Flipped classroom and digitization: an inductive study on the learning framework for 21st century skill acquisition

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ABSTRACT

While increasingly demands have been made on Higher Education Institutions for revamping curriculum designs and instructional pedagogies to adapt to the 21st century digitized learning and skill environment, the COVID-19 pandemic underscored this adaption as the singular solution to maintain the learning continuum. The inverted or flipped classroom has emerged as an enabling learning framework offering a convergence of technological advancements with active and collaborative learning. This study investigates the correlation between the flipped learning pedagogy in higher education and the acquisition of 21st century skills in the current digitized environment to meet Industry 4.0 readiness landscape. Primary data for this study was collected using a scientifically deployed mixed methods survey research and in-depth interviews from undergraduate students across universities to get their input on what they experienced and perceived as learners through the classroom flip experience. Until today, there has been lack of focus on Higher Education in the literature on an effective pedagogy for cultivating 21st century skills. This is an original research work which presents a holistic view of what elements are offered by 'flipped learning' as key to the development of 21st century skills and competences considering the demands of the fourth industrial revolution (IR 4.0) from Higher Education Institutions, for creation of a job resilient workforce. The findings of the study showed that the flipped classroom model was experientially and perceptibly preferred by undergraduates for the acquisition of 21st century skills and competencies needed for industry 4.0 readiness amongst other reasons. The results of this study have implications for students, faculty and higher education institutions.

Keywords: flipped classroom; flipped learning; higher education; 21st century skills; Industry 4.0 readiness; digitization.

INTRODUCTION

'Industry 4.0', a term coined at the 'Hannover fair 2011', also termed as the Fourth Industrial Revolution or IR 4.0 broadly refers to the widespread change and adoption of information and communications technology (ICT) across all sectors of industrial production and application in the 21st century**.** IR 4.0 is unprecedented in its exponential pace and rapid technological transformations relative to its predecessors. It seeks a continuous evolution in the technical and non- technical skill sets of future employees and/or entrepreneurs. Consequently, higher education curriculums need to be contextualized across disciplines to meet the demands of industry 4.0. Although, accretion of technology assisted teaching and learning has increased rapidly **(Ragulina et al. 2018),** there continues to be a gap in IT skills and soft skills and industry 4.0 expectations from university graduates. The changing employment landscape demands higher focus on graduate capabilities instead of their formal qualifications. As such, higher education systems should focus on building broader skill sets comprising of IT skills, job specific capabilities and soft skills that act an enablers for 'capability development, interdisciplinary collaboration and innovation' (p.15).

New formats of education incorporating high quality anytime-anywhere online learning platforms are required to build capabilities rather than granting degrees alone **(Lorenz et.al 2015)**.

The framework of education for acquisition of 'industry 4.0' readiness skills and technologies has been coined as Education 4.0. Education 3.0 was characterized by the advent of technology and digitization. While the emphasis of Education 3.0 was on "knowledge production and co-constructivism," its successor is being looked upon to harness innovation, production and classroom replacement". **(Bongomin, et.al., 2020. p.10)**. Hussin **(2018 p.92)** outlines the nine elements of 'Education 4.0' **(Fisk, 2017)**. 'Learning anytime, anywhere, e-learning tools, peer learning, 'identifying the sources of learning' rather than only learning, freedom of choice of methodology of learning (blended; flipped or bring your own device), project based collaborative learning, practical experiences through internships, combined assessment tools and student participation in curriculum development-constitute some of the elements of the new paradigm of learning. Significant role will be that of 'Flipped classroom approach' enabling more interactive and personalized in-class learning where the teacher assumes the role of a facilitator and mentor. 21st century students ought to be fully engaged in their own learning process with access to digital tools and online platforms **(Hussin, 2018)**.

 The pervasive access to the internet and burgeoning digitization at the crossroads of Industry 4.0 presents us with an opportunity to reexamine the current instructional pedagogies in the context of 'deeper learning' for the acquisition of 21st century skills and Industry 4.0 readiness.There is limited literature and research on effective and relevant pedagogies in higher education institutes for developing deeper learning and 21st century skills and to meet the evolving landscape of IR 4.0. This study investigates the relevance and effectiveness of 'Flipped Learning' pedagogy for building 21st century skills and responding to the evolving landscape of IR 4.0. This research takes into account student perceptions and experiences of flipped classroom across universities in the UAE and India and a small number in Canada, Australia and the United States. Data was collected through surveys and virtual interviews

In summary, this research is conducted with the endeavor to answer the following research questions:

-What quality of learning outcomes are desirable for acquisition of twenty first century skills and industry 4.0 readiness by university graduates?

-How is 'flipped learning' in a classroom flip an effective and sustainable pedagogy in higher education for the acquisition of 21st century skills?

LITERATURE REVIEW
Industry 4.0 readiness skills

In the continually evolving employment landscape of IR 4.0, 'analytical thinking', 'innovation', 'active learning' and 'learning strategies' would be increasingly sought for skills. "Proficiency in new technologies is only one part of the 2022 skills equation, however, 'human' skills such as creativity, originality and initiative, critical thinking, persuasion and negotiation will likewise retain or increase their value, as will attention to detail, resilience, flexibility and complex problem-solving. Emotional intelligence, leadership and social influence as well as service orientation also see an outsized increase in demand relative to their current prominence" **(Schwab, The Future of Jobs Report, 2018, p.12)**. Thus, it is imperative that skills competency is treated with a flexible approach by higher education institutes for developing 'lasting career' in a global, knowledge-based economy. With a future of work that is constantly evolving, institutionalization of 'automation' will be increasingly underpinned by 'non-automatable human skills' **(Jahanian, 2020)**.

Thus, there's a need for amalgamation of IR 4.0 technologies in academic environments for concurrent adoption of technical innovations and development of capacity for collaboration and teamwork of students **(Penprase, 2018)**. At the same time, however, 21st-century learners must develop a multidimensional frame of reference towards problem solving tasks and foster skills of creativity, complex communication and critical thinking **(Jahanian, 2020)**. Till date, there is a lack of focus on Higher Education in the literature that there is a need to develop abilities and skills and accept novel ways to cope with the continually evolving social and economic landscape of IR 4.0 **(Gleason, 2018)**.

Education 4.0 and Twenty first Century Skills

Education 4.0 is aimed at creating a set of learners who are equipped to slip into industry 4.0 where skill sets amongst potential employees are competitive, solution oriented and indiscriminate. The competitive edge of one student over the other will be based on individual motivation, willingness and initiative while universities are

geared to expose them to a more homogeneous/equitable set of learning stimulus. In the Education 4.0 landscape, the learner is at the centre of the learning environment, while technological revolution provides impetus as the key driver enabling student centered learning. The 'new normal' is student 'well-being' and 'quality of learning experiences' rather than learning 'outcomes' or 'achievements.' Teaching methodologies that afford opportunities for application of student learning to practical and real time situations aid them to develop new ideas, insights and thought process are being adopted **(OECD, 2019 p.13)**.

Thus, the goals 'Education 4.0' are underpinned by four elements viz: 'employability' and distinguished from 'employment'; 'student experience' characterized by flexibility, choice of curriculum and personalized experience; research excellence and societal acceptance of different pedagogies, remote learning and courses. Blended learning and 'flipped classroom' models are becoming popular in Higher Education Institutes with emphasis on experiential and interactive learning. **(FICCI-EY Report, 2018).** This is because, learner centric pedagogies such as flipped classroom empower the learners to exercise agency and play a dynamic role in framing their lessons. The cumulative effect is development of attitudes and persistence, stronger sense of empowerment, superior analytical thinking and problem-solving abilities- 21st century skills.

Flipped learning: Principles and Possibilities

Learning through visual stimuli, touch and feel is not an invention rather an integral part of class- room teaching method since time immemorial. Historically, emphasis has been placed on learning by doing and learning through doing, essentially the grammar of syntax argues for a noun and a verb agreement to enable function (a tangible outcome). Flipped learning model is a process of scaling up this rudimentary practice into a possibility for those learners who yearn for an engaging classroom space for application of learnt concepts and taxonomy. As information becomes more and more accessible, "simply transmitting information should not be the focus of teaching; helping students to assimilate that information should," said Eric Mazur **(Berrett, 2012 p.4)**."Once you engage the students' minds, there's an eagerness to learn, to be right, to master"**(Berrett, 2012 p.5).** The students are expected to collect and pre-read information out of class through a variety of options which could include books, study material, recorded and/or online lectures and videos and podcasts, which was traditionally in-class work. While, what was ordinarily homework, that is, applying what was earlier done in class to problems, is now done in class with the help of educators and peers **(Bergmann and Sams, 2012).** This pedagogy was first popularized in secondary education in the United States in 2007, by Jonathan Bergmann and Aaron Sams, who are credited with devising the phrase 'flipped classroom' **(Berrett, 2012).**

The next sections will discuss the elements of 'Flipped learning' pedagogical technique and its correlation to the acquisition of 21st century skills in detail.

Unfolding and Characteristics

Inversion of 'content delivery' is a very old practice. It could be suggested that the flipped classroom model has been extant in the larger learning environment since long before, through the prerequisite of students completing preparatory work before coming to class for invigorating a conceptual understanding at a more profound level **(Strayer, 2012)**. The instances of Humanities students where literature and classics were read out of class while in-class time was used for thematic and archetypal discussions, and Law students prepared out of class for 'Socratic Seminars,' were cases in point. **(Berrett, 2012 p.5).** The differentiator today is the increased availability of pervasive technological tools allowing more blended forms of learning including 'flipped classroom' possible and scalable.

The flipped classroom is, thus, '(1) a means to increase the interaction and personalize contact time between students and teachers and (2) an environment where students take responsibility for their own learning' **(Bergmann et al., 2013)**. It blends direct instruction outside of class with active 'constructivist and collaborative' learning inside of class. **(Bergmann et.al., 2013).** The pedagogue often replaces the textbooks with internet sources, videos etc. **(Davies, 2013)**. However, as described by **Gunyou (2015),** it is not a replacement of teachers and teaching material with 'e-learning' or 'online videos' etc. Rather, flipped classroom 'flips' the role of an educator to that of a mentor whereas the pupil while enjoying his pace and space of learning is more responsible for the same. **As Baker (2000) puts it,** the teacher becomes the "guide on the side" and not the "sage on the stage." Simultaneously, the role of the student changes from that of a passive recipient of information download to that of a responsible pupil onerous for his preparatory work outside of class and for the active learning in class. Class time is freed up for more interactive and collaborative learning through discussions, debates, group work

and problem solving -enabling deeper content learning and focus on higher skills of creativity, analytical ability and critical thinking. This additional in-class time and flexibility also affords an opportunity to the instructors create more challenging activities for advanced level students, while enabling the strugglers to engage in different activities, thus truly achieving a personalized learning environment Thus, in the flipped classroom setting, students takeover control of their own learning thereby increasing the interaction time between the students and teacher and collaboration time amongst students**.** In addition, since flipped model provides course content to students through online/pre- recorded videos, absent students do not fall behind and can cover up for the lost class and can study the same at their own pace and time **(Bergmann & Sams, 2012; Herreid, 2013)**.

Role of Technology

Technological advancements underpin the increased recognition of 'flipped learning' as an effective pedagogical technique. While understanding the role of technology in the expansion of flipped learning, it is important to remember that the essence of flipped learning is providing students with material that they can study outside the classroom, this can easily but with proper management skills be done without the involvement of technology as well, but it is the value addition of technology that has allowed the spectrum of flipped learning to blend with education with ease.

The designing of "Open Course Ware" or "Open Educational Resources" (OER) by the Massachusetts Institute of Technology (MIT) in 2001, provided learning resources such as videos and textbooks; leading to the unfolding of flipped classroom some years later **(Bishop & Verleger, 2013)**. In 2006, Salman Khan, an alumnus of MIT continued the program of MIT (Open Course Ware) with the establishment of 'Khan Academy' by uploading more than 3200 videos from different fields of study for free online access **(Bishop & Verleger, 2013)**.

Thus, developments in technology and affordability of internet have enabled educators to shift out of the classroom part of learning which can be 'automated' viz: dissemination and reception of course content, with ease, while allowing in class time for learning of the part which cannot be 'automated' viz: 'higher order skills' and peer activities. This shift underpins the flipped learning methodology. **(Jong, 2017)**.

Moreover, one can no longer be oblivious to the fact that students of this millennial generation have grown up on uninterrupted and affordable internet access and a plethora of affordable internet tools and gadgets. 21st century students are comfortable and 'ready to adapt' to technology for learning. For them learning through the medium of technology is only natural and a blended learning pedagogy that employs the flipped classroom is only a natural progression of progressive education. **(Deri, et.al., 2018)**.

The Technique of the ' Flip'

"There is no single way to flip your classroom - there is no such thing as the flipped classroom. There is no specific methodology to be replicated, no checklist to follow that leads to guaranteed results" **(Bergmann and Sams, 2012 p. 11)**. **Tucker (2012)** argues that there is no unique prescribed format to the approach. The main idea is to flip the typical instructional approach: "With teacher-created videos and interactive lessons, instruction that used to occur in class is now accessed at home, in advance of class. Class becomes the place to work through problems, advance concepts and engage in collaborative learning" **(2012, p.82).** However, the learning outcomes depended on the pedagogue's design of the curriculum. The pre-class asynchronous activities must be integrated to the face-to-face (F2F) synchronous active learning methodologies to enable students to appreciate the approach in order to be actuated to do necessary preparation out of class. What mattered was "how these resources were integrated into the overall approach" **(Tucker, 2012 p.82)**.

Hamdan et.al., (2013) agree that while there is no "how-to" list associated with the Flipped Learning model, there are unifying themes which identified those four Pillars of F-L-I-P, an acronym of (i) 'Flexible Environment,' permitting students to opt for flexible timeframes and space and provide them with different ways of learning; (ii) 'Learning Culture,' through meaningful activities and differentiation; (iii) 'Intentional content,' created by the educator that is relevant and accessible to all; (iv) 'Professional Educator,' who enables achievement of the first three pillars. The focus of the educator should be on the 'learner and learning' to get the best of the face-face time with the students by a methodology he is free to devise. 'Professional and reflective educators who actively engage in scholarly networks are indispensable for the effective implementation of flipped learning' **(2013, p.6)**. This agrees with the finding that an effective deployment of the model can lead to maximum optimization of the educator's time and expertise **(Berrett, 2012)**.

"A well-organized flipped course includes very careful scaffolding of the learning activities, both in the classroom and at home." **(Deri, et.al., 2018 p.75).** In the process, university students learn how to organize their learning and time management. With the evolving technological landscape and availability of affordable internet, the integration of technology into learning is an optimal choice. But technology is only able to hold a candle to the methodology, creativity, skill and proficiency of the instructor structuring it.

Challenges of the 'flip'

Directed learning and guidance nurtures the student acquisition of knowledge out of class and in-class preparedness for the effectiveness of flipped methodology (**Mason, et.al. 2013).** "Pedagogical integrity" underpins the implementation of the flipped classroom, which may languish in its absence. For instance, student out of class preparedness may falter if the same is not engaging enough or less interactive or is not integrated well to in class active learning. Students and teachers need to be fully and continually engaged throughout the learning process (**O'Flaherty & Phillips, 2015).**

Measurable impact of the Flip on learning outcomes

Studies have reported advantages of implementing flipped pedagogy in regular courses. **Kong (2015)** reports that flipped classroom in 'humanities courses' improved critical thinking abilities of students and they could evaluate their own learning better. **O'Flaherty, & Phillips (2015, p.86)** report that within literature, there are suggestions of growing 'indirect evidence' such as enhanced learner satisfaction and grades, that furthers the 'flipped learning' pedagogy. (**Mason, et.al., 2013; Wilson, 2014**). **Jong, (2017)** compared 'Flipped social enquiry learning' with 'Guided social enquiry learning'. Overall, student interviews found the 'flipped learning experience' to be more superior inside and outside of class. The author recommended incorporation of flipped learning pedagogy to the other constructivist learning pedagogies.

Fulton (2012) reported that flipped learning model provided increased student accomplishment, engrossment and several opportunities for effectively employing technology 'for 21st century learning'. **Wilson (2014)** found that flipped learning positively affected student attitudes as well as performance. In line, **Mason et.al. (2013)** found enhanced confidence in learning and higher student engagement in a flipped classroom which further implicates a reduction in learning anxiety amongst pupil and increased efficiency. (**Teo et al., 2014).** Jodie Bastan, a lead A-level Geography teacher at City College, Norwich shares that her experience of 'flipped learning' led her students to become geographers with higher confidence in their abilities by focusing on higher skills. By researching and exploring the subject topic before getting into the classroom, the students were encouraged to make notes to get ready for an interactive session and 'identify the areas they need to focus on'. This may possibly lead each class to begin with a 'differentiated starter' to assess the knowledge each student had gained, as distinct from classroom learning where each student is assumed to be at the same starting level (**Baston, 2016).** In an investigative research undertaken in a '300-level sociology course' learning outcomes and student reviews of their 'learning experiences' were compared by teaching one of the two groups of students by the lecture method while the other group was taught using 'Team-Based Learning'(TBL) methodology. By TBL, the author adopted a blended pedagogy utilizing latest drifts in university education including 'active learning, backward engineering and flipped classroom'. TBL was found to have an edge over lecture method with respect to students' perceptions of enhancement of their "verbal expression and creative thinking." These perceptions were attributable to the bilateral flow of communication in a blended classroom enabling students to participate in activities, verbally express themselves and often find themselves involved in 'problem-solving tasks' requiring 'critical and creative thinking' (**Huggins, et.al.2015).**

Interventional methodolgy to bridge the gap between academic learning and acquiring 21st century skills

Pellegrino & Hilton (2013) define 21st century skills as "broad, transferable skills and knowledge that can be applied in new situations." "This transferable knowledge includes both content knowledge in a domain and procedural knowledge of how, why, and when to apply this knowledge to answer questions and solve problems (called "skills"). This blend of content knowledge and related skills is referred to as 21st century competencies." **(p.23, p.70).** Irrespective of the catalogue of skills or the terminology delineating them, all 21st century skills are germane to the complexity of the 21st century world. Nearly all of these skills direct on 'similar types of complex thinking, learning, and communication skills', also referred to as abilities of 'higher-order thinking skills, deeper

learning out- comes, and complex thinking and communication skills.' "Higher-level thinking skills take time to develop and teaching them generally requires a tradeoff of breadth for depth." **Saavedra and Opfer (2012, p.10).** The ability to 'transfer' forms the bridge between 'deeper learning' and 21st century competencies, that is, "the ability to use prior learning to support new learning or problem solving in culturally relevant contexts." **(Pellegrino & Hilton, 2013, p.75).** Furthermore, this 'transfer' occurs only when efficacious 'instructional methodology' is deployed. Pellegrino and Hilton found structured informal learning and problem-based learning (PBL), (amongst others) as enabling instructional methodologies towards achieving 'deeper learning' and 'transfer'. According to the study PBL instruction "often follows six key principles **(Barrows, 1996)**: 1. Student-centered learning 2. Small groups 3. Tutor as a facilitator or guide 4. Problems first 5. The problem is the tool to achieve knowledge and problem-solving skills 6. Self-directed learning." **(Pellegrino & Hilton, 2013, p.166).** Thus, the study predicates the learning flow from problem-based learning (PBL) instructional methodology to achieve 'deeper learning' which further enables development of '21st century skills'. The flipped pedagogy intervenes at the very first step by creating time and scope for PBL, which underpins the twin objectives of 'deeper learning' and 'ability to transfer' for 21st century competencies.

Adapting the skill of 'transfer' is not easy and requires enabling environment. **Saavedra and Opfer (2012, p.8)** propose nine lessons that correspond to imparting 21st century skills to students. These are: '(i) Make curriculums relevant to the big picture and student lives; (ii) Teach through the disciplines including skills for production of knowledge; (iii) Develop thinking skills; (iv) Encourage learning transfer; (v) Teach students how to learn; (vi) Address misunderstandings directly; (vii) Treat teamwork like an outcome; (viii) Exploit technology to support learning; (ix) Foster creativity skills. The lessons of transfer, metacognition, teamwork, technology, and creativity are 2lst century skills in themselves.

Galway, et.al., (2014) suggest that higher educational institutes are expected to nurture these competencies by deploying appropriate instructional pedagogies. Knowledge and information transmission can no longer be the singular competence of higher educational institutes. Institutes of higher education are increasingly being demanded to provide trainings in transitional abilities for greater graduate mainstreaming in the 21st century. Problem solving based learning methodologies should be integrated into university curriculums to meet these expectations. In-class time should be devoted to activity-based learning that cannot be automated (**Bishop & Verleger 2013**).Thus, educational institutes of the 21st century need to adopt 'student-centered' and personalized pedagogies to prepare life-long learners capable of thinking and doing what automation and technology cannot achieve **(Gleason, 2018).**

Flipped pedagogy can be an opportunity to build curriculum and instruction design that lead to maximization of face-to face time through activities aiming to employ 'learning strategies that promote higher-order thinking, social learning and 21st century skills.' In the current digitized environment, instructional methodology underscores curriculum design and students' acquisition of knowledge and competence skills for transferring learning so gained, to workplace environments (**Beetham & Sharpe, 2013).**"Content is not going to be the thing we do. We're going to help unpack that content," says Professor Michael S. Palmer **(Berrett, 2012 p.5)**. The objective of 'flipping' is to flip the "learning attitudes and habits, as well as linking education closer to the world of work", which underpin the practice of education. **(Berrett, 2012).**

 "Meaningful instruction imitates the real world." The traditional lecture- based instruction approach is contrary to the working landscape which requires constant collaboration. **(Gunyou, 2015 p.15).** In this line, even the online courses taken individually and exclusively online do not score better. Technology enabled online platforms when synergized with a well-structured, activity based flipped classroom model is the recipe for successful and relevant instruction methodology today **(Gunyou, 2015). Huang and Lin (2017),** propose a 'team -based classroom' in a flipped learning approach. The findings of the study in a 'human resource management' class that was flipped with the objective of developing a learning experience that feeds into workplaces and communities, suggest that team based learning in a flipped classroom created more opportunities for teamwork, knowledge sharing, shared problem solving, negotiation and constructive feedback to peers increasing student motivation and enjoyment which enhanced the learning experience and quality. Several characteristics of the flipped learning model are comparable to work environments in the 21st century. The confab dynamics between the educator and the student through valuable content and instruction delivery results in a productive and engaging learning outcome for the student. This reciprocation can be seen in the context of work relationships between subordinate and his manager. Relevant and valuable resources provided by the educator prior to in class session prepares students for deeper

learning during the in-class session and motivates him to contribute effectively. In work environments, meeting and discussion agendas are circulated well in advance to seek an effective contribution in-meeting. This harmony and multi-level skill development in this process through the flipped model can be very effective for employability readiness for undergraduates. **(Francis, 2014).** This flows into the findings that suggest that employers not only expect graduates to have technical and discipline competences from their degrees but also require them to demonstrate a range of broader skills and attributes that include 'team-working, interpersonal & communication skills, leadership, critical thinking, problem solving and managerial abilities.' **(Lowden, et.al. 2011, p.12).** These skills are increasingly viewed as important, not only for graduates and not only in an employment context. They are viewed as increasingly important in the changing context of contemporary life. Nonetheless, these skills are essential in the employment context and are considered important to make graduates prepared or ready for success in today's rapidly changing work environment **(Tran, 2016).**

Figure 1 hereinbelow summarizes and illustrates how the elements and strategies deployed in a 'Flipped learning' framework lead to learning outcomes that lead to the acquisition of 21st century skills and industry 4.0 employability readiness skills.

Elements & Strategies of Flipped Learning

1. Active learning environment
2. Student participation
3. Discussions, Questioning & Challenging
4. Expressing opinions & ideas
5. Personalized learning
6. Capacity building & Deeper learning
7. Application based tasks/Problem solving tasks
8. Self-regulated independent learning
9. Peer engagement & learning
10. Group work
11. Team based Learning
12. Digital tools/online platforms

Quality of learning outcomes

1. Complex thinking, analytical & communication skills
2. Higher confidence levels
3. Critical thinking
4. Creativity
5. Empowerment
6. Information assimilation and application
7. Transferability/Transitional capabilities
8. Problem-solving abilities
9. Initiative & Independence
10. Collaboration
11. Team Work
12. ICT skills

Acquisition of 21st Century Skills and Industry 4.0 employability readiness Skills
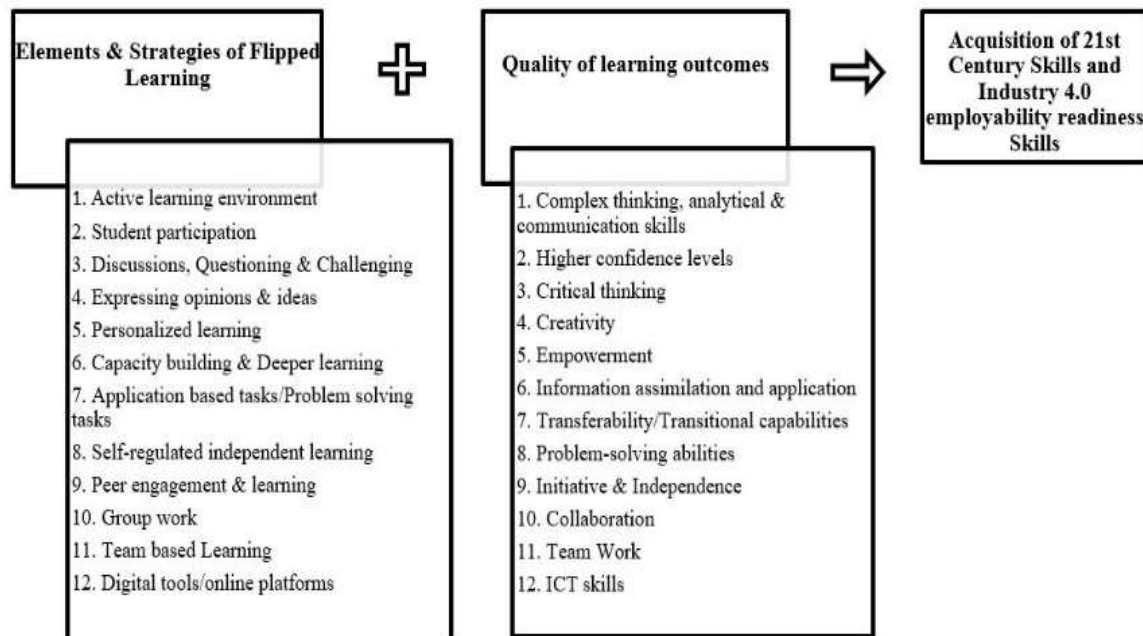
Figure 1: Process flow of flipped classroom' learning outcomes for acquisition of 21st century skills

The following sections will analyze data collected for this study and give recommendations on how 'flipped learning' in a classroom flip an effective pedagogy in higher education for the acquisition of 21st century skills.

METHODS
Research Design
This study employs an inductive qualitative approach diving into the increasingly adapted construct of flipped learning. Constructs emerge from concepts which are general notions about a given theoretical phenomena. As theorists, researchers and practitioners we tend to determine a construct basis our experiences of concepts to capture their meaning and significance, inquire into them and model them **(Gioia et.al., 2013)**. Qualitative methods foreground the idea that the topic has been examined before **(Eisenhardt and Graebner, 2007)**. A detailed and systematic review of literature was undertaken as a precursor to such research identifying specific inadequacies in the prior literature, such as inherent conflicts or lack of ecological validity, that call for a fresh approach unconstrained by extant theory **(Gioia et al., 2013).**

This research deploys cross-sectional Grounded Theory (GT) for the purposes of conducting a qualitative enquiry into the concept of Flipped Learning. GT involves constant comparative analysis whereby groups are compared

basis theoretical similarities and differences. Grounded Theory is most appropriate for understanding the process by which individuals construct meaning out of shared experiences. Grounded theorizing **(Babchuk, 1997)** is the process of inductively and repetitively constructing theory from observations using a process of theoretical sampling in which incipient insights guide and inform selection and inclusion of the "next" informant or slice of data.

In the same context, categories of people were not predetermined rather the research process and interview responses determined the next steps in terms of ensuing questions and sample size. In fact, the respondents' level of exposure to flipped learning determined the papers domain of inquiry.

Research Tools

A total data set of 300 student participants using a scientifically deployed mixed methodology research, as described in detail below enabled succinct data analysis.

Quantitative Methodology

Survey research method employing closed ended questions was utilized to collect data for this study. This method was considered appropriate since the purpose of the study was to evaluate undergraduate student experiences and perceptions on the felt and anticipated learning outcomes of flipped classroom with the aim to gather data to undertake an analysis of the flipped learning pedagogy as an effective and sustainable tool for developing 21st century skills amongst university students. The study also aimed to examine the quality of desired learning outcomes for acquisition of twenty first century skills and industry 4.0 readiness amongst undergraduate university students. Along these lines, a questionnaire was designed consisting of approximately 17 questions for the quantitative analysis. It was ensured that, the respondents on whom the survey questionnaire was administered had had some experience of 'flipped learning', in essence.

Stratified Random Sampling method was deployed for data collection. In order to do so, students names were listed out in alphabetical order from each class of undergraduate programs (first to sixth semester) across disciplines, of a University in the UAE. Every second person in the list was selected which then gave a sample set of 120 out of 252. Although 126 were reached out to, only 120 filled in the survey.

Qualitative sampling methodology

The sampling frame comprised undergraduate university students (including three year, four year and five year programs) across disciplines including engineering, pharma, economics, management, psychology and language programs (about 5% of the respondents were from language programs) across universities in the UAE, India and about 10% of the undergraduates from universities in Canada, US and Australia. A pre-test was administered on three students from different disciplines which led to a change in question sequence, language and enabled altering some questions.

Purposive sampling enabled identification of known students and those who were themselves exposed to flipped learning. Ten out of a set of 61 students were trained into carrying out in depth-interviews while the other students served as interlocutors for a wider outreach thus deploying snowballing method of data collection. The trained team of students reached participants across continents and disciplines with two definite criteria, potential respondents had to be undergraduate students at a university and had to have some exposure to flipped learning. As for Quantitative Sampling, it was ensured that, the respondents on whom the survey questionnaire was administered had had some experience of 'flipped learning', in essence. An interview guide comprising 12 questions was administered by the ten trained students who then telephonically, through video calls and in person conducted qualitative enquiry under the following themes, viz: nature of flipped learning, impact and quality of learning outcomes, role of digitization, its relevance to acquiring 21st century skills, preparation for employability for industry 4.0 and the sustainability of the 'flipped learning' format. Informed consent was sought from the participants.

Responses of the participants were thereafter transcribed, summarized and analyzed. Development of a code book highlighting around six main domains of enquiry and contextualizing responses falling under those domains came in handy for data naming and segmentation. Color coding these thematic areas enabled a clear emergence of the socio-demographic profile and the six identified areas of enquiry from 183 participant transcripts. Code summaries emerging from the identified codes enabled data analysis.

RESULTS AND DISCUSSION

Almost all the respondents tended to compare the 'flipped classroom' over the 'traditional classroom' in their responses. Eighty three percent (83%) of the respondents chose 'flipped learning' over traditional classroom methodology for various reasons, rationales and experiences as discussed below, while 17% exhibited preference for the traditional classroom pedagogy for reasons discussed below.

'Flipped Learning': Eighty-seven (87%) of these 83% respondents reported that 'flipped learning' pedagogical technique provided them with an active, dynamic and engaging learning environment. These respondents opined that the pedagogy enhanced their learning experience and boosted their confidence by bringing them out of their comfort zone and introverted self in an interactive environment, kindling genuine interest in debates and discussions and self-discovery of missed opportunities, talent and academic interest. "We feel empowered and more passionate when a classroom presentation gives us an opportunity to be involved and increases our sense of responsibility." One of these respondent's summarized the experience as, "Flipped learning is making class time more enjoyable, productive and engaging for students and teachers. It embraces different minds, ways of thinking and learning and enables greater participation." These findings resonate with those of **Toto & Nguyen (2009)** that the classroom flip enabled inside -of -class learning space that was spent using real world tools and involvement in practical applications resulted in increased learner engagement.

Almost 79% of these 83% respondents stated that out-of-class research and study made the in-class learning less monotonous and allowed students to build curiosity, opinions and ideas as against the spoon- feeding approach in traditional classroom. This is in line with the finding that flipped learning 'corrected the spoon-fed delivery style of the GCSE' thereby augmenting the critical, evaluative and problem-solving skills of students **(Baston, 2016 p.70).**

Almost 90% of these 83% respondents stated that the 'anytime anywhere' concept of learning and the possibility of going over the video recording repeated number of times is a strong element of the classroom flip. It enables better grasp and reinforcement of concepts and figuring out of doubts. Thus, this method gives freedom to the students to learn at their own pace. Pre-recorded videos of teachers ignite and capture a student's interest and the more challenging questions can addressed during the in-class time. **Herreid (2013)** recommends blending videos into courses as significant number of students prefer technological aids such as videos for class preparation more enjoyable than textbook reading. They add that the 21st century generation finds this model more functional, engaging and apposite for different subjects. Students are likely to contribute and reciprocate with more productive energy in class if the instructor provides material and guided tools to navigate resources with equal energy.

The survey results further found that almost 80% of these respondents (83%) felt a higher sense of ownership over the learning process and receive more frequent feedback. Educators get an opportunity to understand the differentiated student abilities better and to build soft skills of students. Learners are accountable and responsible for their learning goals and have no choice but to navigate with a sense of discipline and collaborate with peers to maximize learning through the 'flip'. In this line, **Barkley (2015)** emphasize that personalized attention and higher teacher-student interaction was the 'major' feature of flipped model. Individual attention to students enabled struggling students to seek help and encouragement from the educator increasing pass rates and retention rates. Student -student collaboration through teamwork and peer teaching fostered a positive and 'powerful learning' environment. Flipped pedagogy addressed distinctions in student learning styles by providing both books and videos.

Multiple perspectives, discipline, self-restraint and self-dependence of the learner are key to out of class learning and to entrepreneurship in future. **Song et.al. (2017)** aptly mention that developing students' self-regulated learning is crucial in cultivating 21st century skills in order to succeed in the digital age.

A significant number of respondents (75% of the 83%) found that the 'flipped learning' pedagogical technique has the time advantage. The digital revolution has enabled access to unlimited information and knowledge in limited amount of time. Instructors can provide the students with reliable sources of information (online books, pdfs, links) which enables the student to effectively use their time in understanding the concepts, rather than spending time in looking for sources from where they can gain knowledge. These results are consistent with the literature that higher instructional efficiency and scalability are some of the other relevant positives that come along with 'flipped' approach relative to the regular approach. **(Davies 2013; Gunyou 2015; Deri, et.al., 2018).** Learners of the 21st century are more comfortable and quite familiar with digital technologies. All the respondents irrespective of their choice of pedagogy admitted to being exposed to a good amount of screen time per day.

Almost 100% of the 83% respondents who supported the 'flip' felt that they were comfortable slipping into this technique as a natural progression having grown on gadgets in a digitized environment. In fact, some respondents opined that this technique reduces screen time, in the sense that the screen time is now channelized more productively towards compulsory out-of class learning. "One of the advantages that flipped learning has over others is that it blends digital technology, traditional and in-person teaching method; it is more flexible in nature, in efforts to motivate and maximize the participation of the students and hence increases the productivity of the class."

Almost 96% of the 83% respondents who chose flipped learning emphasized that the pedagogical technique underpins the development of 21st century skills. These respondents found an increase in their self-study capacity and deeper learning through generation of curiosity and involvement in research, inquiry, in-class questioning and meaningful peer interactions. "Flipped learning tends to increase the preparation level as we research more, use articles etc. This also encourages independent learning, as I am able to satisfy my own need for that knowledge until, I am content." These views were succinctly articulated by a respondent in the following words, "We can collect information through many mediums unlike a traditional class, which is just one source. Information can be gathered from people, books, TV, magazines etc. thus is more motivating and makes us want to think more and do more. According to me, traditional learning does not stimulate your thoughts, you do not think for yourself with traditional teaching, as it is very bookish. When it comes to traditional teaching Google is used for last minute, copy paste, rather than extensive interesting research." These respondents further stated that active listening and pro-active collaboration, complex communication, spontaneity and creative dialogue were some of the other outcomes of this technique through deployment of group activities, quizzes, discussions and problem solving. In this line, **Bergmann and Sams (2012)** aptly contend that 'Learning' is at the heart of flipped pedagogy, thus allowing more time and space for students to not only create and present their own content but also to test their 'learning'. In the process, students tend to engage with each other more and develop the aptitude in working as a team. This aspect of the pedagogical technique where students work together to achieve the same goals constitutes an integral part of 21st century learning. Skills such as team- work, learning with and through peers and cooperation develop as incidental to in class interactive time, which are sought by employers. These findings are consistent with the finding that peer collaboration and more constructive in class time are the key elements approving of the flipped pedagogy apart from the invigoration it brought **(Pierce & Fox, 2012; Gunyou 2015)**.

A significant number of these 96% respondents stated that out of class learning allows them to explore a variety of material along-with the instructor specified material, assimilate the same, reflect and then communicate ideas and opinions in class, which is a sublime process of developing analytical and critical thinking and reasoning skills and with those skills they could possibly survive longer in the real world. This is consistent with the argument that the technique of seeking in class problem solving of non- template problems students learn how to think. The self-construction of information and knowledge leads to a more creative output, honing this sought for 21st skill by employers (**Berrett 2012**). Everyone is given an opportunity to discuss, analyse and present their work thereby increasing interpersonal skills and self -confidence of 21st century learners. One of the Respondent's observed, "It is the era that values real life skills and transferable skills. Simply relying on different materials is not enough for one to survive this digital age. One has to think different from the others, get something new, be able to research and finally communicate ideas, which are possibilities of the flipped learning technique." These findings are congruous with previous studies (**Bergmann & Sams, 2012; Berrett, 2012; Tucker, 2012; Saavedra and Opfer, 2012; Herreid, 2013; Bishop & Verleger 2013; Pellegrino & Hilton, 2013**).

Some of the respondents made a unique and worthwhile observation, "Students of this generation inhere impatience by evolution. For them 'flipped learning' experience has added more meaning to online research and inculcated higher patience with information management and application through in-class discussions and activities thus paving the way for creative thinking thereby nurturing future entrepreneurs." Another respondent observed, "Students are faced with less pressure to get an answer right, they have more time to develop creative thinking skills that are valuable in their future career".

Almost 91% of these 83% respondents reported sharpening of IT skills using this pedagogy. One of the important 21st century skills is 'digital literacy' for employability. The 'Flipped learning' pedagogical technique enhances the Information and Communication Technology (ICT) skills of students and they are prepared better for joining mainstream work life through power point presentations, videos and other ways, that students present in class. In

the era of IR 4.0 many existing jobs are being redefined and new jobs are being created with the increasing demand for (ICT) related knowledge and skills. Familiarizing students with digital learning techniques will enable them to appropriately use the technologies for communication, collaboration and information management. These results are in line with previous studies **(Jong 2017, Deri, et.al., 2018).**

Figure 2 hereinbelow summarizes the reasons and rationale for choice of Flipped learning framework by almost 83% of the Respondents.
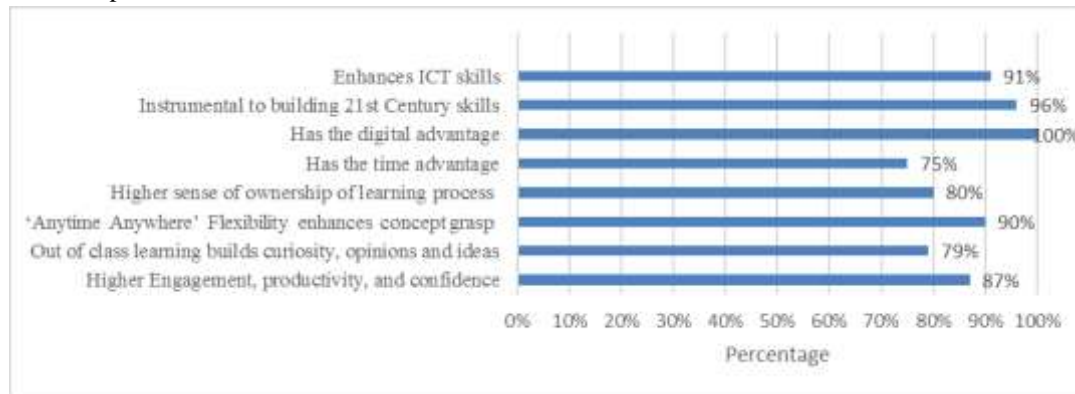

Figure 2: Reasons for choice of 'flipped learning' framework by 83% Respondents

Limitations of the pedagogy:

Almost 85% of these respondents who supported 'the flipped pedagogy' (83% of the total data set) cautioned that an ill implemented flip can lead to loss of interest by students in the pedagogy. These respondents felt that structure and execution of the classroom flip were key to its success. Out of class material requires guidance from the instructor and so do the in -class discussions and activities. Credibility of online resources maybe often questionable, if not navigated through under guidance. This pedagogical technique being relatively new, particularly in higher education, the shift from traditional to flipped ought to be gradual after preparing the students and Faculty. Self -learning out of class being novel to students accustomed to traditional classroom teaching may find it overwhelming or burdensome. Although, this is more of difficulty with the transition rather than the technique itself. A few respondents cautioned that lack of personalized attention by the instructor and motivation can impact an introverted student's morale against participation in discussions, debates and in- class activities. This can be counterproductive to the intended purpose of the flip. A teacher who is not as interactive may negatively impact the effectiveness of this technique. In agreement, **Huggins, et.al. (2015)** report that an educator's student engagement ability was a relevant variable that could affect the effectiveness of either pedagogy. The study concluded that "there is not a "one-size-fits-all" approach effective teaching, and instructors should match their methods to their learning objectives and teaching strengths."

Pandemic related spur: About 15% of the 83% who supported 'flipped learning' were exposed to the pedagogy for the first time during the lockdown imposed by governments owing to the Covid-19 pandemic. While almost all of these 15% respondents reported positively for the one or more of the reasons discussed above, a specific observation was that the classroom flip technique very engaging and fun in otherwise uncertain and nearly depressive times. A significant number of students felt that to their pleasant surprise, the technique held deeper learning promise and bound their interest in learning and self-development.

Traditional Classroom learning: The 17% respondents who preferred the traditional classroom technique exhibited resistance to flipped learning exhibited mainly because of inertia against change of the traditional classroom environment that they have been used to. These respondents find it too overwhelming and rather feel lazy at the thought of out of class self-learning as opposed to home assignments. These respondents stated that 'flipped learning' may not be for everyone, students need a lot of self- discipline for an effective learning, or else they would lose out on both out- of class and in-class learning. The traditional classroom allows students to ask questions as the lecture or in-class teaching material is in progress and is even for those students who do not undertake study and research out of class. There is greater chance of these students remembering at least some of what was taught in class. Presence of the educator for exploring a new topic was considered more effective by some respondents. These respondents felt they would prefer to have an instantaneous clarification of doubts rather than 'save doubts' for the next class and instead prefer to research further through online material and video

lectures post an in class introductory session. Affordability of computer devices and continued internet accessibility to all was also came across as a possible hinderance. A significant number of these respondents opined that flipped learning was beneficial for independent learners and self-motivated and self-disciplined students.

CONCLUSION

The study examines the effectiveness and sustainability of the 'flipped learning' pedagogical technique in higher education for cultivating 21st century skills and Industry 4.0 readiness. The results of the study showed that the flipped classroom model was experientially and perceptibly preferred by undergraduates for the acquisition of 21st century skills and competencies needed for industry 4.0 readiness amongst other reasons. It emerges from the study that proponents of flipped pedagogy underscore the advantages of this approach for several reasons: student ownership and responsibility for his own learning, in class activities leading to content mastery and acquisition of higher order transferable skills thus equipping the students with 21st century workplace readiness skills. A typical classroom session is aimed at student attention to the basic contours of the course understudy and to be able to draw out extant literature which defends and or criticizes the facts and theories of yesteryears. Classroom space cannot be viewed today simply as a hub for knowledge dissemination rather a facility provided to young and continuing learners to set out on an individual/ distinct learning process through multiple aspects of a given phenomenon. Flipped learning is a compilation of skills of an individual teacher to increase his/her area of influence in order to address the topic/subject of teaching. It enables the opportunity to capitalize on available resources and technology in order to enhance the understanding and analysis of the nuances of the subject. The pedagogics of teaching in a flipped classroom seeks more organization and focused interaction from the teacher and students. The 'flipped learning' technique is increasingly being viewed as an in classroom and /or remote classroom methodology aimed at providing 21st century skills to the students. It is aimed at utilizing the skills that the students are expected to display. This model of teaching and learning moves beyond comprehension of phenomena to the method of its application and analysis in real life situations.

The practical implications of the this study based on survey results and interviews emphasize that to prepare learners of the 21st century pedagogical approaches that go beyond the standard lecture method and involve greater student participation, ownership and peer stimulation, dialogue and engagement and afford a symbiotic positive learning environment need to be adopted. Faculty in Higher Educational Institutes must be empowered and supported to adopt flexible pedagogies enhanced by technological aids. 'Learning how to learn and the 'how' of things,' has assumed greater significance than 'knowing' things. Higher education must become relevant for 21st century employees, entrepreneurs and successful individuals in developing the required skill set. A blended pedagogy deploying flipped classroom can be an effective tool in honing skills such as applied knowledge, creativity, confidence, communication, presentation, teamwork , critical thinking, problem solving by allowing more time to students and educators to experiment in an 'interactive and relationship-rich environment' seeking higher engagement in maximizing learning goals. We need to prepare 'well-formed minds' and not 'well-filled minds' to meet the challenges and expectations of the 21st century and IR 4.0.

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