. The paper demonstrates through pedagogic initiatives executed that the Additive Curriculum model can lead to improved student learning experience and benefit leading to a gain in employability skills.

***Keywords*-Student Learning Experience; Teaching Learning organisation; Value creating teaching-learning; Experiential Learning; Employability Skills; Digital Economy**

***JETLP Category*—Research**

Introduction

One of the goals of Higher Education (HE) is to prepare students to obtain employment in a country's and global economy (Robbins, 1963; Kromydas, 2017). Economy is impacted by advances in science and technology and has been shaped by successive industrial revolutions, with the current economy driving as well as being driven by Industry 4.0 which is the result of rapid advances in convergence technologies, internet included, giving rise to networked digital enterprises and digital economy (Williams, 2021; Libert et al., 2016). According to WEF "Future of Jobs 2023" report (The Future of Jobs Report 2023, 2024), the percentage ratio of business-related tasks performed by machines to that performed by humans is now at 34:66% and expected to change to 42:58% by 2027. This implies destruction or major modification of existing job roles, primarily those that can be automized, and creation of new job roles, some driving the process of automation itself. A shift in requirements from technical skills to cognitive, behavioral and metacognitive skills, and renewable energy and sustainability sectors driving new job creation are also reported. Similar forecasts and observations have been made in other industry reports (Hazan et al., 2024) (FICCI, EY, 2024).

To continue to be professionally productive in such a rapidly changing economic environment, Datta and Mandke (2021) state that the workforce needs to transform into "learning engineers" or "learning professionals" with information processing, information use and new knowledge creation competencies to drive the emerging work processes, and continuously enhance self-performance for value creating work. This puts reverse pressure on educational institutions and teachers to prepare students to prepare students not only for the workplace of the 'present', i.e., what is 'now', 'vivid' or 'physical' and is 'observed', but also the world of work of 'futures', i.e., what comes with a 'delay' and cannot be 'observed.' Thus, HE has to equip students for the structured learning information requirements of the present as well as 'futures' requirements where learning:

a. Is always on the 'future front' coping with complexity and uncertainty that the Teaching-Learning (T-L) system environment continuously encounters
b. Is unstructured in that it necessarily constructs knowledge by origination of information in research and discovery mode and processes the originated information in new way
c. Is involved in unstructured problem solving of the world of work, with its complexities and uncertainties, by engaging with the customer, unexpected customer included

It can be observed in incumbent HE that a student's learning experience is organised into lectures, tutorials, practicals (LTP) in terms of deductively derived curriculum content. Courses are taught independent of one another. This framework can be viewed as a 'subtractive' curriculum wherein content is delivered by 'cutting' or 'subtracting' progressively from the starting to the final semester. The subtractive curriculum processes, with its focus on pre-determined content, are insufficient to address the requirements of the digital economy that is characterized by complexity and uncertainty arising from interdependent, conflicting and evolving system environmental factors. Learning outcomes have to shift from its proven process of operating on traditionally specified static subject domain knowledge specifics. Simons, RJ. et al. (2000) state that to handle exponential growth of information, "new learning outcomes –

learning, thinking, collaboration and regulation skills – that can be applied on 'information' and learning processes" are required.

We state that learning outcomes as stated above have to further transform to operate on 'learned information' and learning processes to 'generate new knowledge that is of value' to all recipients, namely, students, teachers, parents, community, institution, industry/business, society, as the case may be. This requires a "connectomnal" teaching-learning organization where effective learning occurs due effective information flow and processing through the complex network of teachers, students, industry and community interplaying by performing multifarious roles (Datta & Mandke, 2021). This forms the basis of the proposed "Additive Curriculum" in contrast to the subtractive curriculum.

With this view, the paper first examines related work reported in literature to identify, adapt and build on requirements of industry and HE's pedagogic constructs to address them. It then describes the Additive Curriculum (AC) model and its framework with its theoretical underpinnings that have been analytically derived to enable acquisition of higher levels of learning and improve student learning experience. Next it details three key pedagogical experiments undertaken based on the AC framework and analyzes the data of surveys conducted to demonstrate improved student experience and benefit leading to employability skills.

Related Work

We begin by examining issues related to employability skills as reported by industry and academicians in the form of industry reports and research papers. Next, we look at various mechanisms being adopted in HE to forge university-industry linkages. Lastly, we investigate instructional methodologies being implemented in HE classrooms to improve student engagement and learning as alternatives and/or supplements to the lecture method.

Industry Needs and HE Inadequacies

OECD, puts forth its "Framework for Education 2030" in its position paper, (OECD, 2018), that is based on three categories of competencies – "Creating new value", "Reconciling tensions and dilemmas" and "Taking responsibility" that it calls "Transformative Competencies" to address the requirements of a world that is changing socially, economically and environmentally at a rapid pace. While The Future of Jobs Report 2023 (2024), Hazan et al. (2024) and FICCI, EY (2024) focus on the demand side to present survey-based analysis and findings of workplace trends and skills requirements, Aspiring Minds (2019), focuses on the supply side and reports on the employability of undergraduate engineers in India, US and China based on the assessment of technical skills. The report finds that Indian engineering education focusses mainly on theory with a meagre 36% undertaking projects beyond coursework. 60% of faculty do not discuss how engineering concepts taught apply to industry. Further only 40% of students undergo internships.

García-Álvarez et al. (2022), through a systematic review of cross-national research work report a set of employability skills stated as valuable by organizations and observe that although career management skill allows navigating a complex and unstable job market in an effective manner, employers did not value this competency. Tushar and Sooraksa (2023) report the finding of a similar set of skills with the addition of 'willingness to learn' attitudinal skill. Souppez (2024) includes 'professional body accreditation of a course' and 'professional body membership' as additional parameters in the research study and report that students did not perceive professional body membership as important. Cheng, et al. (2022), in their study, have included government as a stakeholder in addition to student, institution and industry and state that the government and HE institutions focus predominantly on the absolute dimension of employability in terms of accreditation and occupational skills, while the industry stresses on the relative dimension and expects "soft skills" and attitudes. Students equated employability with career building as well, apart from securing a job. The differing perception amongst the stakeholders leads to a gap in meeting industry needs. Kövesi and Csizmadia (2016), through their analysis of interviews with different industries hiring engineering graduates, report that interviewees stated that "engineering mind-set" and "systems thinking" are found to be lacking in addition to skills reported in literature. Asefer and Abidin (2021) adopt the term "soft skills" and "hard skills" and state that while hard skills are a predictor of whether a student finds a job, soft skills can predict if the student keeps the job. Geisinger, Brandi N. and Raman, D. Raj (2013), on investigating reasons for students dropping out of engineering, state that students leave "due to lack of interest or uncertain career goals" as they enter college with "vague ideas of what an engineer does".

Atman, Cynthia J., et al (2010) researching on the early experiences of students on entering workplace report that new hires, in contrast to the experience of problem solving undertaken in teams during their study program, found:

a. industry problems complex and ambiguous
b. unable to see how the work being done by them fits into team and company's larger goals
c. work environment structure unfamiliar
d. new terminology and communication modes unique to the company have to be acquired
e. workplace teams large and diverse consisting of both engineers and non-engineers in various capacities
f. teams have to interact with clients or customers directly with which they have no prior experience

Thus, it can be seen that project environment in institutions does not mirror the work environment leading to lack of abilities and attitudes required by the industry as there is no realistic linkage between university and workplace problems and processes leading to dissonance in student experience. Additionally, both industry and university do not give due regard to individual student's career aspirations thus leading to instruction not being brain-aligned. Students have to possess competencies beyond domain knowledge acquisition in order to contribute effectively at the workplace. Subjects are taught independently of each other in courses and there is a lack of underlying learning themes connecting the subjects studied.

Connecting with Industry

Mandke (1989) traces the efforts of HEs to create pedagogical devices for education-work linkage beginning with the first half of the nineteenth century and state that the education-work linkage models, with the exception of BITS and MIT Practice School, still viewed the linkage through clearly delineated roles of the university imparting domain knowledge and industry imparting workplace skills both behavioural and cognitive. The paper puts forth the concept of the "Work-Bench" as a learning situation outside the classroom and goes on to say that the work-bench activity has to be entrepreneurial in nature with the teacher playing the active role of connecting theory and practice as well as assessment and assessment includes behavioural and cognitive outcomes such as analytical ability, decision-making ability, leadership ability, interpersonal relations and related skills. Reinhard (2006) describes the German Berufsakademie Work-Integrated Learning (WIL) Program and how it differs from internships and has its basis as active cooperation between industry and university.

Jackson and Dean (2022), studied the impact of the three forms of WIL, namely, "work-based", "non-workplace" and "global" on preparedness for employment and perceived improvement in skills in three domains namely, foundation, adaptive and collaborative. They conclude that since no one form of WIL can be said to be better than the other, all forms should be used. Further WIL should take place throughout the study programme. Garwe (2020), in their study report that the timing of WIL does not impact the employability status. Burns and Chopra (2017) on the basis of their meta-analysis of WIL studies state that most studies limited their research to the investigation of the effects of one industry engagement on student learning outcomes. Kay et al. (2019), in their project study to identify emerging WIL models for the evolving digital economy report additional forms that they have classified into five models – "micro-placements, online projects or placements, hackathons, competitions and events, incubators/start-ups and consulting".

Given the rapidly changing nature of digital economy, providing the right internships and placements to all students may not be feasible. In-curriculum industry engagement practices can provide the required experience and exposure and have the additional advantage of being incorporated throughout the curriculum (Male & King, 2019). Coll et al. (2011) state that WIL implies integration of knowledge and skills acquired in the HE and workplace, and can mean to take into the workplace what has been learned in the HE and vice versa. Their research study did not find any evidence of explicit actions being taken or pedagogies devised to this end apart from using reflection as a mechanism to document learning and self-improvement. They suggest three means to bring integration:

a. Formal stating of integration at the beginning of WIL itself
b. Adopt Reflection-before-action in addition to reflection-on-action and reflection-in-action models in pedagogies
c. Work with industry supervisors to evolve formal pedagogies for WIL

A 'WIL Partnerships for Employability Framework' was developed after extensive stakeholder survey and interaction which identified domains for employability that can be realized through collaborative partnerships rather than drawing up and maintaining partnership agreements. Social connections and Role models and mentors were two of the unique domains stated as being important by stakeholders (Ferns et al., 2019). Guidelines, recommendations and principles have been provided to assist universities, governments, industries, students and graduates to frame their individual policies and procedures for effective education-work linkages that can add value to all stakeholders. (Choi-Lundberg, D., et al., 2024; Borbély-Pecze &

Hutchinson, 2014; Stirling et al., 2016; Gallagher, 2019; Male & King, 2014; Broadbent & McCann, 2016)

Active learning as a pedagogic practice

Prince and Felder (2006) distinguishing between deductive and inductive approaches to teaching-learning state that the inductive approaches were found to yield better student performances but caution that the inductive instructional methods have to be carefully constructed. Freeman et al. (2014) in their meta analysis of studies conducted to compare active learning methods with traditional lecturing in STEM found that examination scores showed improvement and failure rates dropped irrespective of the active learning method employed in comparison with the lecture method. Improvement in concept inventories scores was higher than examination scores. Weiman (2014) states that as concept inventories are designed to assess expertise achieved during a course and active learning methods promote thinking like an expert, concept inventories scores showed a higher improvement than course examination scores.

Project-based learning is being researched and adopted in HE as it facilitates the inculcation of employability skills as well as technical skills. Ries et al. (2017) in their bibliometric and classification review report that studies have shown improved technical, soft and multidisciplinary skills. They also report having observed the usage of tools and techniques such as virtual meetings, e-learning, mathematical data analysis and modelling software and robots. Guo et al. (2020) observe that most studies do not make a distinction between problem-based learning and project-based learning and in their review study have selected only project-based learning studies to identify the evaluated learning outcomes and measurement instruments adopted in the studies. Hart (2019) has refined the focus further and reviewed those studies that used interdisciplinary projects to improve discipline and employability skills and report that the perceived gain in Interdisciplinary effectiveness increased with the increase in breadth and depth of the interdisciplinary project whereas the discipline knowledge gain decreased.

Clausen and Andersson (2018) and Jakubik (2017), through their respective case studies of masters students undertaking authentic problems of business and society to create value, show that students' perceived satisfaction, theoretical knowledge and employment relevant skills show improvement. They stress on creating a learning community consisting of educators, students, industry practitioners and society stakeholders. Making students create separate presentations and demonstrations for external stakeholders and internal university faculty enables them to acquire the necessary theoretical knowledge and skills as well as industry relevant skills. (Clausen & Andersson, 2018) Joseph (2013), in order to improve HE student learning experience, used differentiated instruction. Students' readiness, interests and learning profiles were assessed beforehand and instruction was differentiated by providing choices in terms of content, process and product. The study reports that students reported "higher levels of intellectual growth" and increased interest in participating in the course. Herodotou et al. (2019) have identified six innovative approaches to teaching and learning that can lead to the development of digital economy competencies such as critical thinking, problem solving, scientific mindset, working in groups amongst others. These approaches, namely "formative analytics, teachback, place-based learning, learning with robots, learning with drones, and citizen inquiry", show varying degrees of maturity in terms of adoption and evidences about effectiveness but are relevant for the future.

In contrast to the 'forward' design approach which consists of identifying content, designing instruction and creating assessments, Wiggins and McTighe (1998) propose a 'backward' design approach to instruction and consists of three stages – identifying the desired learning outcomes, determining the assessments that will demonstrate learning outcomes achievement and plan learning strategies and instruction to achieve identified learning outcomes. Datta and Mandke (2021) have presented a "feed-backward instruction design (FBID)" approach that is used in the AC and states that desired learning outcomes should be derived from learning and employability futures' leading to the learning ecosystem behaving like an open system. FBID also places emphasis on continuous feedback to identify the gap between desired and actual outcomes and using this gap for new information origination leading to a step gain in learning.

From the studies reporting pedagogic and instructional means adopted, it can be observed that they can be classified into two types - Standalone in the past and Statically Connected in the recent past and present. A third type, "Networked Dynamically", which addresses information and information flow that is complex and unknown, ambiguous, uncertain and infinite choice for learner benefit and improved experience futures is proposed, the details of which can be seen in (Datta & Mandke, 2021). Further, it can be said that learning outcomes have to be viewed beyond acquisition of technical competencies, and active learning pedagogies undertaken need to have realistic linkages with industry work. Universities should construct meaningful engagements with students with respect to their motivation and aspirations right from the first year of the chosen academic program itself. Furthermore, these engagements should continue to function till the final year and beyond encouraging lifelong learning. This paper builds on the findings reported in literature and identifies characteristics of the teaching-learning that are capable of meeting the needs of the networked digital economy. The problem-solving engagements chosen should lead to value creation for industry, institution, student and society. Methods to integrate realistic business processes and problems with realistic teaching-learning processes and problems to solve chosen industry problem is needed. Convergence technology usage for networked teaching-learning and business work needs to be identified and used.

Additive Curriculum Model - Theoretical Underpinnings

Traditionally, learning is defined "as a relatively permanent change in behaviour or in behavioural potentiality that results from experience and cannot be attributed to temporary environmental states." This definition while comprising the experiential aspect of learning does not include the nature of experience that is necessary for learning to take to take place. As examples, the experience can be in the form of reinforced practice, or contiguity between a stimulus and a response, or the 'acquiring' and/or 'utilizing' of information. The authors state that from the cognitive perspective the experience that is necessary for learning to take place is that of acquiring and/or utilizing of information in a 'research and discovery' mode to originate information Thus, a modified definition of learning can be stated as - learning is relatively permanent change in behaviour or behavioural potentiality that results from experience of acquiring and/or utilizing information in a research and discovery mode while originating information.

Advances in cognitive research and brain science are informing more and more about how an individual, group and organization learns. The key insight that is emerging is that they learn by constantly positioning themselves at the edge of their incumbent information and knowledge space boundary that separates the known factors and criteria from the unknown – many factors and multiple criteria, i.e., at the 'sharp edge', and by constructing new information, i.e., originating information, while experiencing learning risk, i.e., the risk of the learned information being of no value, arising out of contextual and situational dynamic decision making. (Mandke & Nayar, 2004)

Another emerging insight is that the processes of learning are changing. Advancing digital technologies has led to an exponential growth in information as well as high-speed information processing with the result that the current feed-forward instruction design which focuses on content acquisition and its assessment using didactic instructional methods makes it difficult for both teachers and students to focus only on acquiring information. Hence a process-oriented instruction model that is based on "learners' processes of knowledge construction and utilization" in the subject domain under study leading to new learning outcomes, learning -to think, -to learn, -to collaborate and -to regulate is needed. (Vermunt & Verschaffel, 2000)

This paper makes the observation that the digitally driven economy and HE learning needs to address performance futures, i.e., behaviour to performance potentiality, which is a consequence of interdependent, evolving, conflicting environmental factors impacting system variables. This is in contrast to futures performance which is a predictable linear extrapolation of the past. The emphasis is on experiencing learning risk, and recognizing, prioritizing and mobilizing for the same. It proposes a process-oriented teaching learning framework as given in Figure 1. When applied to instruction in the classroom, classroom instruction has to now address futures' unstructured learning requirements and can thus be viewed as '*interplay'* between student and teacher – interplay between internal regulation by student and external regulation by teacher, between constructive conflict and destructive conflict in respect of instructional content, between contextualization and de-contextualization of content (Simons et al., 2000).

At lesson content delivery level, teacher and student depart from traditional and proven roles as defined under guided mode of instruction wherein normally teacher routinely lectures and student passively listens and takes notes. While *interplaying*, each student is required to determine her (or his) learning value creating objective leveraging individual prior knowledge, interest, and intelligence(s), recognize and follow learning environmental anomalies, research and find content information; brainstorm and answer questions and share her (or his) thoughts and learnt opinions; practice in real time using technology including convergence technology so as to achieve real world value creating educational objectives. The teacher too is required to assist the student in the above process and evaluate students' learning outcomes for independent work and self-directed learning.

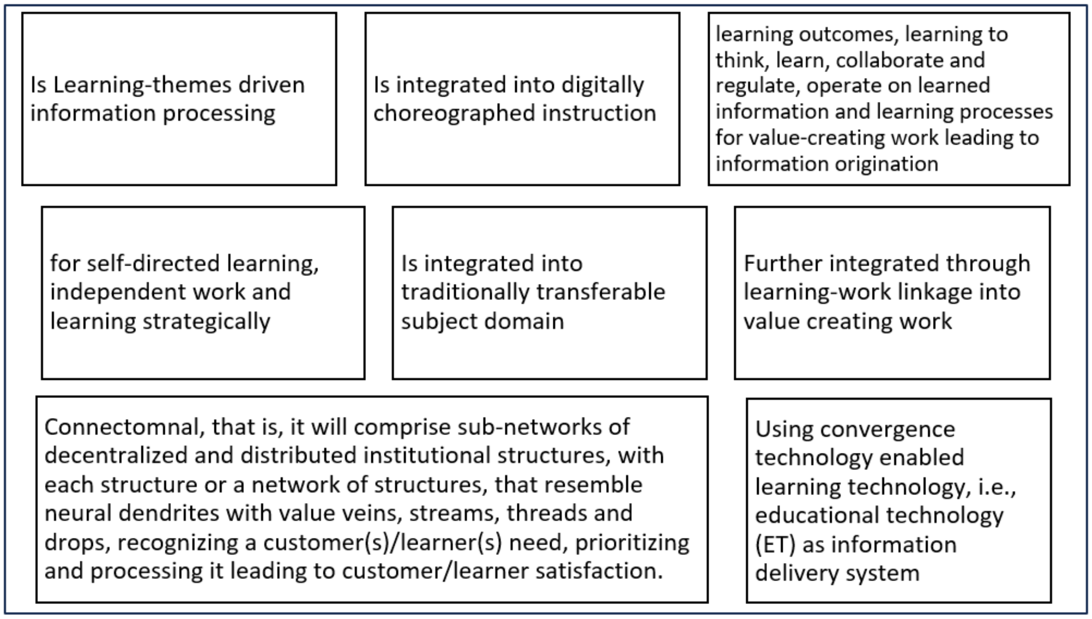

Figure 1: Process-oriented Teaching-Learning Framework

Role of Convergence Technology

Teacher-student interplay positions instruction as a brain aligned value creating process-centric value stream. Interplaying students and teachers form a connectome network to perform value creating work (Datta & Mandke, 2021). Effective information processing through this connectome delivers effective learning. It makes classroom T-L organization and process complex in information and hence requiring the need for technology assistance. The objective of Convergence Technology-enabled Learning Technology is to (i) automize structured learning processes so as to (ii) release student's attention dynamics (Bruning et al., 2004) resources for effective learning at the sharp end of her (or his) unstructured information and knowledge environment space boundary and (iii) enable individual student to complete value creating metacognitive tasks and satisfies individual learning requirements (as against collective learning requirements as is the incumbent practice) leading to brain aligned instruction. Following this, according to this paper, Educational Technology (ET) in the form of a CT-enabled networked system, which automizes integration of a process-centric-integrity-learning-process- with a T-L process and/or with a business process.

Additive Curriculum – Key Elements

The key elements of the AC model is shown diagrammatically in Figure 2. Table 1 lists how the AC Model differs from the prevalent Teaching-Learning model at a broad level. It is based on a decentralized and distributed model of teaching-learning instruction wherein learning is made declarative, proceduralized and conditinalized (contextual). It makes the curriculum responsive and mass-customisable:

- Mould to suit student aspirations
- Enable goal setting and monitoring
- Real linkages with goal environment

- What is studied is used
- What will be used is studied

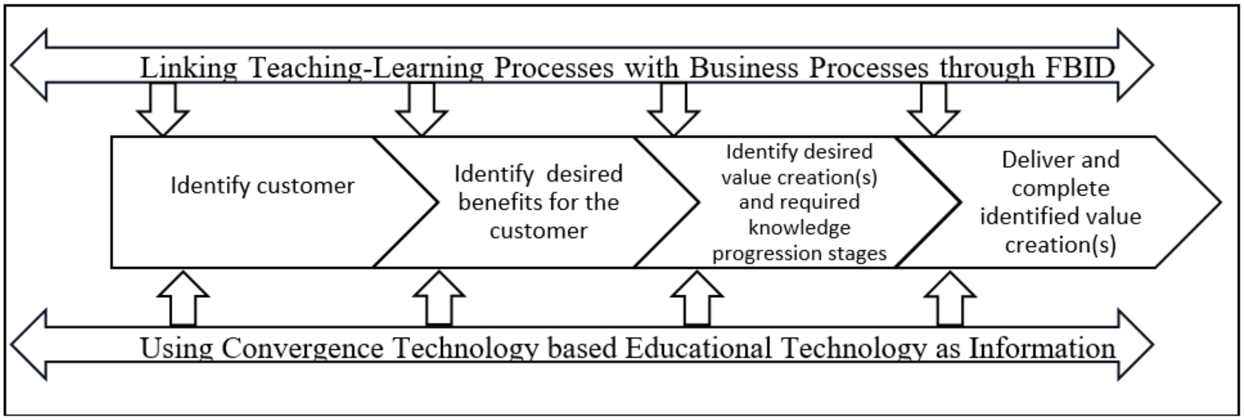

Figure 2: Key Elements of Additive Curriculum Model

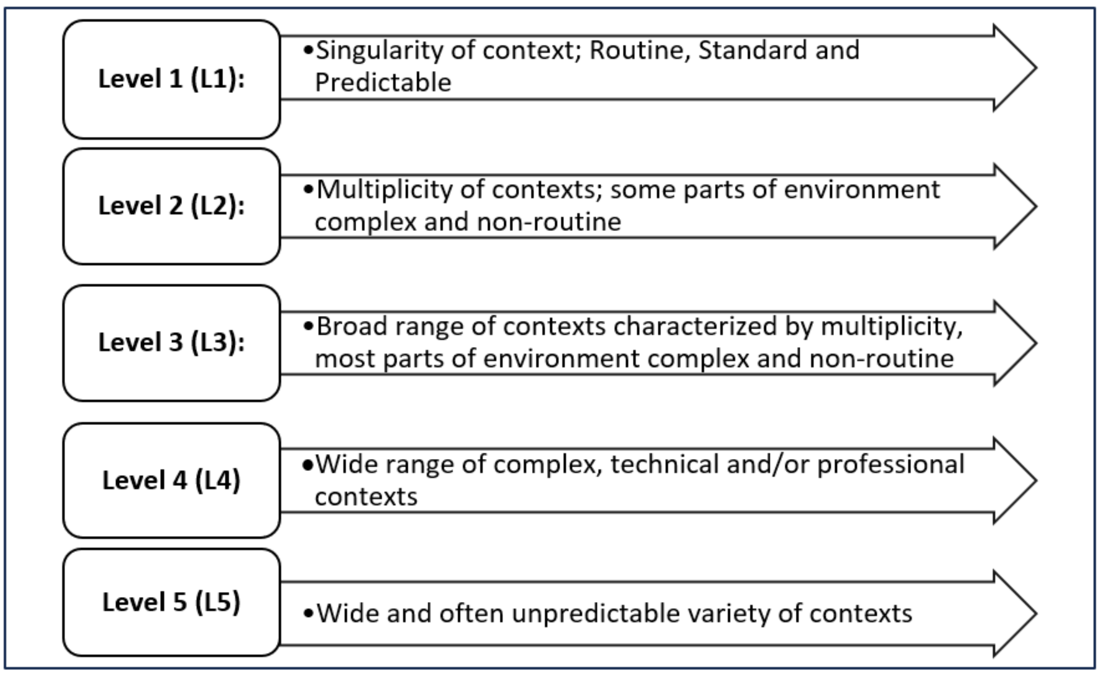

Figure 3: Five Levels of Environment Contexts

Table 1: Traditional Teaching-Learning versus Additive Curriculum based model

	Traditional Teaching-Learning Model	Additive Curriculum based Model
Student	Expected/Collective	Unexpected/mass-customizible
Result	Pre-determined	Learning Opportunity Seeking
Process	Yes/Linear	Yes/Non-linear, networked
Resource	Adequate	Inadequate

A systems view of integrating realistic business problems and realistic learning problems through value creating experiential learning is given in Datta, et al. (2024). While the 'world of information' is the standpoint of the incumbent teaching-learning model, the 'world of information flow and information processing' is the viewpoint of the AC model. Five environment/requirement contexts that students are expected to operate in are identified and defined with the highest gains in learning achieved at Level 5 (Figure 3).

The incumbent teaching-learning model assumes levels 1-2. Integrating realistic learning problems on Futures' front with realistic customer/business problems yield realistic learning-work integration problems leading to information origination, unexpected information included. While traditional teaching-learning model supposes collective requirements based problem solving, be it student, teacher, ET, content or problem, the AC model relies on individualized student, teacher progression, ET progression, content progression, and value stream prioritized L3-L5 requirements.

Experiment Design

Three different AC-based pedagogic experiments that have been completed are described in this section. These experiments used FBID to turn content, delivery and assessment into learning outcomes relevant to the industry. They integrated business processes and learning processes and used ET as information delivery system to solve problems by creating value. They demonstrate horizontal integration of subjects across a semester and vertical integration across academic year pursuing. Three levels of progressive learning attainment have been defined - (i) Research & Discovery Mode of Learning [First year students] (ii) Supervisory-Complex-Problem-Solving-mode of learning (Second year students) (iii) Professional-Complex-Problem-Solving-mode of learning (Third/Final year students) – with the teams consisting of all three levels, the members collaboratively solving the business problem.

The "Information Literacy Skills Rubric" for "masterful" proposed by Nelson (2008) have been translated into learning function elements (LFEs) and learning function units (LFUs) that act on learned information using ET in the context and situation presented by the industry problem. While these learning function elements have not been categorized as done by van Hoult-Wolters et al. (2000), they have been chosen from the perspective of being able to work effectively on the problem/project identified leading to self-directed learning and independent work.

Experiments Conducted

Table 2 lists experiments conducted with student groups across academic years.

Table 2: AC-based Experiments Conducted

Experiment	Academic Year	Courses	Number of students	Projects	Roles
Nanoelectronics Learners Premier League (LPL)	First year, first semester B.Tech students	Chemistry, Physics, Electronics, Communication	220	20	11
Integrated Software Development Program (ISDP)	Second year, second semester B.Tech students	Operating Systems, DBMS, Computer Architecture and Organisation, Network Security, Cryptography	179	15	5

Math-Programming-Machine Learning Project	First and third year, second semester students	Mathematics, Fundamentals of Programming, Machine Learning	150	14	12

Extended Teaching Learning Organization

The teaching organization was extended beyond the course teachers and additionally comprised - 20 Buddy Mentors (3rd year students) from Learning Technology Project Course, 2 Associate Mentors, 4 Learning Mentors from ET PhD and M.Tech scholars pool and 2 Industry Mentors who headed technical functions in the University. The individual Course Faculty/Teacher got modelled as a networked team, i.e., connectomnal. Similarly the individual learner got modelled as a networked team, i.e., again connectonmal. The engagements were planned and monitored by 4 student members of a specially created body COEET (Centre for Excellence in Educational Technology) for modified teaching-learning organisation. Figures 4 and 5 give a representation of the teaching-learning organization adopted. Together they depict the decentralized and distributed information processing by an ensemble of academic, professional, and user communities delivering brain-like-network-processed informational-work outcomes (i.e., brain-like-network-learned-information use outcomes); namely, Connecting to grow, Pruning, Maturing, Reinventing, and Meta-cognizing, through formations of connectome-structured networked small-group organizations of information nodes for dynamic decision making.

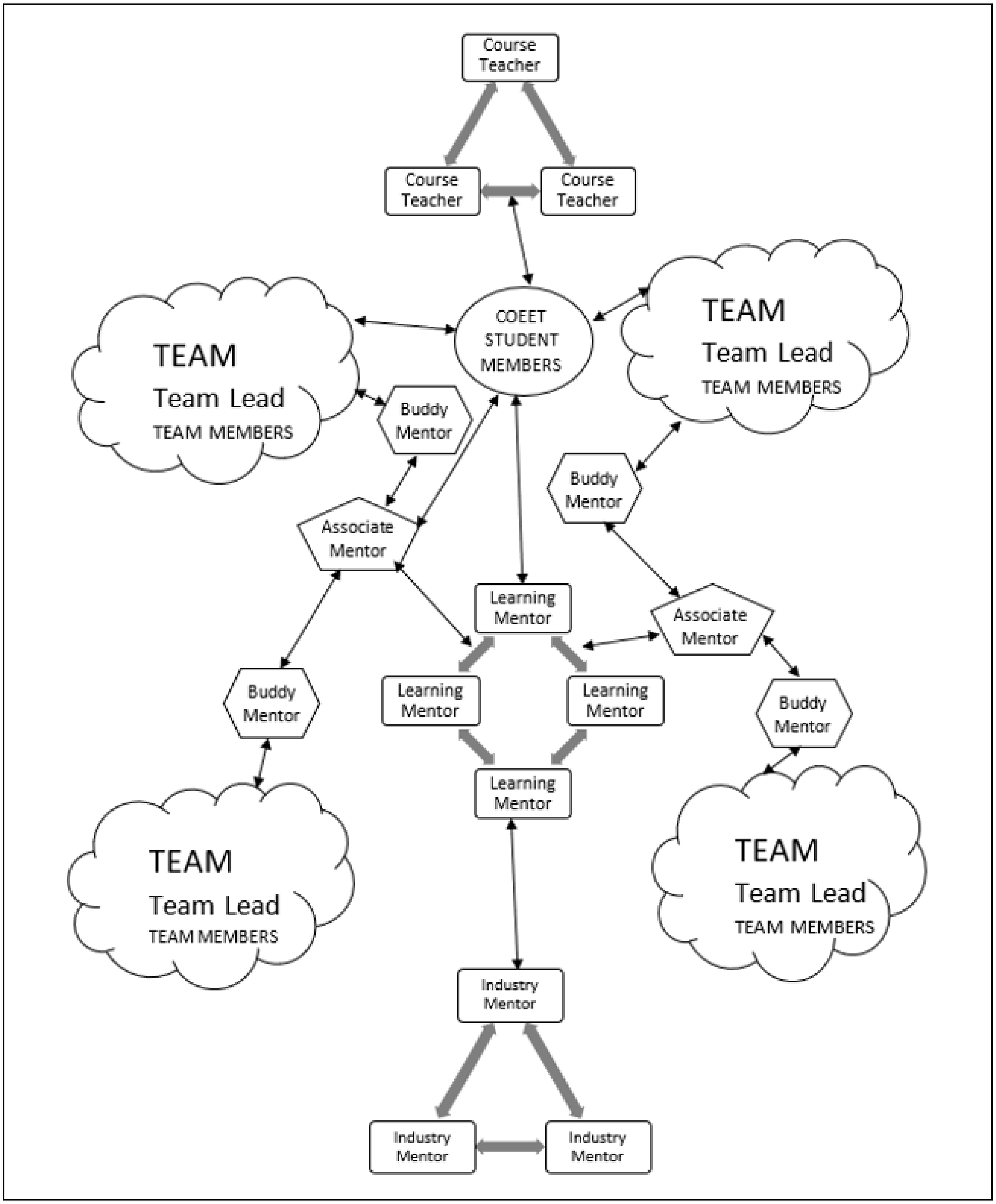

Figure 4: Members of the Teaching-Learning Organisation

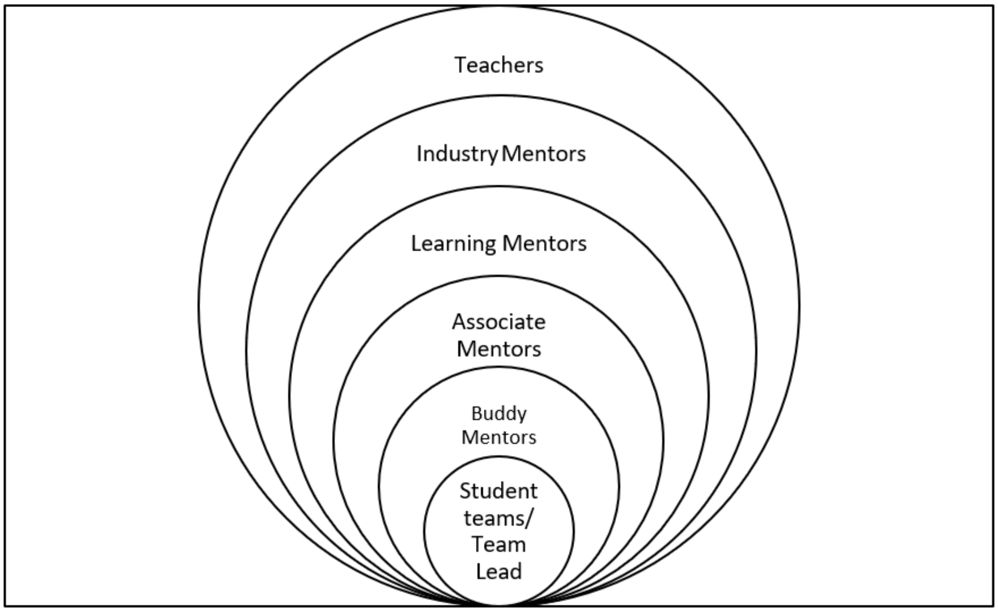

Figure 5: Representation of Connectomnal Teaching Learning Organization

Data Collection

A comprehensive survey instrument was designed to assess adherence to teaching-learning process as defined by the AC pedagogic model, improved student learning experience and benefit attained by participating in AC projects. The validated instrument was used to collect data from the participants in the AC model-based pedagogic initiatives. Some representative parameters captured are the following:

1. Adherence to AC pedagogic process – resource usage, rubric usage, mentor interaction
2. Student learning experience - engagement with project content, engagement with course content in classroom, engagement with peer students, seeing interconnections between courses, engagement with seniors, apply skills in one domain to another – transfer of learning, raising the bar of learning
3. Student benefit – Self-directed learning skills, metacognitive knowledge and regulation practices, working with industry standard collaborative tools, transferable skills - working on unexpected industry problems, ability to apply skills in one domain to another

Related validated instruments also captured parameters related to role performed, student employability skills perception, student self-efficacy perception, collaboration using CT amongst participants – students, teachers, mentors and seniors which are not discussed here as it beyond scope.

Participants

- All AC projects undergone by students on rolls at the university at the time of administering the survey instrument is given in Appendix C.
- Students belong to Academic Years (AY) 2019-20, 2020-21, 2021-22, 2022-23 and are identified as belonging to Batch 19 to 22. An academic year consists of two semesters and a summer term. The summer term is not under consideration.

- Batch 19 and Batch 20 were Covid-19 batches [online till March 2022] while Batch 21 was hybrid batch [online from Aug 2021 – Mar 2022]. Batch 22 was a normal non-Covid batch.
- Batches on rolls at the time of filling the instrument were Batch 19, 20, 21, 22
- Batches on campus were Batch 20, 21, 22; Batch 19 was doing Industry Practice onsite at various organisations.
- The instrument was filled during the period April-May 2023 by Batches 20, 21, 22
- Batch 20 – 12 responses, Batch 21 – 67 responses, Batch 22 – 57 responses

Validation of instrument

The validation process is shown as a graphical representation in Figure 6. The instrument was created as per researcher's experience with AC projects implementation carried out since 2016 in action research mode. The instrument was sent to five faculty members who have participated in at least one AC activity, an educational psychologist, Educational Technology research scholars, EdTech Initiatives project director, EdTech mentor professor, Center for Industry Collaboration regional director and an EdTech professional for their feedback. Their comments were incorporated and the updated questionnaire was tested with 42 AC students. Based on the responses received, some words were replaced with their synonyms appropriate to the target cohort's background so as to make it understandable to them. After changes, the instrument was again sent to all stakeholders mentioned above. The final approved instrument were used for the collection of final data.

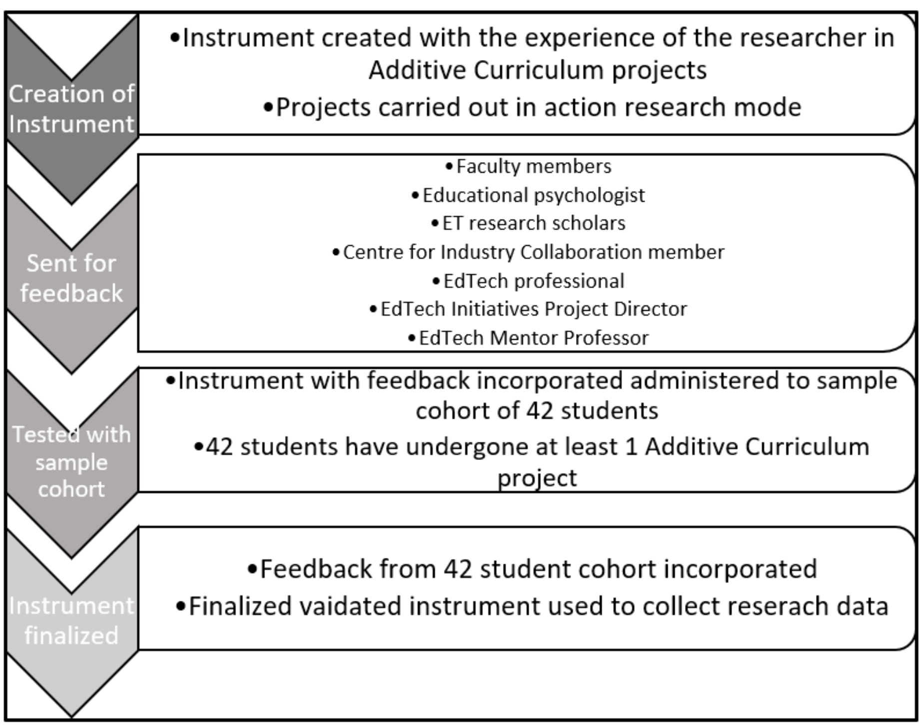

Figure 6: Graphical Representation of Validation of Instrument

Data Collection with validated instrument

The instrument was administered to all first-, second-, and third-year undergraduate students undergoing the 4-year B.Tech programme. The eligibility criterion adopted was that the students should have participated in at least one AC project. The instruments were administered at the end of completion of the AC project they have undertaken. 136 students participated in the data collection with validated instrument.

Figure 7 shows the steps followed to collect the data. To reach out to the eligible students, the researcher connected with the faculty participating in the AC projects and mutually arrived at class period(s) convenient to students and faculty for filling the instrument. The faculty next circulated the link of the instrument form to all eligible students. During the designated class period, the faculty introduced the researcher to the students. The researcher explained briefly the mechanics of filling up the instrument and handled issues with accessing the instrument. After which each student filled up the instrument individually.

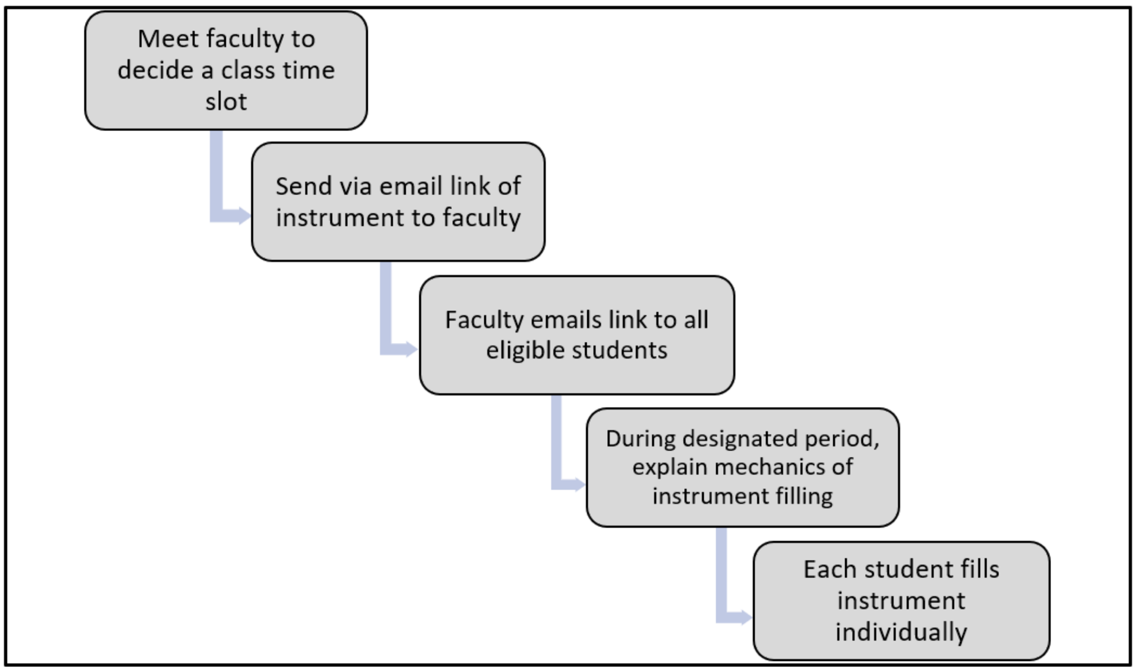

Figure 7: Steps Followed to Collect Data

Data Analysis

With respect to applying knowledge from one domain to the other (Table 3) - 91.2% applied their skills in presentation tools/social media, 80.1% applied their mathematical abilities, 73.5% applied their knowledge from literature & language, 61% applied their music-graphics-media knowledge and 56.6% applied their knowledge in creating software applications/apps. Photography (47.8%), Biological Sciences (47.1%), Theatre (39.7%), and Sports (25.0%) drew less than 50% stating that they applied their knowledge. Of the 9 domains probed, 91.3% had used their knowledge from at least one domain in the AC project. 11.8% reported they had used all nine domains (needs to be probed how), while 3.7% reported they had used none (needs to be probed why). 61.8% reported that they had applied at least 5 or more domains. (Table 4)

Table 3: Transfer of learning from another domain to the project

Domain Areas Applied	**Yes**	**Not Yet**	**% Yes**	**% Not Yet**
I applied my mathematical abilities.	109	27	80.1	19.9
I used my abilities in creating software applications/apps	77	59	56.6	43.4
I used my knowledge of biological sciences.	64	72	47.1	52.9
I transferred concepts/analogies from my knowledge of literature and language.	100	36	73.5	26.5
I expressed from knowledge about music, graphics, media, culture, etc.	83	53	61	39
I drew on sports knowledge.	34	102	25	75
I used/transferred information from my knowledge of theatre/plays/acting.	54	82	39.7	60.3
I utilized my photography knowledge and skills.	65	71	47.8	52.2
I used my skills in presentation tools/social media/website creation tools	124	12	91.2	8.8

Table 4: Transfer of learning – Number of Domain Areas

Number of Domain Areas Applied	**%**
ALL	11.8
NONE	3.7
GREATER THAN 5	61.8
AT LEAST 1	96.3

Seeing Linkages with Courses undertaken

As shown in Table 5, 87.5% reported that they were able to identify topics from the courses they are undergoing that relate to the AC project being executed while 79.4% applied the knowledge to the project. Further, 77.9% reported that they were able to view a given concept from the perspective of different courses.

Table 5: Seeing linkages with courses undertaken/undertaking

Question	I was able to identify topics from the course curriculum I am undertaking that relate to my project	I recognized the same concepts from perspective of multiple courses	I applied my knowledge from the courses I have undertaken/am undertaking to my project
Yes	119	106	108

Not Yet	16	29	27
% Yes	87.5	77.9	79.4
% Not Yet	11.8	21.3	19.9

Raising the bar of learning

The questions pertaining to how far the student went beyond the existing knowledge boundary in designing and implementing his/her task in the AC project thus raising the bar of acquired knowledge saw the students reporting the following (Table 6): 84.6% said they went beyond information provided in class, 79.4% said the project addressed more content areas than they had initially thought. 86% reported that they learnt more by executing the project compared to the normal way of learning for the same amount of time [spent on the project] indicative of an improvement in learning efficiency, 86.8% said they used the information to solve new and different type of problems indicative of an improvement in both raising the content bar as well as learning effectiveness.

Table 6: Raising the bar of content learning

Question	Yes	Not Yet	% Yes	% Not Yet
The project required me to go beyond information given in the class to make inferences and connections in the explanations of concepts.	115	21	84.6	15.4
The project required me to use information to solve new and different type of problem.	118	17	86.8	12.5
The project addressed instruction in more content areas than initially planned	108	28	79.4	20.6
I learnt more than in the ordinary way of learning in the time I have spent	117	19	86	14
I was able to identify topics from the domain areas of the courses I am undertaking that relate to my project	110	25	80.9	18.4
I identified topics from my project that went beyond the courses I have undertaken till now	113	22	83.1	16.2

Self-directed/Strategic learning and Independent Work

From Tables 7 & 8, it can be seen that students practiced both dimensions of metacognition – metacognitive knowledge and metacognitive regulation. Table 7 pertains to the pre-project phase, that is, just before beginning project implementation while Table 8 pertains to implementation phase. During the pre-project phase, questions related to cognition such as determining purpose of project and finding out if they have the necessary background received 86% and 79.4% reporting in the affirmative respectively. Questions related to metacognitive regulation included students reflecting on planning (I deliberated if I have the resource/materials I need – 76.5%), monitoring (I deliberated if I need to use a graphic organizer, a timeline, an outline, or a "to do" list – 71.3%) and evaluation (I deliberated if I need more information from the following: Teacher, Classmate, Resources – 82.4%) phases.

Table 7: Self-directed learning – Pre-project implementation phase

Question	Yes	Not Yet	% Yes	% Not Yet
The purpose or outcome of the assignment (and the project work) was determined	117	19	86	14
I factored what will I learn or gain from this experiential learning	104	32	76.5	23.5
I deliberated if I have proper background and/or/ skill to perform in this assignment	108	28	79.4	20.6
I deliberated if I have the resource/materials I need	104	32	76.5	23.5
I deliberated if I have adequate thinking space, space to concentrate and work comfortably, enjoyably	105	31	77.2	22.8
I deliberated if I should create a plan to carry out the assignment	109	27	80.1	19.9
I deliberated if I need to use a graphic organizer, a timeline, an outline, or a "to do" list	97	39	71.3	28.7
I deliberated if I need to clarify my thoughts or ask questions	114	22	83.8	16.2
I deliberated if I need more information from the following: Teacher, Classmate, Resources	112	24	82.4	17.6

During AC project implementation phase, students were provided with a work schedule that they had to adhere to. Metacognitive regulation was assessed to check if the students reflected and self-monitored themselves – Table 8. The question 'How am I doing' was reported as having been asked by most students (87.5%) indicative of metacognitive reflection. The question 'Am I putting my best effort?' received an affirmative response from 84.6% of the students. Questions related to seeking external help received least affirmative responses, example 'Do I need help?' (66.2%); 'Do I need encouragement to continue' (66.9%). 'Am I going in the wrong direction' was asked of themselves by 63.2% of the students. Together they are indicative a positive regard students have with respect to the work done. Students also attempted to strategize to do the project work as can be seen from the response received to the question 'Have I completed parts of the assignment that I know I can do, so I have more time to work on the segments that require more thinking?' (82.4%)

Table 8: Metacognition practice through continuous self-monitoring

Question	Yes	Not Yet	% Yes	% Not Yet
How am I doing?	119	17	87.5	12.5
Am I continuing to find the assignment challenging (Said differently, Am I getting bored)?	95	41	69.9	30.1
Do I need encouragement to continue?	91	45	66.9	33.1
Am I putting forth my best effort?	115	21	84.6	15.4
Am I on the right track?	110	26	80.9	19.1
Am I following the time line or pacing the work?	97	39	71.3	28.7
Have I spent too much time and energy on this section?	105	31	77.2	22.8
Am I bogged down? Am I going in the wrong direction?	86	50	63.2	36.8
Do I need help?	90	46	66.2	33.8
Do I need more information?	106	30	77.9	22.1
Do I need additional materials or resources?	112	24	82.4	17.6
Have I completed parts of the assignment that I know I can do, so I have more time to work on the segments that require more thinking?	112	24	82.4	17.6

Belief change with respect to learning

As Table 9 shows, over 80% students reported having undergone a belief change about learning – what needs to be done or what the learner needs to be aware of for achieving academic results. The following responses were received - Learners leverage different intelligences to learn a topic (83.1%); learners should be aware of learning goals (84.6%), learning style (82.4%) and learning strategies (85.3%). Students also discovered that they were working on concepts that they had not understood well earlier despite having studied them (93.4%) and the project expected them to rely on their knowledge and opinion and not of others (87.5%).

Table 9: Belief change

Question	Yes	Not Yet	% Yes	% Not Yet
I discovered that the project required me to work on concepts in the selected topic, which I had not understood well earlier	127	9	93.4	6.6
I discovered that the project required me to develop the meaning of the assignment work activity undertaken based on my knowledge and opinion, not just of others	119	16	87.5	11.8
Now I recognize that learners leverage different intelligences to learn a topic. I was not aware of this reality before doing this project.	113	23	83.1	16.9
Now I recognize that in any lesson study, a learner in order to achieve good academic results should be aware of her (or his) Learning Goal(s)	115	21	84.6	15.4
Now I recognize that in any lesson study, a learner in order to achieve good academic results should be aware of her (or his) Learning Style	112	24	82.4	17.6
Now I recognize that in any lesson study, a learner in order to achieve good academic results should be aware of her (or his) Learning Strategy	116	20	85.3	14.7

Adherence to additive curriculum project processes

The AC pedagogy has clearly laid out processes to be followed while engaging in the AC projects. Project-process questions pertained to AC project resources provided – have they been accessed, read and used; rubric – was it read, understood and applied; mentoring – was advice received from buddy and learning mentors; and how often was the interaction. Further the number of hours reported as having spent and the evidences reported as having been produced were captured as part of adherence to AC project process.

While 83.1% reported as having received resource material as part of project orientation (Figure 8), 76.2% reported as having accessed most of all resources while 64% reported as having critically read the resources accessed – Table 10. 72.8% reported as having found the resource material useful – Figure 9. 80.1% reported as having understood the directions and guidelines provided in the resource material and 87.5% reported as having decided on what rules they need to follow with respect to project work process – Table 11. While 58.1% reported as having received the rubric as part of project orientation (Figure 8), 75% reported as having read the rubric, 64% reported as having understood the rubric while 69.9% reported as having applied the rubric indicative of application of the rubric by some students without understanding – Figure 10. While 86.8% reported as the project being well defined by mentors, 94.1% reported as having interacted with buddy mentors and 87.5% reported as receiving advice from learning mentors (Table 12).

Table 10: Accessing and Studying resources

Question	All	Most	Some	None	%All	%Most	%Some	%None
Did you access each and every Guidance material and Learning Resource provided throughout the length of the project work?	22	83	27	4	16.2	61	19.9	2.9
Did you critically study the resource material?	25	62	45	4	18.4	45.6	33.1	2.9

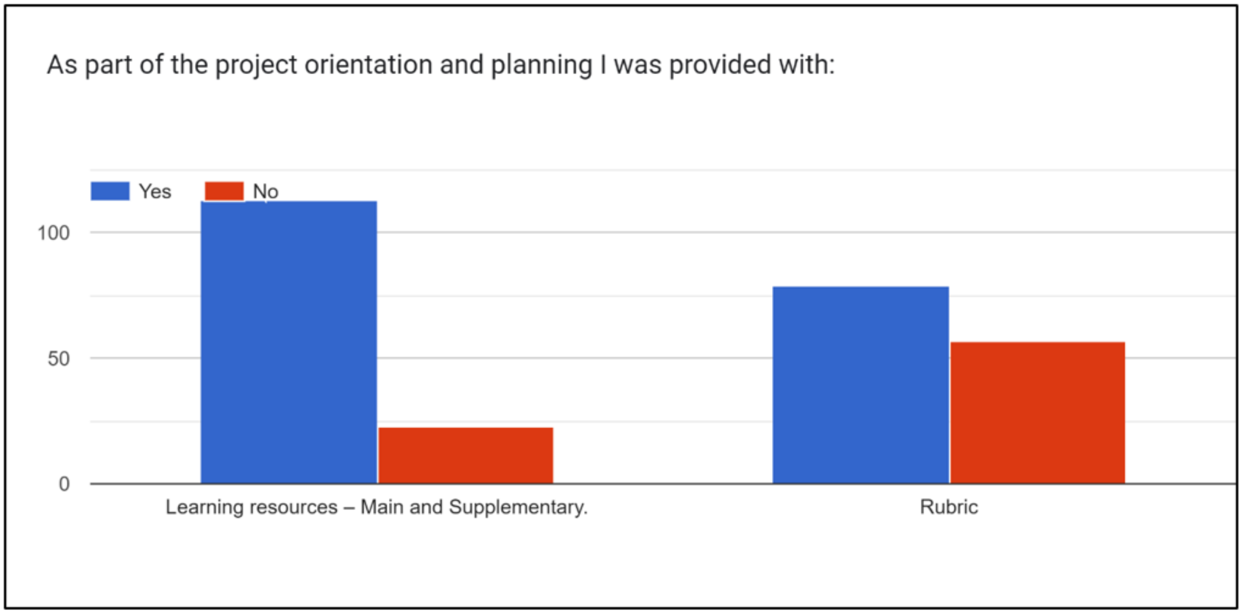

Figure 8: Learning Resources and Rubric Received

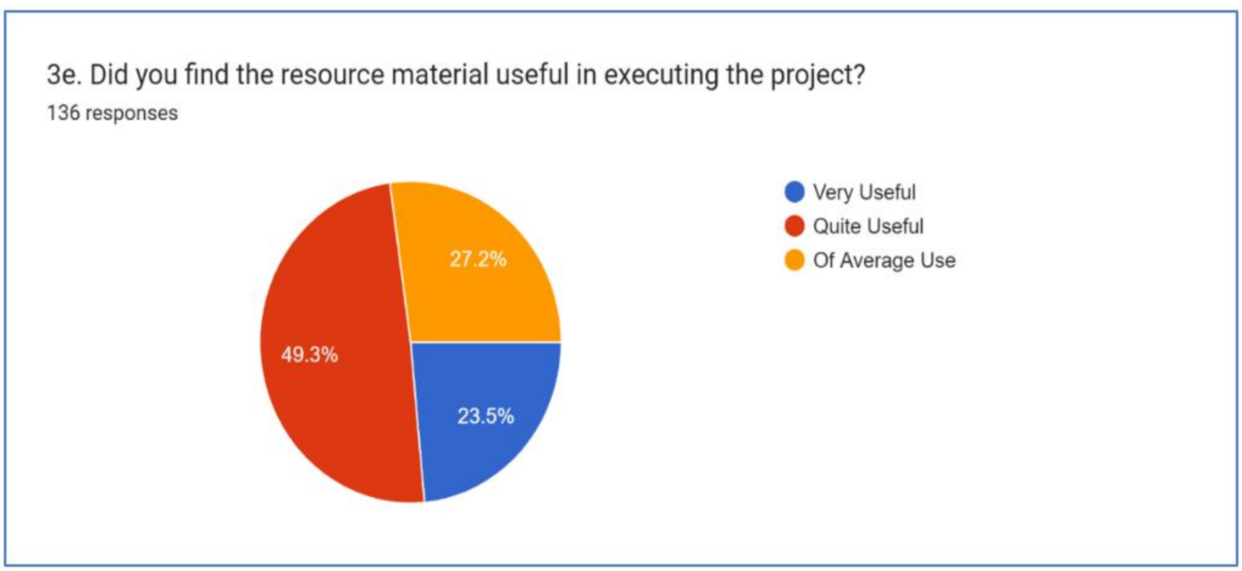

Figure 9: Usefulness of resource materials

Table 11: Directions, Guidelines and Rules

Question	Yes	Not Yet	% Yes	% Not Yet
I understood the directions and guidelines given in the learning resource provided	109	27	80.1	19.9
I decided on which assignment work process rules must be adhered to? (e.g., ensuring attendance at team meetings, Sharing information, meeting delivery schedule, keeping time, etc.)	119	17	87.5	12.5

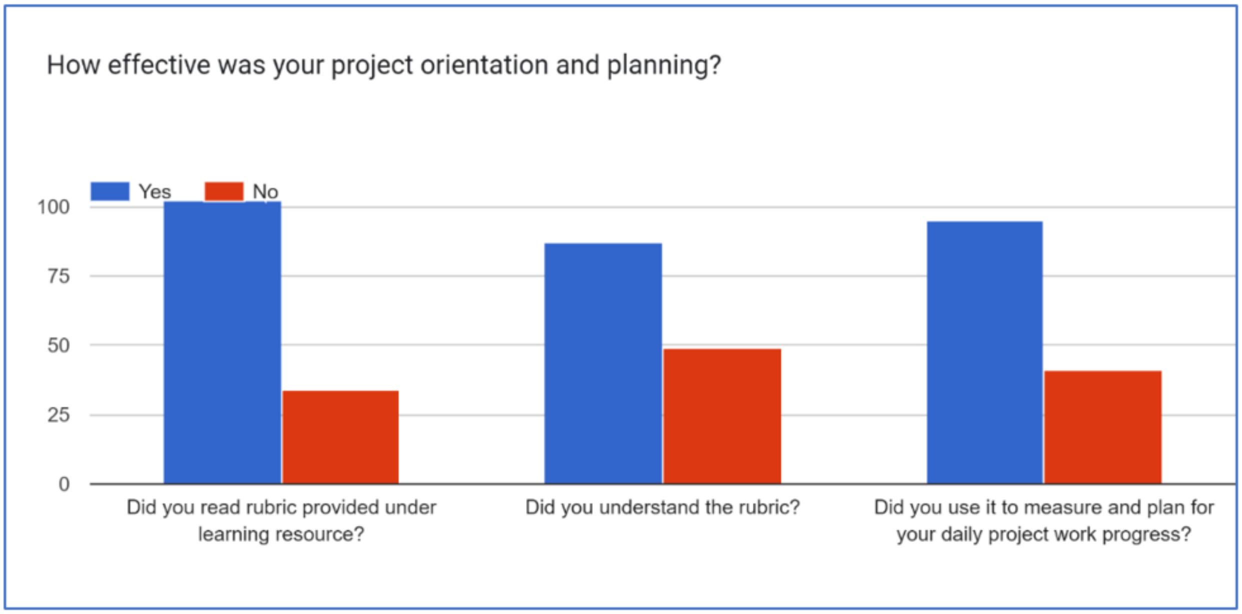

Figure 10: Rubric Understanding and Usage

Table 12: Interaction and Inputs from Mentors

Question	Yes	No	% Yes	% No
Was your work in the project well defined by the group/ buddy/associate/learning mentor?	118	18	86.8	13.2
I sought/discussed in person with Buddy Mentor guidance on my role, working with my team, interacting with associate/learning/industry mentors	128	8	94.1	5.9
I received advise on project work and learning progress from the Learning Mentor	119	17	87.5	12.5

Time Spent on Additive Curriculum Project

40.4% of students spent equal to or greater than the duration of the project while 53% spent 50-100% of project duration. The rest (6.6%) spent less than 50% of project duration showing that a significant number of students spend more time while working on an AC project indicative of increased motivation and learning that needs to be investigated further – Figure 11.

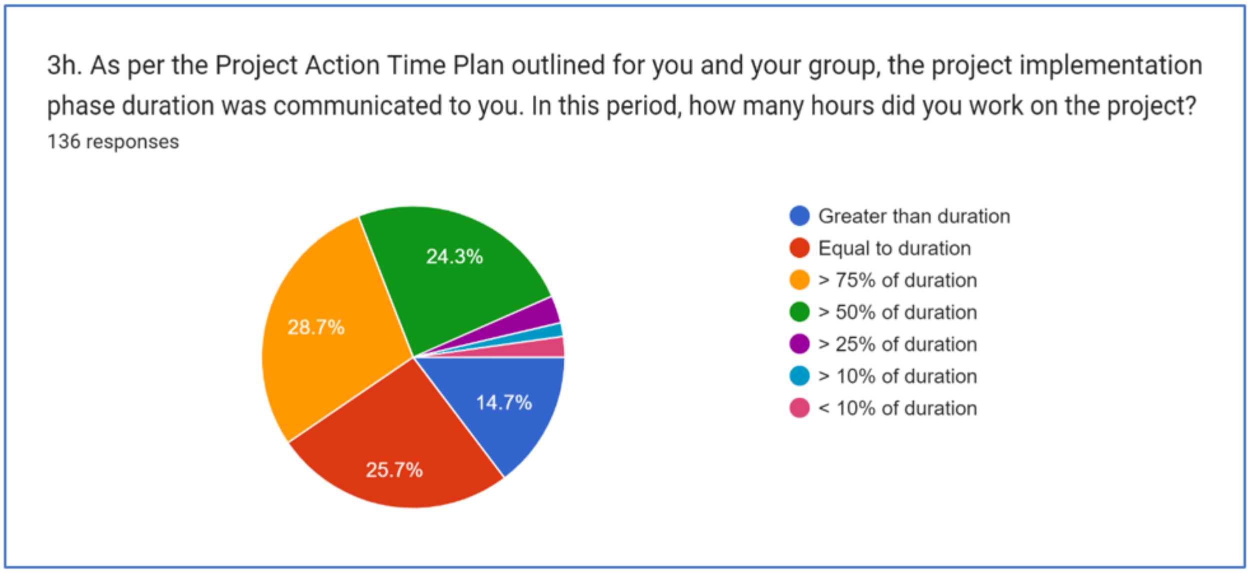

Figure 11: Time spent on project work

Evidences Generated as part of Additive Curriculum Project

All students produced at least one of the following evidences – Project Reports (94.1% - most), Audio-video Recordings (85.3%), Video shots of team meetings/activities (69.9% -least), Photographs (81.6%), Snapshots of work in progress (83.8%), Screen shots from social networking tools used for collaboration (88.2%). Each evidence was produced by more than half of the students – Figure 12.

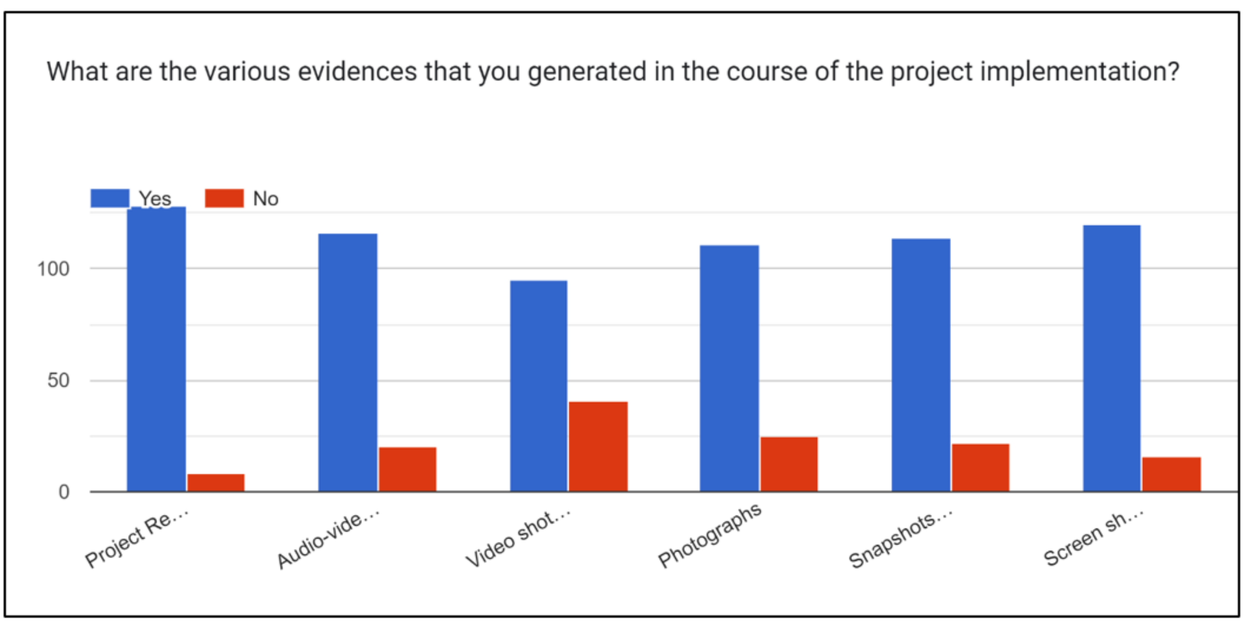

Figure 12: Project Evidences Produced

Results and Discussion

The paper's objective was to find out if the proposed AC pedagogy would lead to improved student learning experience and benefit. To do so three pedagogic experiments that are instances of the AC model have been reported. A validated questionnaire was used to find out adherence to the laid out AC pedagogic process, improved student learning experience and student benefits. The AC process expects students to have accessed and used project resources, project rubric as well as interacted with the project mentors. All three aspects have been reported positively. Data analysis indicates that the project orientation should be strengthened as lower percentages of students reported receiving resources and rubric during project orientation phase but higher percentages of students accessed and used these in the project execution phase.

Students reported positively on seeing interconnections between courses, raising the bar of content for themselves, engagement with senior students in terms of mentoring which otherwise would not have occurred – these indicating of improved student experience beyond lecture-practical classroom experience. It is important to note that the incumbent lecture-tutorial-practical teaching structure remained intact. Transfer of learning was also observed indicating improved student learning experience. Student benefits were observed in terms of self-directed learning skills, metacognitive knowledge and regulation practices followed. Working with industry standard collaborative tools, acquisition of transferable skills - working on unexpected industry problems, ability to apply skills in one domain to another were some employability skills that students benefitted from.

An important benefit of a strengthened teaching organization, as above, was that in classroom instruction it introduced a shift from "evaluation" to "assessment". "Evaluation", which is the tradition in classroom instruction, tests students – instruction seeing them (students) as with "collective" requirements - through "standardized tests", which aim at knowing what a student does not know and which basically assess only verbal and linguistic and logical and mathematical intelligences. Against this, acknowledging unique way of each student's learning, "assessing" aims at finding and identifying what a student is good at and (aims at) understanding and mastery of a domain of study the student should be engaged (demonstrating) in number of alternate ways leads to differentiated assessment. In this context, literature informs that student's multiple intelligences, interest, prior knowledge, motivation, ways of knowing and solving problems, and strategizing & managing once own learning, thinking and problem-solving (individual learner local environmental and strategy factors that they constitute) lead to individualize learning. In this respect, AC pedagogy provides a foundation to mass-customize instruction, recognize and leverage student strengths through differentiated assessment thus providing a mechanism for assessing employment readiness right from first year of study.

The Math-Programming-Machine Learning project showed how instruction can be vertically integrated spanning academic years and how junior students doing basic courses can benefit from working with senior students doing courses directly relevant to industry by working on real-world industry applications. This benefitted junior students because they saw the relevance of basic courses, in this case Math and Fundamentals of Programming, in Machine Learning. Senior students similarly benefitted by refreshing their Math concepts because of having junior members who can be called upon for math skills relevant to Machine Learning as well can contribute to programming aspects of project. Both benefitted by improvement in Long Term Memory for application in future once the studies are completed as well as empowering themselves for employability skills futures'.

Conclusion

Thus, the ability to produce highly complex instructional designs with powerful pedagogies and turn content, delivery and assessment into real world relevant learning outcomes using convergence technology enabled learning technology, i.e., Educational Technology (ET) as information delivery system is creating for institutions and their classrooms a new Teaching-Learning (T-L) interplay language for Futures' Skills for Work-Wide-Work-Long Learning (3WL) leading to improved student experience and employability.

The research investigation was seen from different angles; namely: (i) general learning principles, always in operation during T-L interplay, as well as subject domain specific learning principles of T-L interplay, in operation during certain phases, (ii) Learning-Work integrating social pedagogy design and implementation to shape the learning environment to leverage learners value stream model (VSM) based collaborative work flows, and (iii) ET used as information delivery system by the environment for benefit and improved learning experiences for recipients (customers, learners). To this end, the university envisions a spectrum of academic and professional communities, which in distributed and decentralized manner networks and engages as "partners and small-collaborative-workflow-groups" in different facets of the above research-query-investigation using ET as information delivery system. Because using ET (Internet included) usually requires small groups to work independently, they need to be instructed (empowered) – enter the T-L processes - in independent work, self-directed learning and learning strategically. Without this instruction the small collaborative workflow groups negate the learning and engagement integral to ET activities – be in classrooms or at workplaces, and may even, to the detriment of learning (or business) objective, become obstacles in delivering futures' performance; in turn making stakes too high for their empowerment.

We emphasize on the nature of the projects and say that they have to be drawn from the industry or society – the latest unsolved challenges, solving which creates immense value to the end customers, expressed in terms students can relate to, interdisciplinary in nature, sufficiently large in scope for group work. Using ET as information delivery system leads to implementation of differentiated content, delivery and assessment leading to mass-customization of instruction. Convergence technologies enable conversations both within the team, with the extended teaching network and the customer, messaging, a safe place for students to voice ideas and concerns, give and take feedback, discuss plans and actions, humour as well as all project-related work in one place with traceability – who did what, when, how and where. The academic course content bar was raised by leveraging metacognitive strategies. Project teams competitively participated in league matches, which in turn facilitates leveraging pedagogically built constructive conflicts demonstrating deliverance of higher order learned content. Strengthening teaching organization by constituting the Course Teacher as a "Teacher Team" leading to a connectomnal instruction organization provides effective engagements for weak student performance improvement both academic and professional skills – strategically learning gains here are maximum. Assessment should be formalized so that it can be added to the student transcript in terms of employability skills acquired. This in turn can be used for placements mapping. The above is amenable to intelligent automation and contribute to the field of learning analytics. Faculty orientation for understanding and executing the Additive Curriculum model has to become part of HE processes and can lead to effective scaling of the process.

References

Asefer, A., & Abidin, Z. (2021). Soft skills and graduates' employability in the 21st century from employers' perspectives: A review of literature. *International Journal of Infrastructure Research and Management*, *9*(2), 44-59. https://iukl.edu.my/rmc/wp-content/uploads/sites/4/2022/02/5.-Al-Asefer_compressed.pdf

Aggarwal, V., Nithyanand, S., Sharma, M. (2019). The National Employability Report – Engineers, Annual Report 2019. *Aspiring Minds*

Atman, C. J., Sheppard, S. D., Turns, J., Adams, R. S., Fleming, L. N., Stevens, R., Streveler, R. A., Smith, K. A., Miller, R. L., Leifer, L. J., Yasuhara, K., & Lund, D. (2010). Enabling Engineering Student Success: The Final Report for the Center for the Advancement of Engineering Education. CAEE-TR-10-02. *Center for the Advancement of Engineering Education (NJ1)*. https://files.eric.ed.gov/fulltext/ED540123.pdf

Borbély-Pecze, T. B., & Hutchinson, J. (2014). Work-based Learning and Lifelong Guidance Policies ELGPN Concept Note No. 5. *European Lifelong Guidance Policy Network* http://derby.openrepository.com/derby/bitstream/10545/550327/1/ELGPN_Concept_Note_5_WBL_web.pdf

Broadbent, O., & McCann, E. (2016). Effective industrial engagement in engineering education- A good practice guide. *Royal Academy of Engineering.* https://raeng.org.uk/media/5qefsl45/raeng-effective-industrial-engagement.pdf

Bruning, R. H., Schraw, G. J., Norby, M. M., and Ronning, R.R. (2004). Cognitive Psychology and Instruction, *Pearson Merrill Prentice Hall*, New Jersey, USA.

Burns, C., & Chopra, S. (2017). A Meta-analysis of the Effect of Industry Engagement on Student Learning in Undergraduate Programs. *The Journal of Technology, Management, and Applied Engineering*, 33(1), 1–20. https://lib.dr.iastate.edu/abe_eng_pubs/776/

Cheng, M., Adekola, O., Albia, J. and Cai, S. (2022), Employability in higher education: a review of key stakeholders' perspectives, *Higher Education Evaluation and Development*, Vol. 16 No. 1, pp. 16-31. https://doi.org/10.1108/HEED-03-2021-0025

Choi-Lundberg, D., Douglas, T., Bird, M-L., Coleman, B., Greenwood, M., Martin, R., Prior, S., Saghafi, F., Roehrer, E., Waddingham, S., Wolsey, C. & Kelder, J-A. (2024). Employability Learning and Teaching Research: A Twenty Year Structured Narrative Review. *Journal of University Teaching and Learning Practice, 21*(5).

Clausen, H. B., & Andersson, V. (2018). Problem-based learning, Education and Employability: A Case Study with Master's Students from Aalborg University, Denmark. *Journal of Teaching in Travel & Tourism*, *19*(2), 126–139. https://doi.org/10.1080/15313220.2018.1522290

Coll, R. K., Eames, C. W., Paku, L. K., Lay, M. C., Hodges, D., Bhat, R., Ram, S., Ayling, D., Fleming, J., Ferkins, L., Wiersma, C., & Martin, A. (2011). An exploration of the pedagogies employed to integrate knowledge in work-integrated learning. T*he Journal of Cooperative Education*, *43*(1), 14–35.

https://researchcommons.waikato.ac.nz/server/api/core/bitstreams/dee73e96-e56d-42af-848c-a6dc53f9bf68/content

Datta, M. S., & Mandke, V. V. (2021). Data Science in Education. In A. Sharaff & G. R. Sinha (Eds.), *Data Science and Its Applications* (pp 127-150). Chapman and Hall/CRC. doi:10.1201/9781003102380

Datta, M. S., Sharma, V., Pal, Y., Jha, A., & Mandke, V. V. (2024). Higher Education Practice in Response to Societal Needs: Need for Policy Change in Credit System for Digitally Transforming Society. Submitted for publication

Ferns, S., Dawson, V., & Howitt, C. (2019). A collaborative framework for enhancing graduate employability. *20*(2), 99–111. http://files.eric.ed.gov/fulltext/EJ1226180.pdf

FICCI, EY. (2024). *Future of Jobs in India: 3.0 Navigating Skills in Digital Age*. https://globalskills.ficci.in/Future-of-Jobs-in-Indial.pdf

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Gallagher, S. (2019). *Peak human potential: preparing Australia's workforce for the digital future National Survey Report*. Centre for New Workforce, Swinburne University. https://www.swinburne.edu.au/media/swinburneeduau/centre-for-the-new-workforce/cnew-national-survey-report.pdf

García-Álvarez, J., Vázquez-Rodríguez, A., Quiroga-Carrillo, A., & Caamaño, D. P. (2022). Transversal Competencies for Employability in University Graduates: A Systematic Review from the Employers' Perspective. *Education Sciences*, *12*(3), 204. https://doi.org/10.3390/educsci12030204

Garwe, E. (2020). Does the timing of work integrated learning affect graduate employability outcomes? *South African Journal of Higher Education*, *35*(4). https://doi.org/10.20853/34-5-4225

Geisinger, B. N., & Raman, D. R. (2013). Why They Leave: Understanding Student Attrition from Engineering Majors. *International Journal of Engineering Education*, *29*(4), 914–925. https://dr.lib.iastate.edu/handle/20.500.12876/1392

Geisinger, Brandi N. and Raman, D. Raj, "Why They Leave: Understanding Student Attrition from Engineering Majors" (2013). *Agricultural and Biosystems Engineering Publications*. 607. https://dr.lib.iastate.edu/handle/20.500.12876/1392

Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, *102*, 101586. https://doi.org/10.1016/j.ijer.2020.101586

Hart, J. L. (2019). Interdisciplinary project-based learning as a means of developing employability skills in undergraduate science degree programs. *Journal of Teaching and Learning for Graduate Employability*, *10*(2), 50–66. https://doi.org/10.21153/jtlge2019vol10no2art827

Hazan, E., Madgavkar, A., Chui, M., Smit, S., Maor, D., Dandona, G. S., & Huyghues-Despointes, R. (2024). *A new future of work: The race to deploy AI and raise skills in Europe and beyond*. McKinsey & Company. https://www.mckinsey.com/mgi/our-research/a-new-future-of-work-the-race-to-deploy-ai-and-raise-skills-in-europe-and-beyond

Herodotou, C., Sharples, M., Gaved, M., Kukulska-Hulme, A., Rienties, B., Scanlon, E., & Whitelock, D. (2019). Innovative Pedagogies of the Future: An Evidence-Based Selection. *Frontiers in Education*, *4*. https://doi.org/10.3389/feduc.2019.00113

Jackson, D., & Dean, B. A. (2022). The contribution of different types of work-integrated learning to graduate employability. *Higher Education Research and Development*, *42*(1), 93–110. https://doi.org/10.1080/07294360.2022.2048638

Jakubik, M. (2017). Solving Business Problems Together. Case: A Master´s Degree Programme in Finland. *Journal of Systemics, Cybernetics and Informatics*, 15(4), 53–57. http://www.iiisci.org/journal/sci/FullText.asp?var=&id=SA045MC17

Joseph, S. (2013). Strategies for enhancing student learning experiences in higher education. *Caribbean Teaching Scholar*, *3*(2), 97–109. https://journals.sta.uwi.edu/ojs/index.php/cts/article/view/411/366

Kay, J., Ferns, S., Russell, L., Smith, J., & Winchester-Seeto, T. (2019). The emerging future: Innovative models of Work-Integrated Learning. *International Journal of Work-Integrated Learning*, *20*(4), 401–413. http://files.eric.ed.gov/fulltext/EJ1238315.pdf

Kövesi, K., & Csizmadia, P. (2016). Industry perception of new engineering graduates: the gap between requirements and reality. In *44th SEFI Conference* (Vol. 11, No. 09).

Kromydas, T. (2017). Rethinking higher education and its relationship with social inequalities: Past knowledge, present state and future potential. *Palgrave Communications*. https://doi.org/10.1057/s41599-017-0001-8.

Libert, B., Beck, M., & Wind, J. (2016). *The Network Imperative*. Harvard Business Review Press.

Male, S., & King, R. (2014). Best practice guidelines for effective industry engagement in Australian engineering degrees. *Australian Council of Engineering Deans Inc*. https://doi.org/10.13140/RG.2.2.31950.87364

Male, S. A., & King, R. W. (2019). Enhancing learning outcomes from industry engagement in Australian engineering education. *Journal of Teaching and Learning for Graduate Employability*, *10*(1), 101–117. https://doi.org/10.21153/jtlge2019vol10no1art792

Mandke, V. V. (1989). *Linking Education-Work – An Indian Experiment of PS (Practice School) System of Education*. In-house Knowledge Dissemination Research Publication, BITS Pilani.

Mandke, V. V., & Nayar, M. K. (2004). Beyond Quality: the Information Integrity Imperative. *Total Quality Management & Business Excellence*, *15*(5–6), 645–654. https://doi.org/10.1080/14783360410001680134

Nelson, K. (2008). Teaching in the digital age: Using the Internet to increase student engagement and understanding. Corwin Press.

OECD. (2018). *The Future of Education and Skills Education 2030*. OECD. https://www.oecd.org/education/2030-project/contact/E2030%20Position%20Paper%20(05.04.2018).pdf

Prince, M. J., & Felder, R. M. (2006). Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases. *Journal of Engineering Education*, *95*(2), 123–138. https://doi.org/10.1002/j.2168-9830.2006.tb00884.x

Reinhard, K. (2006). The German Berufsakademie Work-integrated Learning Program: A Potential Higher Education Model for West and East. *Asia-Pacific Journal of Cooperative Education*, *7*(1). https://www.voced.edu.au/content/ngv%3A54414

Reis, A. C. B., Barbalho, S. C. M., & Zanette, A. C. D. (2017). A Bibliometric and Classification Study of Project-based Learning in Engineering Education. *Production*, *27*(spe). https://doi.org/10.1590/0103-6513.225816

Robbins L, [Chairman]. (1963). Higher education [Report of the Committee appointed by the Prime Minister under the chairmanship of Lord Robbins, 1961-63]. London: HMSO.

Ruël, G. C., Nauta, A., & Bastiaans, N. (2003). Free-riding and Team Performance in Project Education. *The International Journal of Management Education*, *1*(1), 26–37. https://pure.rug.nl/ws/files/3010481/03a42.pdf

Simons, RJ., van der Linden, J., Duffy, T. (2000). New Learning: Three Ways to Learn in a New Balance. In: Simons, RJ., van der Linden, J., Duffy, T. (eds) *New Learning*. Springer, Dordrecht. https://doi.org/10.1007/0-306-47614-2_11

Souppez, J. B. R. (2023). Engineering employability skills: Students, academics, and industry professionals perception. *International Journal of Mechanical Engineering Education*. https://doi.org/10.1177/03064190231214178

Stirling, A., Kerr, G., Banwell, J., MacPherson, E., & Heron, A. (2016). A practical guide for work-integrated learning: Effective practices to enhance the educational quality of structured work experiences offered through colleges and universities. Toronto, ON, Canada: Higher Education Quality Council of Ontario.

Di Battista, A., Grayling, S., Hasselaar, E., Leopold, T., Li, R., Rayner, M., & Zahidi, S. (2023). *Future of Jobs Report 2023*. World Economic Forum, Geneva, Switzerland. https://www.weforum.org/reports/the-future-of-jobs-report-2023.

Tushar, H., & Sooraksa, N. (2023). Global employability skills in the 21st century workplace: A semi-systematic literature review. *Heliyon*, *9*(11), e21023. https://doi.org/10.1016/j.heliyon.2023.e21023

van Hout-Wolters, B., Simons, RJ., and Volet, S. (2000). Active Learning: Self-Directed Learning and Independent Work. In: Simons, RJ., van der Linden, J., Duffy, T. (eds) *New Learning*. Springer, Dordrecht. https://doi.org/10.1007/0-306-47614-2_11

Vermunt, J., and Verschaffel, L., (2000). Process-Oriented Teaching. In: Simons, RJ., van der Linden, J., Duffy, T. (eds) *New Learning*. Springer, Dordrecht. https://doi.org/10.1007/0-306-47614-2_11

Vuksanovic, N., Santa, R., Moisander, T., Taskila, V.M. and Leen, E. (2014). Student Advancement of Graduates Employability: Employability with Students' Eyes. *The European Students' Union*. https://www.esu-online.org/wp-content/uploads/2016/07/Sage-EWSB-online-FINAL.pdf

Wieman, C. E. (2014). Large-scale comparison of science teaching methods sends clear message. *Proceedings of the National Academy of Sciences*, *111*(23), 8319–8320. https://doi.org/10.1073/pnas.1407304111

Wiggins, G. P., & McTighe, J. (1998). *Understanding by Design (pp. 13-34)*. ASCD.

Williams, L. D. (2021). Concepts of Digital Economy and Industry 4.0 in Intelligent and information systems. *International Journal of Intelligent Networks*, *2*, 122–129. https://doi.org/10.1016/j.ijin.2021.09.002