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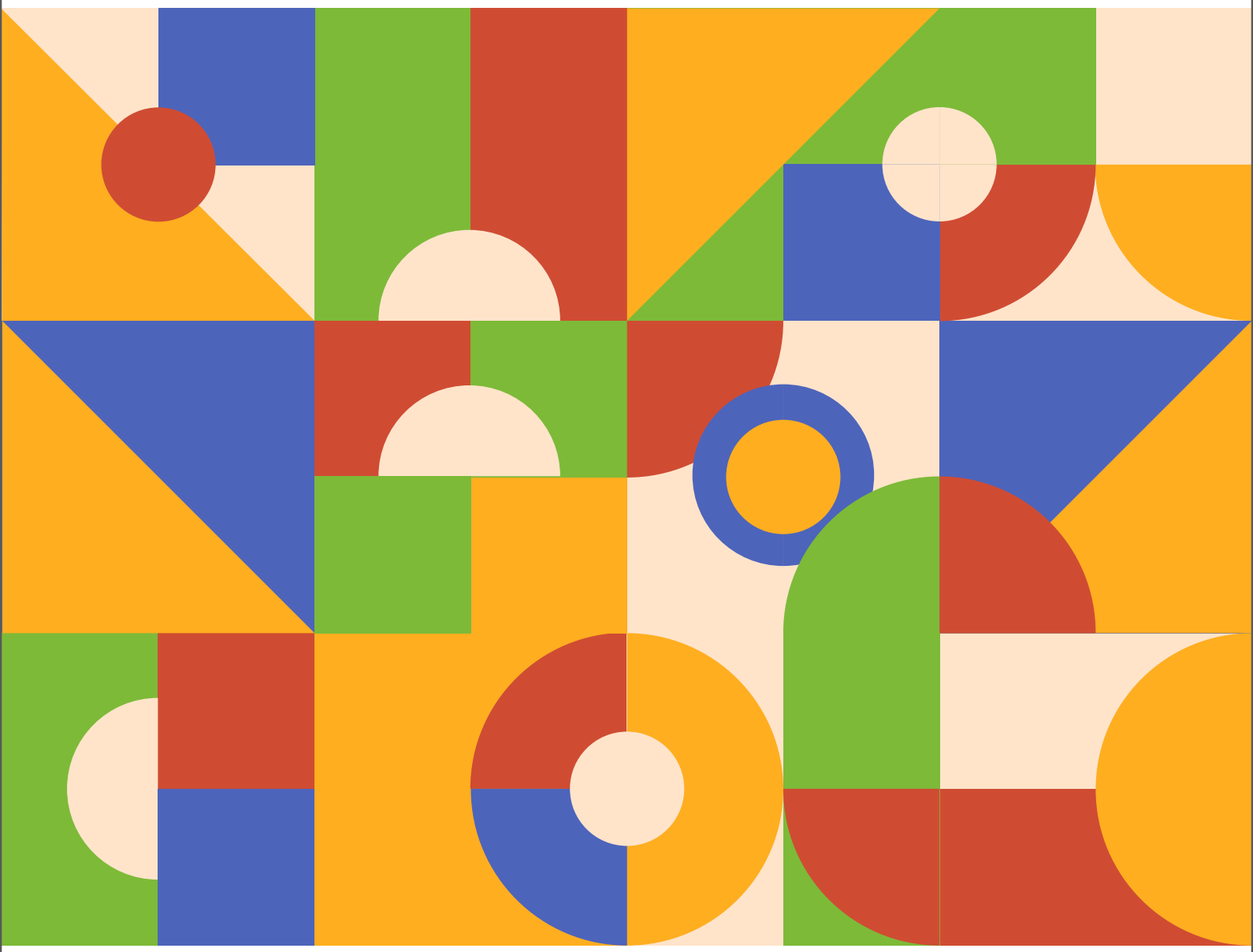

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About Interwoven

Interwoven, Navrachana University's peer reviewed interdisciplinary journal, weaves together a wide range of ideas to offer a layered mosaic of scholarly work. Peer reviewed journals are essential for academic work as they bring new rigor to make corrections and also a completely new perspective to the proposed idea.

Interwoven offers a platform to present scholarly articles that are disciplinary and non-disciplinary, and engage in a rich academic discourse. Non-disciplinary articles, because of their generalistic content provide a means for all readers to find a common ground to connect and get involved regardless of their expertise. Disciplinary work, on the other hand, is presented in a form that non-disciplinary readers can read, understand and participate in an academic discourse to reflect, reinvent and expand traditional disciplinary boundaries.

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Interwoven is a double blind peer reviewed interdisciplinary journal of Navrachana University, published online biannually. The journal covers inherently general topics as well as specialized topics written for readers from wide backgrounds. The effort is to build a strong interdisciplinary academic and research culture in the society.

Regarding review process, there is a strong criteria established for an article to be considered for revision, acceptance or rejection. Every article undergoes check for Plagiarism. Each article is reviewed by three referees.

Interwoven has been granted an e-ISSN number (2581-9275). We strongly encourage faculty, scientists, postdoctoral fellows and research scholars to contribute their scholarly work in the form of research articles, review articles, perspectives, critiques, book reviews and articles in social research. We look forward to expand our authors and readers network and set a benchmark in the process of growth for students, faculty, University and the society at large by spreading awareness about various knowledge domains. We also encourage undergraduate and postgraduate students involved in dissertation work to write journal articles and promote new research ideas to expand their vision beyond standard academic curriculum.

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Volume - 4

Issue - 1

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A Perspective on Geometric Pedagogy for Secondary School Students in a Virtual Classroom

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Abstract

We were encouraged to write this article after observing closely a group of students in standard IX, taking the online lessons in Geometry, due to the closure of schools in the Covid-19 pandemic. It was evident from their body language that the diligent efforts of the teacher were not sufficient to grab their attention. Diving deeper, we found that the topics in Geometry involved construction, which relied heavily on explaining the steps by doing them physically in the classroom. To address this and similar issues, we have proposed a pedagogy with an objective to create an interactive environment in virtual geometry classes, where the mathematical concepts and the steps of construction are taught with the traditional methods blended with modern graphic software tools.

Keywords

Geometry, pedagogy, interactive environment

Introduction

Presently many schools across the world are closed as a precautionary measure against the spread of Covid-19 pandemic. The age-old method of classroom teaching has been subsequently shifted to online education, which is a new way of teaching-learning for the instructors as well as the students. Many school children are seriously affected by this sudden shift, whereas their instructors are struggling to find innovative methods of engaging them as

effectively as in classroom teaching. But, as we all know that online education is imposing serious challenges at various levels of teaching-learning, a few of them being discussed below:

- Online teaching requires development of innovative teaching strategies and techniques. Instructors need to be tech savvy to promptly shift to online mode of teaching from the traditional classroom education.
- It is challenging for any subject instructor to grab the attention of students on the computer screen and also to keep them actively engaged for the entire duration of these virtual classes. Also, different courses require different levels of engagements, and hence teaching needs to be customized as per the requirements of the subject.
- Considering the emotional state of students is also very important in online teaching, particularly during such unprecedented times, when many families are in distress due to economic, health and other issues. Children are also affected seriously due to the prolonged lockdowns and pandemic related effects on their families.
- Identifying the slow learners and giving individual attention to students who need extra help may be difficult in virtual classrooms.

Although most of the issues discussed above have evolved as effects of the ongoing pandemic and are difficult to address, but they also provide food for the thought of coming up with innovative ideas at various social, economic, or educational platforms for future use. From our perspective, the present situation also encourages us to modify our age-old methods of teaching to be blended with modern software tools, giving more freedom for experimentation to the students. Playing around with the ideas and learning by exploring is far more engaging than accepting the textbook concepts as absolute truth, as is expected in traditional classroom teachings.

In this manuscript, we present our perspective on the method of teaching geometrical concepts to secondary school students in online mode. Geometry is a science which encompasses a collection of abstract statements and proofs of these statements[1]. Studies in Geometry constitute an inexhaustible source of ideas for developing logical and creative thinking[2]. Practical problems ranging from designing a city, measuring the earth to using shadows to tell time, led to the development of this branch of mathematics[3]. Secondary school students need to have a wide variation of foundational knowledge in Geometry as the building blocks for their respective fields of choice in future. They require a more personalized approach to learn

topics like Practical Geometry, which is a blend of abstract mathematical ideas and their applications to the real world. We closely analyzed the methodologies used by teachers to deliver the topics in the areas of practical mathematics and concluded that it was really difficult to deliver both the problem-solving techniques and the abstract mathematical concepts simultaneously, particularly in online mode. In this regard, we tried to develop a blended approach to make the teaching of practical mathematics in virtual environments more effective, which can also be carried forward in regular classroom teaching later.

Drawbacks in online teaching

- As instructors are teaching remotely, necessary infrastructure like blackboards are usually not present or are difficult to install. They have to depend more on verbal communication instead of figures/graphs/drawings etc. to enhance the learning. Although power point presentations have replaced the blackboard usage, but it has been observed that it allows passive learning in students and a majority of them end up with reduced attention span in the lecture.
- 3D software for giving real time perspective of geometrical shapes is not shown or linked with the mathematical ideas. Incorporating such software requires time and training for the instructor, hence is not an easy task for them.
- There is no eye contact between instructor and student, because of the virtual classrooms. As a result, it becomes impossible to judge the engagement of the students during the class hours. The disengaged students start inappropriate usage of the electronic gadgets.

First, we discuss some preliminary suggestions which are expected to bring interactive and exploratory learning in virtual classrooms, also appropriate for teaching subjects other than mathematics.

Primary Suggestions: These suggestions can be implemented in the virtual classrooms of mathematics and can be modified as per the requirements of teaching other subjects to ensure a conducive environment for learning.

Assumption: Classroom session is of 40 minutes; Maximum classroom strength is 40.

- Putting students together in groups of 6 to 7 students enhances collaborative efforts and creates good interactive learning environment. The assignments can be designed in such a way that students need to interact with each other for solving. They are benefitted by the peer effect of learning and multiple ways of problem solving. This also makes students feel that they are not isolated in a virtual environment.
- Letting one of the groups present the contents of the previous lecture in the first few minutes of the class and giving some time to the other students to raise questions. This reinforces their learning and increases their alertness in class.
- Leading students through real world examples in mathematics and creating attractive visual effects by using different colors for different sets of parallel lines, angles or shapes gives more clarity. Integrating each lesson with short videos on topics like construction of angles or quadrilateral help the students to move along and continue the construction activity. Instructors may share these videos with students through e-mail for their later reference.
- Dynamic geometry software tools allow for exploration in geometric studies. For example, a teacher can ask students to explore how a particular quadrilateral behaves when one of its vertices is dragged and this question is one that cannot be posed in a paper-pencil environment[4]. In fact, playing around with the dimensions, rotation, magnification, etc. of the shapes and figures are possible while using these software tools, which is very important in conceptual understanding of the subject.

Some of the free and easily available software tools to teach Geometry are Geo Gebra, Geometry pad, Shapes 3D, Desmos etc. Instructors need to download and install these software tools from the internet on their computers or smart phones.

We give the following sample problem containing construction work. We also give screenshots which demonstrate the geometrical construction work using Desmos software geometry tool. This software tool is great for teaching geometry and offers a graphing calculator that can be used by students. It allows the instructors to monitor and share student work. It is even accessible for visually impaired students.

This Sample Problem is selected from the topic ‘Number Systems’ whose solution contains geometrical construction work. The abstractness of the dense packing of rational and irrational numbers in the real number system is very difficult to visualize, particularly for a student who

has just begin to learn mathematics as a concept rather than a tool to manipulate real world observations. Constructing the beautiful spiral of circles with irrational numbers as radii and their intersection with the real line gives the idea that the irrational numbers are densely packed within the real line. To begin with we give a brief introduction to the real number system.

Mathematically, a number is called a rational number, if it can be written in the form $\frac{p}{q}$, where p and q are integers and q≠0 and is called an irrational number if it cannot be written in the form $\frac{p}{q}$. Now in real sense, the rational numbers include whole numbers, terminating and recurring decimal numbers whereas the irrational numbers are non-terminating and non-recurring decimal numbers, for example 1.010010001…is an irrational number. The collection of all rational numbers and irrational numbers together make up what we call the real numbers, denoted by R. Therefore, a real number is either rational or irrational. Also, every real number is represented by a unique point on the number line and vice versa.

Sample Problem: Show how the irrational number $\sqrt{5}$ can be represented on the number line

Solution: The following steps of construction in the solution of the above problem is shown in Figures 1 and 2.

1. On the number line, choose points A = 0 and B = 1. Now line segment AB is of unit length. Construct BC of unit length perpendicular to AB. Join the points A and C to get a right triangle ABC. Using the Pythagoras theorem, we see that AC = $\sqrt{1^2 + 1^2}$= $\sqrt{2}$.
2. Construct CD of unit length perpendicular to AC. Join A and D to get a right triangle ACD. Now using Pythagoras theorem, the length of hypotenuse, AD= $\sqrt{\left(\sqrt{2}\right)^2 + 1^2}$ = $\sqrt{3}$
3. Again, construct DE of unit length perpendicular to AD and join AE to get a right triangle. Similarly, as in the above steps we get, AE = $\sqrt{(\sqrt{3})^2 + 1^2}$ = $\sqrt{4}$. Continuing the similar procedure by constructing EF of unit length perpendicular to AE and joining AF, we get AF = $\sqrt{(\sqrt{4})^2 + 1^2}$ = $\sqrt{5}$.

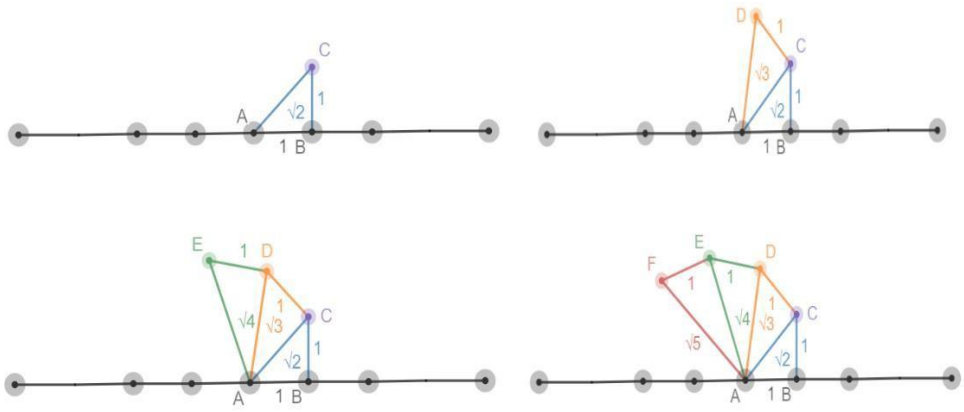

Figure 1: Steps of the solution

4. Using a compass, with centre A and radius AF, draw an arc which intersects the right side of the number line at a point which represents $\sqrt{5}$.

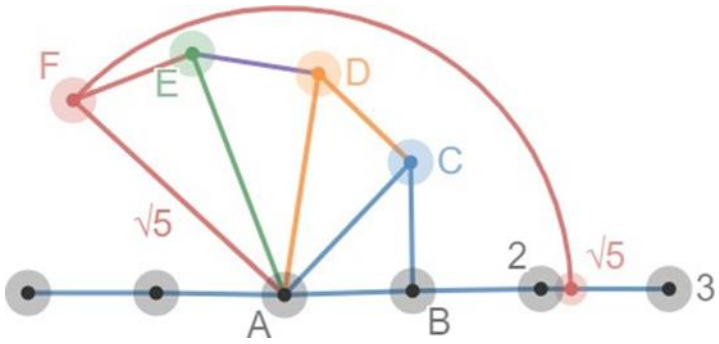

Figure 2: Representation of an irrational number $\sqrt{5}$ on number line

Square root spiral: The following Figure 3 shows a beautiful spiral depicting $\sqrt{2}, \sqrt{3}, \sqrt{4}, \ldots$ and their representation on the number line.

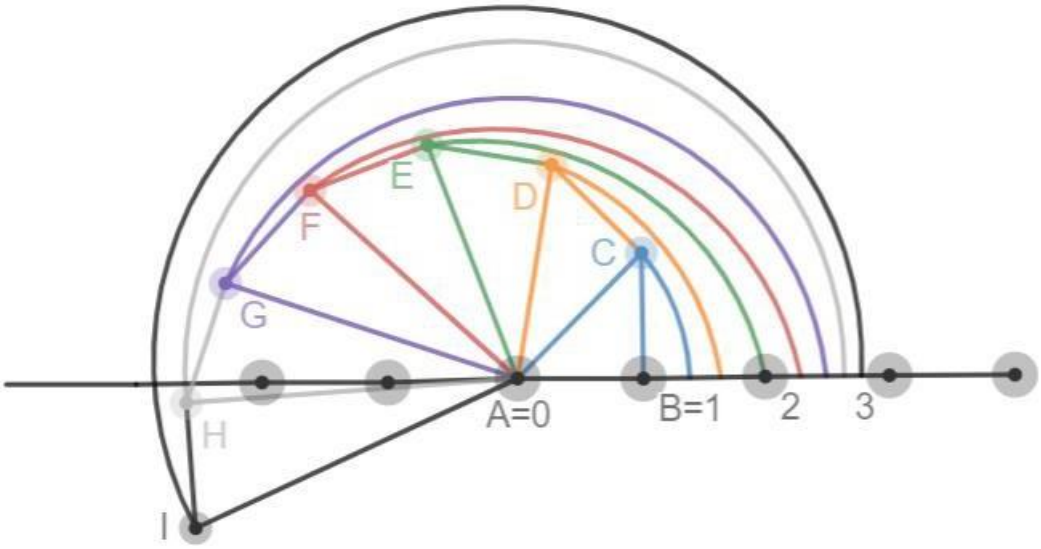

Figure 3: Square root spiral

The following table demonstrates different irrational numbers in the above Figure 3 with their respective colours of arcs on number line.

Irrational number	Color of arc
√2	Blue
√3	Orange
√4	Green
√5	Red
√6	Violet
√7	Grey
√8	Black

Table 1: Irrational Numbers and Colour of Arcs

The above construction helps the students to internalize some very important features of the number line, representing the set of real numbers R, which are discussed as below:

- Well Ordered property of the real numbers, i.e. given any two real numbers x and y, one and only one of the following is true: $(i) x < y (ii) x = y (iii) x > y$. The real line is ordered from left to right, meaning while comparing any two numbers, we know that the number on the right is bigger. Thus, for square roots, it can be seen very easily seen that $2 = \sqrt{4} > \sqrt{3} > \sqrt{2} > \sqrt{1} = 1$ [Fig.3] or we can say that if

$n > m$. we have $\sqrt{n} > \sqrt{m}$.

- Denseness of the set of rational numbers and set of irrational numbers, i.e., the numbers in the number line are not isolated points but are densely packed in it. More specifically, we can say that there is no next real number in the real line. From the definition of irrational numbers, we know that irrational numbers are non-terminating and non-recurring decimal numbers, say for example $\sqrt{2} = 1.4142135$ ..... and $\sqrt{3} = 1.73205080$ .....Now, we can find an infinite number of rational numbers between these two numbers such as 1.5, 1.51, 1.511, 1.5111,…..Similarly, between any two rational numbers, say 1 and 2, we can find an infinite or rather uncountable number of irrational numbers say $\sqrt{2}$, $\sqrt{2.1}$,$\sqrt{2.11}$,…..and so on. Visualization of this concept with the software tools helps them to understand the abstract concepts of limiting values of functions, continuity, and differentiability to a greater extent in further studies.

Hence, we see that the abstractness in the mathematics can be reduced by adding visualization with software tools in online as well as classroom teachings. This will add a great value to the mathematical understanding of the students and applying it for studying the infinitesimally small to infinitely large objects in the Universe, recognize patterns around them and many such things in their respective courses.

The following is the link for the video of the above construction which we have prepared and uploaded on YouTube: https://youtu.be/jlatb0MK_NA

Also, we discuss about another problem in Geometric constructions in Mathematics with the help of Desmos Software. The standard method of constructing the angle bisectors can be demonstrated with the help of the software, which is very easily grasped by the students, even in virtual mode of teaching. The link for the lecture is: https://youtu.be/YG6UUwqwwUs

We have made an effort to get feedback for the video lecture containing the solution of the Sample problems from a teacher Ms.Tannvi Trivedi, presently teaching Mathematics to class IX students and from a group of randomly selected class IX students. Ms. Trivedi has found this software tool to be useful for explaining the problems involving construction in Geometry.

The Feedback of a Group of Class IX students is as follows:

- Venkata Sai Sachin, Class IX: The video was excellent. I understood the concept of representation of irrational numbers and got all my doubts cleared.
- Dutt Parmar, Class IX: The video was great, and the way of teaching was also great. Now representation of irrational numbers on number line is clear to me.
- ShauryaThaplyal, Class IX: This was really a great knowledge and easier way to do a very important topic. This will really help me. Great work and thank you for the effort.
- Neel Shah, Class IX: This video gave a clear understanding of how $\sqrt{5}$ is represented on number line. Also, more videos of this kind can be very helpful.
- Parth Dighe, Class IX: I liked this video very much. Clear concept. Depiction is good. Points are explained very clearly.
- Monit, Class IX: This video is very useful as the Number systems topic is quite difficult. But with this video all my doubts about representation of irrational numbers are cleared.

Conclusion

The world as we know has changed irreversibly with Covid-19. Virtual classrooms are now the de-facto mode of teaching in schools and colleges. Without visualization of the mathematical models, students would not be able to comprehend the intricacies of the subject and learning may become mechanical with the routine problem-solving approach. Traditionally, the geometrical problems were taught using black board and wooden geometrical tools. However, in the online teaching scenario, teachers are mostly teaching remotely and do not have access to the earlier tools they were familiar with. In this situation, software technology tools can be of great help and can even be incorporated with regular classroom teaching after pandemic is over. Necessary software tools are available for instructors on internet, free of cost and are very easy to learn without any requirement of formal training.

A good fundamental knowledge of the subject at an early stage in student life will make it easy for them to understand the advanced knowledge of the related subjects as they progress.

We hope that our perspective encourages the instructors to think and work in the direction of modifying the age-old teaching methods for those branches of science which are complex and needs visualization for effective understanding of the nuances of the subject. For further readings, we suggest the following literature, which we found extremely valuable towards developing this manuscript.

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A Study on Evolution of Models Measuring Entrepreneurial Intention

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Abstract

Over the years, the studies in the domain on Entrepreneurship have evolved from discussing traits and demographic variables to intentions in determining entrepreneurial behaviour. The current study focuses on evolution of entrepreneurial intention as the closest predictor of entrepreneurial behaviour. The various entrepreneurial intention models are discussed and their antecedents are compared and contrasted. The systematic appraisal of all entrepreneurial intention models revealed that entrepreneurial self-efficacy is the best pre-dominant construct influencing entrepreneurial intention. The construct is ubiquitous in the majority of the models proposing the need for a scientific tool for measuring self-efficacy for the appropriate measure of entrepreneurial behaviour.

Keywords

Entrepreneurship, Entrepreneurial behaviour, Entrepreneurial intention, Self-efficacy

Introduction

The positive impact of entrepreneurship on generating employment, fostering growth, and providing an innovative solution to crucial problems of the economy has drawn the interest of the government in promoting entrepreneurship aggressively. This is mirrored by varied initiatives and schemes of government to foster entrepreneurship like the Start-up India initiative, Atal Innovation Mission, Student Start-up and Innovation Policy, and many more. New Education policy also emphasizes exposing the students to entrepreneurship as a major

career options. Most of the universities across the country are offering compulsory or elective courses on Entrepreneurship. Also, government-aided, as well as private incubators across the nation are promoting and nurturing new ideas and businesses. Currently, India is considered the third-largest start-up ecosystem in the world with more than 55000 start-ups, this is expected to surge to more than 100000 start-ups by 2025[1].

The conclusive success of entrepreneurship initiatives can be appraised through new venture creation, but these initiatives may not lead to immediate venture creation. This has encouraged the academic interest in understanding the pre-determinants of entrepreneurial decisions and actions. The following sections of the paper deliberate and debates the antecedents of entrepreneurial actions used for measuring entrepreneurial behaviour over the years.

The major advancement in Measuring Entrepreneurial Behaviour

The early literature of the 19th and 20th centuries advocates that the decision of pursuing entrepreneurship is primarily dependent on the traits of the individuals. Individuals possessing certain traits like the need for achievement [2,3]; risk-taking capability [2,4]; internal locus of control [4,5]; tolerance of ambiguity[3]; pro-activeness[6] etc. are expected to exhibit the entrepreneurial behavior.

Another set of studies focuses on demographic factors like gender, age, family background, education, prior experience[6,7,8]as the major contributors to the entrepreneurial choice of the individuals. However, largely it is agreed that entrepreneurial behavior is much more complex to be simply predicted with demographic variables like age, gender, family background, etc.[9]. Both, personality theory and demography served as the major approaches in the study of entrepreneurship decision making for a long time.

In 1989, Gartner strongly suggested that the focus of entrepreneurship research should shift from entrepreneurial traits to organizational emergence[10]. The personality traits approach for measuring entrepreneurship quotient was not developed specifically for the field of entrepreneurship but rather was borrowed from psychology. Researchers also found that most of the traits considered in entrepreneurship research, were common to any successful person, not necessarily an entrepreneur, and proclaimed that mere presence of these traits cannot be considered as determinants to choosing an entrepreneurial career[9,10,11,12,13]. The shortcomings

of personality and demographic approaches in predicting entrepreneurial behaviour stimulated the need for developing new paradigms to predict entrepreneurial behaviour. As a consequence, entrepreneurial intention emerged as the alternative approach for measuring entrepreneurial behaviour. This approach had the capability for considering new constructs for measuring entrepreneurial behaviour and at the same time also incorporating the important and relevant personal characteristics.

Barbara Bird in 1988 proposed that entrepreneurial intention strongly determines the action of the entrepreneur towards new venture creation even to the extent of subsequent organizational outcomes like survival, development, growth, and changes[14]. Intentions depend upon the situation as well as the person and hence can be a better predictor of behavior as compared to person or situation individually. Intentions are considered to be the best predictor of any planned behavior and as entrepreneurship is a planned behavior, various studies consequently found intention as a major determinant of entrepreneurial behavior[12,15,16,17]. Intention refers to the state of mind directing a person's attention, action, and experience towards a specific goal to achieve some means. The intention is a function of belief that forms the attitude and finally determines behavior as suggested by Fishbein & Ajzen in 1975in their Theory of Reasoned Action[18]. Their theory suggests the following linear path of beliefs transforming to actions:

Beliefs —> Attitudes —> Intentions —» Behavior

Following the significance of entrepreneurial intention in predicting entrepreneurial behaviour, various intention models have been proposed since the late 20th century. The next section of the paper deliberates on these intention models.

Discussion and comparison of Entrepreneurial Intention Models

Some of the notable intention-based models in the literature are Social Learning Theory, Self-efficacy Theory, Sokol's model of the entrepreneurial event (SEE), Bird's Intention model, Ajzen's Theory of Planned Behaviour (TPB), Entrepreneurial Potential Model, Entrepreneurial Intention Model, etc. The following section discusses the evolution of intention models applied for measuring entrepreneurial intention over the years.

i. Social Learning Theory (1977):

The social learning proposes that the behavior is roughly planned before it is performed. It suggests psychological functioning as the interplay of inner forces and controlling behavior.

Accordingly, human behavior is a combination of stimulus, cognitive skills, and reinforcement control. Behavioral patterns of the people are formed as a result of learning from direct experiences as well as learning from observing the behavior of other people (modelling). The cognitive skills of an individual determine what he/she learns from his own experience and experiences of others and how it influences his/her future actions. Reinforcement also plays a critical role in forming the behavior of an individual. People tend to discard the actions which are unrewarding and frequently perform those which are positively rewarded. There is a continuous interaction between the behavior and the three controlling factors of behavior i.e. stimulus, cognitive skills, and reinforcement that determine the actions of an individual[19].

ii. Self-efficacy Theory (1977):

As an extension to Social Learning Theory which proposed that cognitive processes are primarily responsible for the acquisition and retention of new behavior, Self-efficacy theory elaborated on these cognitive processes. According to it, the two cognitive activities that predominantly motivate an individual to behave in a particular manner include the cognitive ability to foresee the rewarding or punishing outcome of the current behavior (outcome expectancy) and self-evaluation of an individual to be able to perform a particular behavior (self-efficacy).

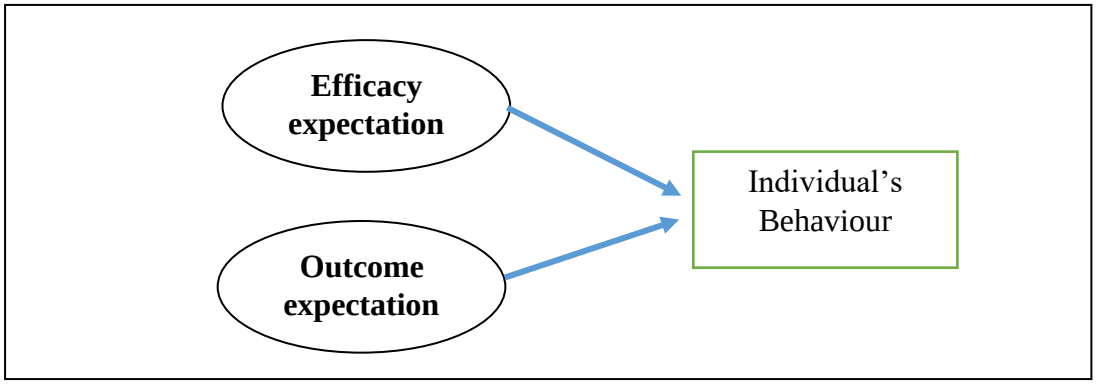

Figure 1: Self-Efficacy Theory[20]

According to this theory, self-efficacy is the primary influencer of the behavior of an individual. It not only determines the choice of activity, but also the amount of effort and their persistence in the difficult situation faced during performing the selected action.

Self-efficacy theory states that the level and strength of self-efficacy can be enhanced through psychological procedures.

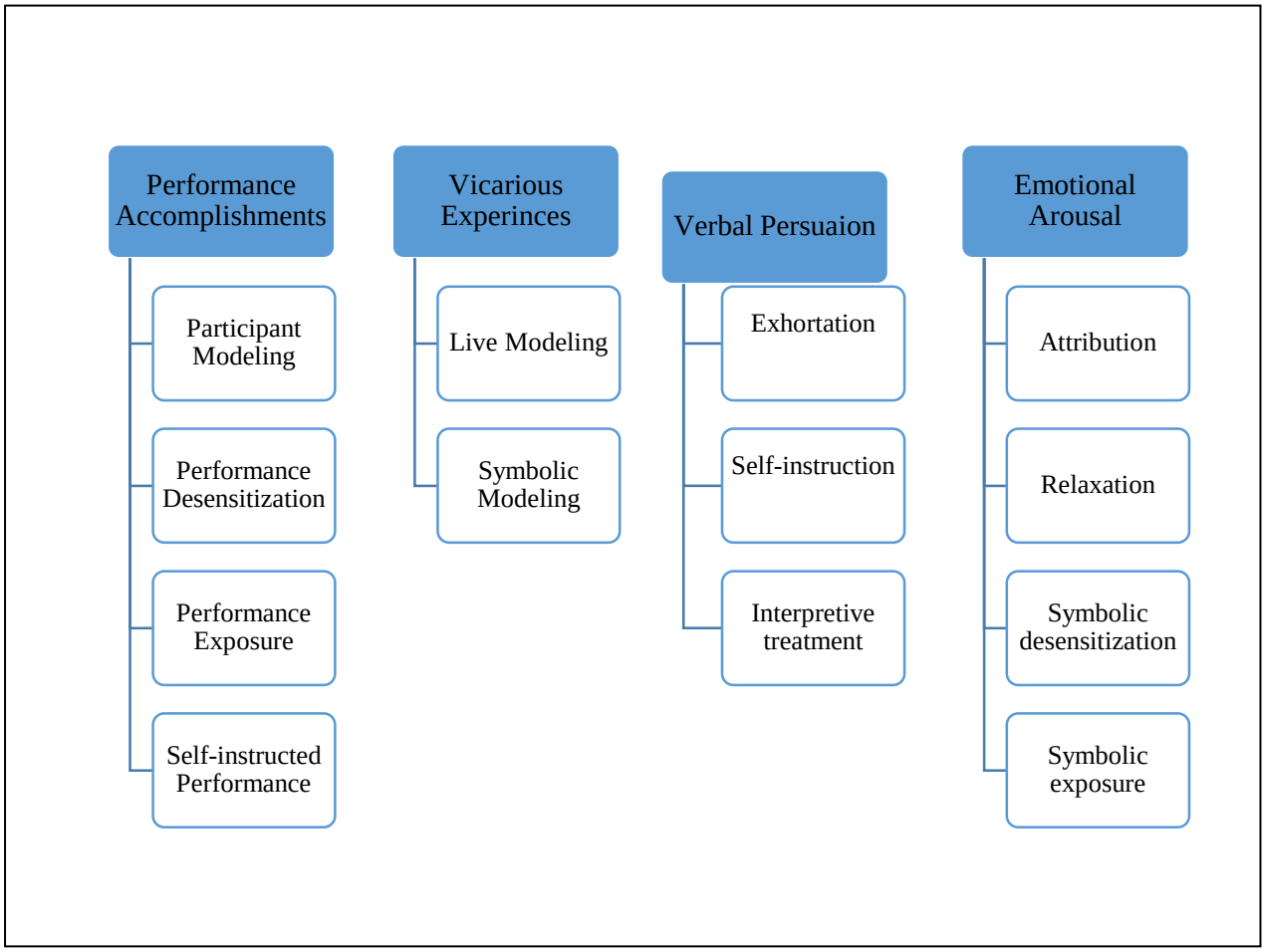

Figure 2: Sources of Self-Efficacy[20]

The theory proposes four cues i.e. performance accomplishments, vicarious experience, verbal persuasion, and physiological states are the major determinants of self-efficacy[20]. Figure 2 provides the diagrammatic representation of four main sources of self-efficacy and their sub-components.

iii. Shapero's Entrepreneurial Event (SEE) Theory (1982)

SEE theory proposed by Shapero & Sokol in 1982, is considered to be the first model that specifically focuses on entrepreneurial intention and behavior[21]. According to this theory, entrepreneurial intention is a function of perceived feasibility, personal desirability, and propensity to act. It gives significant importance to the perception of the individual towards attractiveness (perceived desirability) and towards his/her capability of starting a venture(perceived feasibility). Of the three factors contributing to the intention, perceived feasibility has been found to have the highest predicting power. Perceived feasibility and perceived desirability in turn is influenced by prior entrepreneurial experience. Kruegerempirically tested the SEE model and even examined the different path models including the direct impact of prior exposure on entrepreneurial intention. It was found a significant impact of prior experience on intention is mediated through perceived feasibility as suggested by SEE and positive prior experience also influence intention by impacting perceived desirability[22].

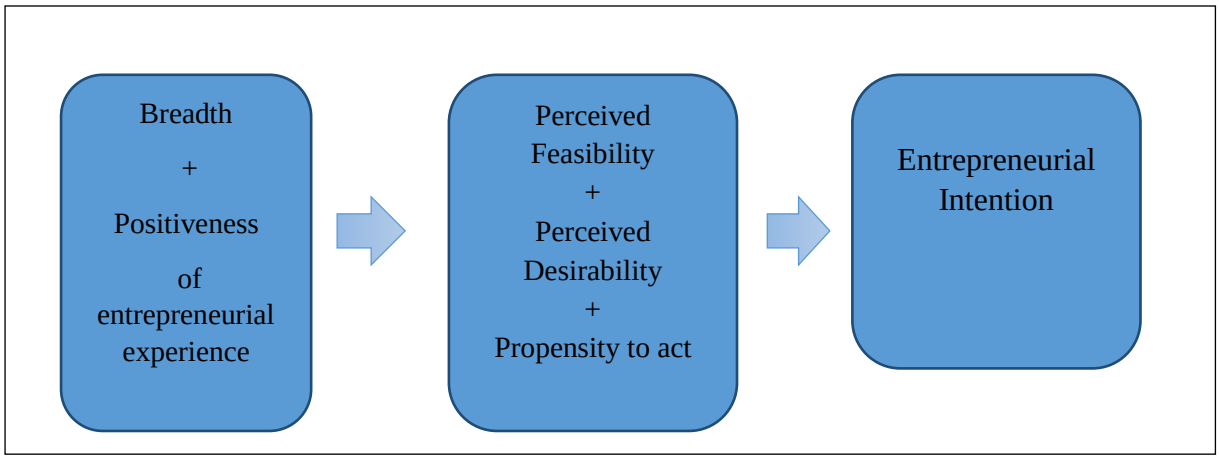

Figure 3: Shapero-Sokol Model of Entrepreneurial Event[21]

iv. Theory of Planned Behavior (1985)

The theory of planned behavior proposed by Ajzen is an extension of the Theory of Reasoned Action. It proposes that the intention is formed based on attitude towards behavior, subjective norms, and perceived behavioral control. Attitude refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behavior in question. Subjective norm refers to the perceived social pressure to perform or not to perform the behavior and whether people will approve of the particular behavior. Perceived behavioral control refers to

the perceived ease or difficulty of performing the behavior based on the experience, anticipated future obstacles, availability of plan of action, and general self-knowledge[23]. Perceived behavioral control is almost synonymous with the concept of self-efficacy proposed by Bandura in 1977. It also empirically established the relationship between perceived control and behavioral performance. A study based on the Theory of Planned Behavior by Ajzenin 1991 advocatedthe predictive ability of perceived behavioral control along with the intention towards the behavior of an individual[24].

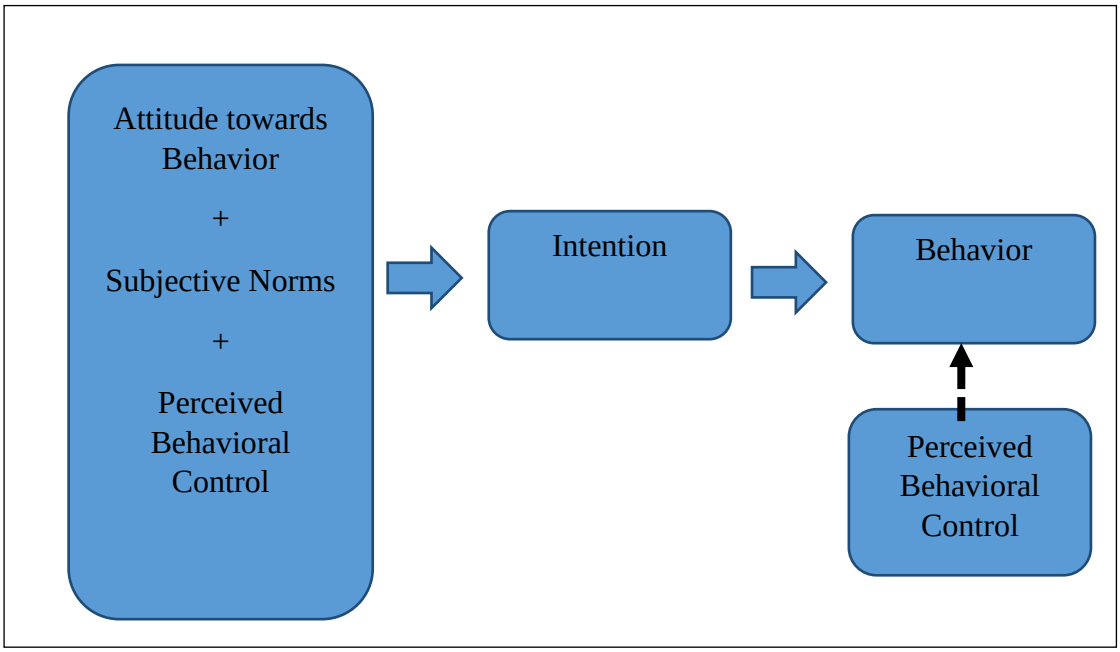

Figure 4: Theory of Planned Behavior[23]

v. Bird's Entrepreneurial Intention Model (1988)

Entrepreneurial intention directs the person towards creating a new venture or creating new ideas within the existing venture. Bird in 1988proposed a framework of Entrepreneurial Intention as interplay rational and intuitive thinking derived from personal and social context (illustrated in Figure 5). The personal factors include prior experience, personality characteristics like locus of control, and abilities like promoting ideas whereas contextual factors affecting the intention include social, economic, and political factors like government regulation, economic scenario, etc. The rational thinking of an individual is framed based upon factors like resource availability, idea feasibility, opportunity analysis whereas intuitive and holistic thinking is influenced by gut feeling and a hunch about the potential of the idea[14].

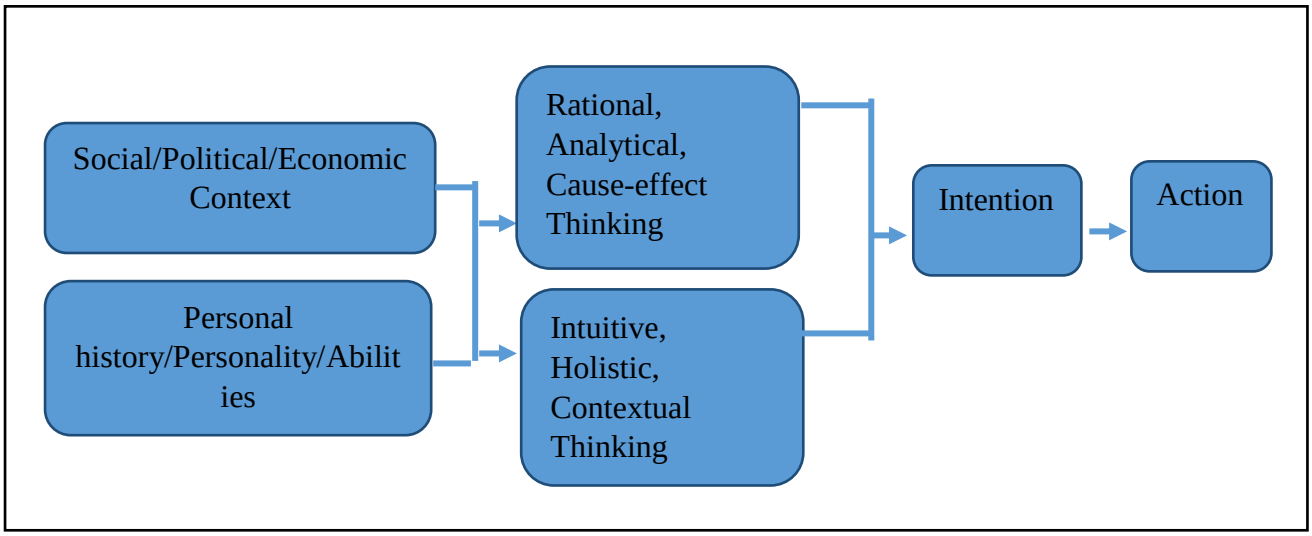

Figure 5: The contexts of intentionality[14]

v. Entrepreneurship Attitude Orientation (EAO) Model (1991)

Robinson, Stimpson, Huefner & Hunt also proposed a model to predict entrepreneurial behavior beyond demographics and personality traits[9]. Their EAO model recommended four attitude sub-scales based on their wide-spread and repeated reference in studies about entrepreneurship to distinguish entrepreneurs from non-entrepreneurs. The subscales of the proposed model included achievement in business, business innovation, perceived personal control of the business outcome, and perceived self-esteem in business.

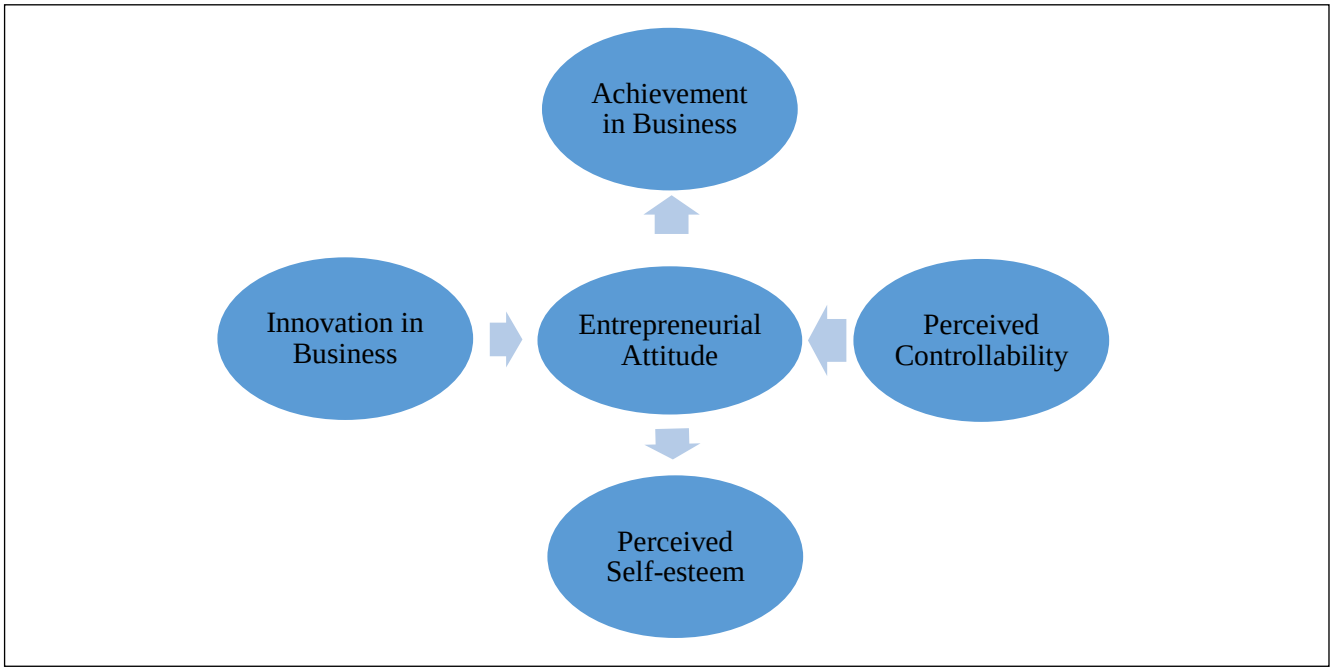

Figure 6: Entrepreneurship Attitude Orientation (EAO) Model[9]

Each of the four attitudinal subscales was measured on three aspects of attitude- cognitive, affect, and conation for entrepreneurs as well as non-entrepreneurs. The construct of perceived personal control refers to the perception of control over one's business and perceived self-esteem pertains to one's confidence and perception about being competent in conjunction with the needs of the business. The results indicated significant differences in the attitude of entrepreneurs' vs non-entrepreneurs on each of the four subscales of attitude validating the significance of EAO. The model is relevant and validated empirically in various consequent studies[25,26,27].

vi. Modified Bird's Model of Entrepreneurial Intention (1994)

Boyd & Vozikis in 1994 proposed that self-efficacy is an important explanatory variable in determining entrepreneurial intention and hence should be integrated into Bird's model of entrepreneurial intention[28]. The significance of self-efficacy in determining the intention was also advocated earlier in Ajzen's Theory of Planned behavior in the form of perceived behavioral control and Shapero and Sokol's SEE theory as Perceived desirability. Theself-efficacy was integrated into Bird's model at two levels; as the precursor to the intention and also as a moderating variable between entrepreneurial intention and entrepreneurial action (illustrated in Figure 7).

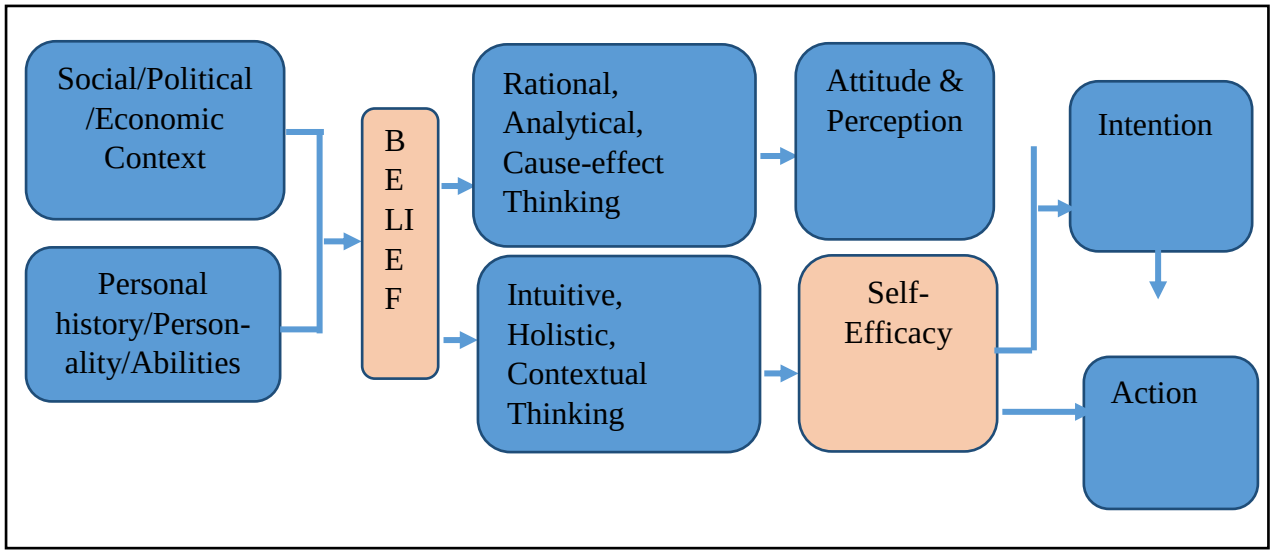

Figure 7: A revised model of Bird's (1988) Contexts of Intentionality[28]

The model suggests that an individual select only those activities and setting which he/she assumes to be capable of based on self-judgment. The model also proposes that not every entrepreneurial intention results in entrepreneurial action. Only when an individual's self-efficacy for the tasks required for entrepreneurial action is high, entrepreneurial intention results in action.

vii. Entrepreneurial Potential Model (1994)

Krueger and Brazeal in 1994 proposed Entrepreneurial Potential model (EPM) which suggests that the potential of the entrepreneur precedes entrepreneurial intention. The preparedness or potential of the entrepreneur, in turn, is determined by the constructs proposed in SEE i.e. perceived feasibility, perceived desirability, and propensity to act. It further advocated the robustness of Shapero's model and regarded feasibility perceptions (self-efficacy) as the major contributor to explaining intention[29]. The model was empirically validated by various researchers [30,31,32].

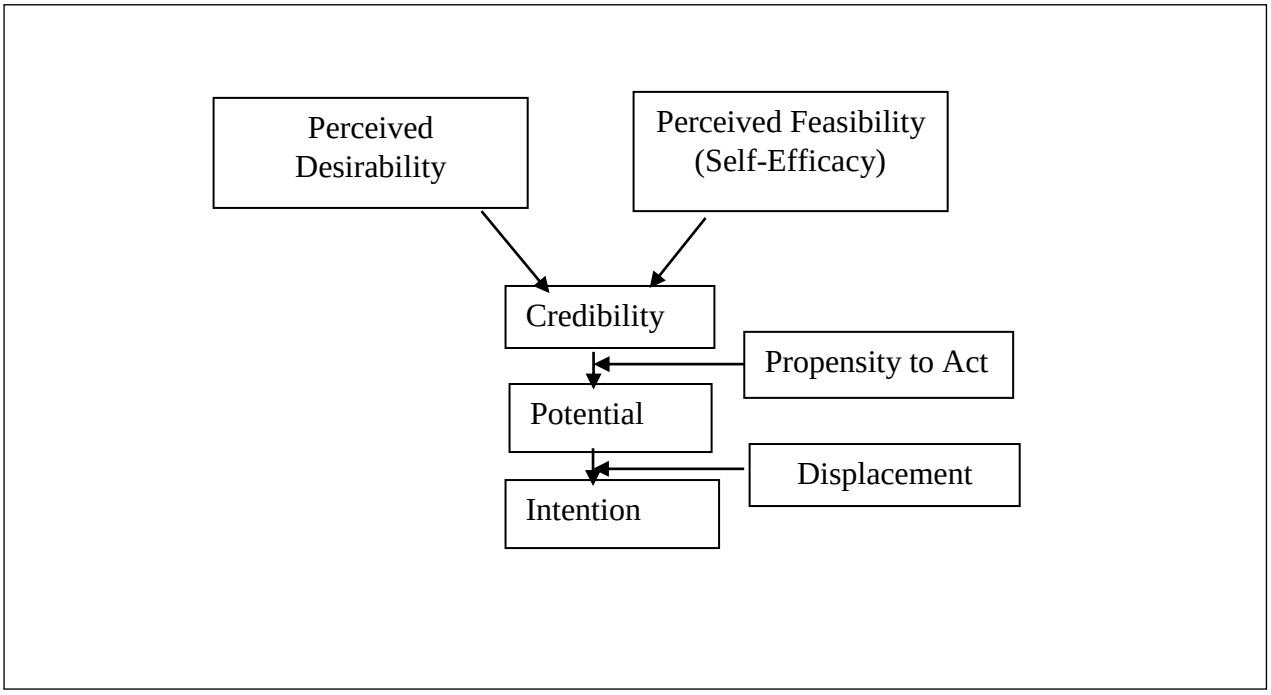

Figure 8: Entrepreneurial Potential Model[29]

viii. Davidsson Model (1995)

Another model for measuring entrepreneurial intention was proposed by Davidsson in 1995[33]. It was considered as the latest model for measuring entrepreneurial intention till 2008[31].Davidsson's model takes into account psycho–economic factors determining entrepreneurial intention. He integrated the already existing determinants from the various theories and models like SEE, TPB, Bird's intention model, Entrepreneurial Potential model and other studies encompassing cultural and structural influences into a single model. According to this model entrepreneurial intention is determined by conviction and situation (i.e. current employment status). Conviction in turn is determined by general attitude (willingness to change, competitiveness, achievement motivation, and need for autonomy) and domain attitude (expected pay off, societal contribution, and perceived know-how). The general and domain attitude are also influenced by personal factors like age, gender, education background, vicarious experience, and radical change experience. Empirical testing of the model revealed the direct or indirect influence of all the variables included in the model but the conviction was found to be the highest influencing variable. Conviction is similar to the concept of self-efficacy proposed by Albert Bandurain 1982[34].

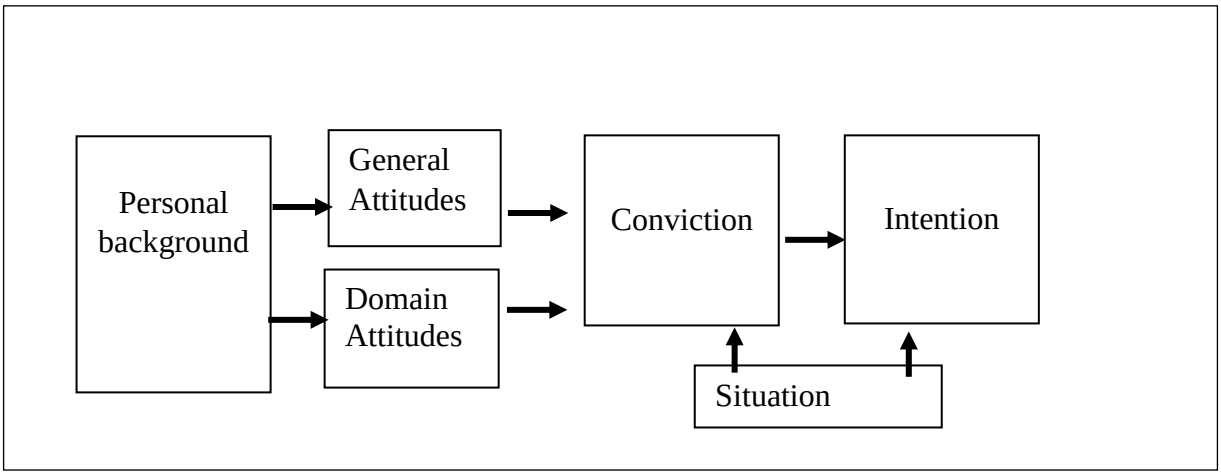

Figure 9: Davidsson Model[33]

ix. Entrepreneurial Intention Model-EIM (2000)

Segal, Borgia & Schoenfeld in 2000 proposed another integrated model for predicting and measuring the entrepreneurial intention based upon the Shapero-Krueger framework and

other economics-based models of entrepreneurial intention. According to this model, the perceived desirability of pursuing entrepreneurship would be based on one's perception of higher valuable outcomes of pursuing entrepreneurship as compared to working for others. The net perceived advantage of self-employment over working for others designated as Perceived Net Desirability of self-employment would be one of the determinants of entrepreneurial intention. Another important modification in the model proposed by them was based on the rationale that an individual's propensity to act entrepreneurially will be highly dependent on his/her willingness to take calculated risks[35]. Figure 12 represents the EIM

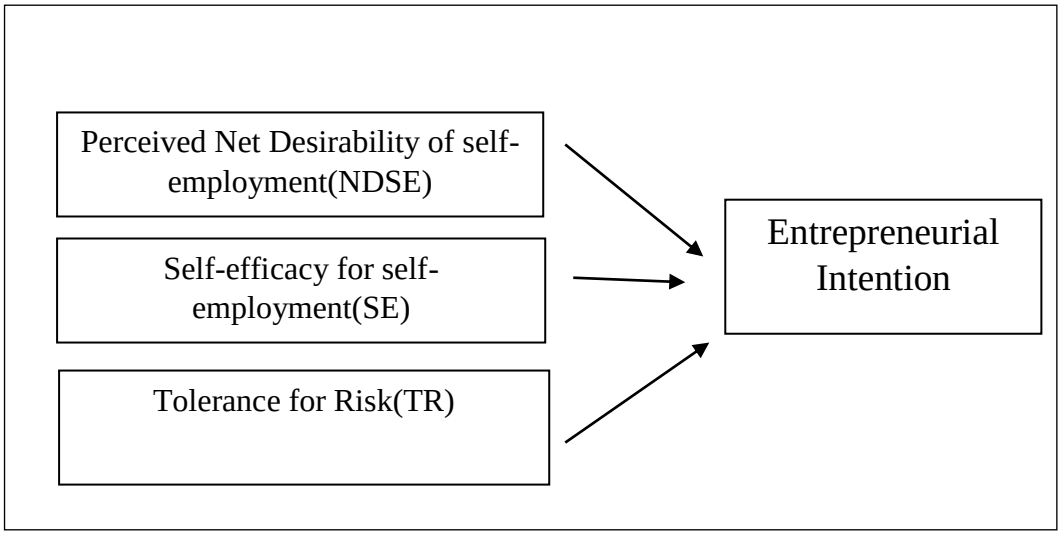

Figure 10: Entrepreneurial Intention Model[35]

x. Extended Models

a) Extension of Systemic Entrepreneurship Intention Model-SEIM-(2019)

Díez-Echavarría, Valencia, Bermúdez-Hernández, Orlando, Lucelly & Adolfo in 2019 proposed an extension of EIM including new constructs for determining entrepreneurial intention. The proposed model suggested additional constructs of entrepreneurial behavior and personal attitude to be incorporated along with the existing determinants[36].

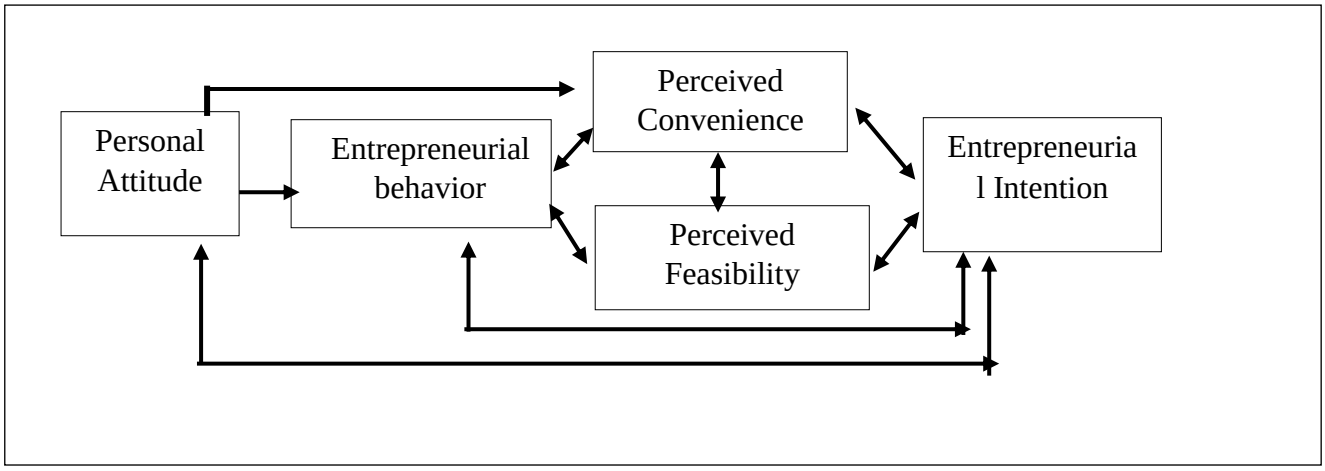

Figure 11: Extension of Systemic Entrepreneurship Intention Model-SEIM-(2019)

b) Hierarchal Model of Perceived Behavioral Control (2002)

Ajzen in 2002 further elaborated on the construct of perceived behavioral control and created a Hierarchal Model of Perceived Behavioral Control. Perceived behavioral control, comprises self-efficacy and controllability. Both are distinguished in the manner that self-efficacy is ease or difficulty in performing a particular action whereas controllability is the extent to which performance of particular action is within the control of an individual. The model also proposed that both self-efficacy and controllability are influenced by factors internal to an individual as well as external factors and some of these factors may overlap in influencing both self-efficacy and controllability[37].

Findings

As intention models are found to demonstrate high predictive ability of consequent entrepreneurial behavior, the entrepreneurial intention and its antecedents appear to be most relevant measures for examining the entrepreneurial behavior of an individual since the actual behavior is a long term phenomenon and hence difficult to observe considering the time-frame of most of the research works.

Various empirical studies have also demonstrated the significant contribution of different variables included across these models in predicting entrepreneurial intention as well as entrepreneurial actions. Souitaris, Zerbinati & Al-Lahamin their study on entrepreneurial intention using TPB found positive correlation of all the three antecedents in the model i.e.

attitude(r=0.42), subjective norms (r=0.53) and perceived behavioural control(r=0.39) with entrepreneurial intention[38]. Another study establishing the significance of Entrepreneurial Potential Model found statistically significant relationship of entrepreneurial intention with perceived desirability and feasibility at 99% confidence level[31].Sanchez in their study on entrepreneurial competency and intention of students in Spain observed positive correlation between like self-efficacy (r=0.44), pro-activeness(r=0.4) and risk(r=0.27) with entrepreneurial intention[39]. Kolvereid in his study on Norwegian students found strong correlation (r=0.598,0.452,0.6) between self-efficacy, attitude and subjective norm with entrepreneurial intention respectively. Moreover, the influence of demographic variables on self-employment choice was also mediated through attitude, subjective norms and perceived self-efficacy[15]. Krueger, Reilly & Carsrud also advocated that the influence of personal and situational factors is mediated through antecedents of entrepreneurial intention rather than directly influencing entrepreneurial intention thereby proposing the significance of studying antecedents of entrepreneurial intention[12].

Table-1 summarizes various antecedents of different entrepreneurial intention models discussed in the previous section to identify the most commonly occurring variables across all models.

Table 1: Comparison of antecedents of entrepreneurial intention in various Entrepreneurial Intention Models

S.No	Author	Year	Model	Variables Included									
				Perceived Feasibility	Perceived Desirability	Attitude	Social Norms	Propensity to Act	Outcome expectation	Perceived Controllability	Personal, Economic, Political Factors	Rational and Intuitive Thinking	Other factors
1	Albert Bandura	1977	Self-efficacy Theory	Efficacy expectation					Outcome expectation				
2	Shapero and Sokol	1982	Shapero Entrepreneurial Event	Perceived Feasibility	Perceived Desirability			Propensity to Act			Prior Entrepreneurial Experience		
3	Ajzen	1985	Theory of Planned Behavior	Perceived behavioral control		Attitude	Social Norms						
4	Bird	1988	Bird's Entrepreneurial Intention Model				Social Factors				Personal, Economic, Political Factors	Rational and Intuitive Thinking	
5	Boyd &Vozikis	1994	Revised Model of Bird's Entrepreneurial Intentionality	Self-efficacy		Attitude	Social Factors				Personal, Economic, Political Factors	Rational and Intuitive Thinking	
6	Robinson, Stimpson, Huefner& Hunt	1991	Entrepreneurial Attitude Orientation	Perceived self-esteem		Attitude				Perceived Controllability	Achievement in business		Innovation in Business
7	Krueger &Brazeal	1994	Entrepreneurial Potential Model	Perceived Feasibility	Perceived Desirability		Social Norms	Propensity to Act			Precipitating Event		

8	Davidsson	1995	Davidsson Model			General and Domain attitude					Age, Experience, Education, Gender		
9	Segal, Borgia & Schoenfeld	2000	Entrepreneur Intention Model	Self-efficacy	Perceived Net Desirability						Tolerance for Risk		
10	Ajzen	2002	Hierarchical Model of Perceived Behavioral Control	Perceived Self-efficacy			Social Factors			Perceived Controllability			
11	Ajzen	2019	Extension of Systemic Entrepreneurship Intention Model (SEIM)	Perceived feasibility	Perceived convenience	Personal Attitude					Risk Tolerance		Entrepreneurial Behavior

The different precursors of entrepreneurial intention as can be identified from Table-1 are:

i. Perceived feasibility
ii. Perceived desirability
iii. Social Norms/factors
iv. Perceived controllability
v. Attitude
vi. Outcome Expectations
vii. Personal factors(Demographic)
viii. Prior entrepreneurial experience
ix. Risk Tolerance
x. Rational and Intuitive thinking
xi. Innovation in business
xii. Economic factors
xiii. Political factors
xiv. Entrepreneurial behavior
xv. Entrepreneurial potential

Among all the antecedents of entrepreneurial intention, entrepreneurial self-efficacy is common across most of the entrepreneurial intention models. It is found to not only directly impact entrepreneurial intention but also moderate the impact of other variables like personal, economic, and political factors on entrepreneurial intention. Krueger, Reilly & Carsud in their empirical study validating the significance of competing models of entrepreneurial intention particularly TPB and SEE, also found that all antecedents were significantly related to entrepreneurial intentions but the entrepreneurial self-efficacy had stronger influence on entrepreneurial intention($p<0.005$) [12]. In another study by Hattab on the Egyptian students, regression analysis revealed that 95% of variation in entrepreneurial intention is attributed by self-efficacy and perceived desirability[40]. Literature suggests that self-efficacy do not only influence the choice of activity but also the effort one puts in any activity as well as the performance. A meta-analysis of 114 studies on self-efficacy by Stajkovic and Luthans found a significant weighted average correlation with r value of 0.38, between self-efficacy and work-related performance[41].

Research Gaps:

To propose a robust model predicting entrepreneurial behaviour, none of the existing research has considered all the constructs derived from various intention models in a single study. A comprehensive model measuring the contribution of all the identified antecedents on entrepreneurial intention will help in establishing the relative significance of each of the precursors of entrepreneurial intention. Further, all the entrepreneurial intention models are

developed in the western context, their application to studies about entrepreneurial intention in India and other developing countries may establish its validity further.

Conclusion:

The comparison of various models for measuring entrepreneurial intention suggests that perceived self-efficacy is the most pre-dominantly occurring antecedent of entrepreneurial intention in most of the intention models.

Various other studies have also empirically established that self-efficacy plays the most critical role in influencing the entrepreneurial intention[12,15,17,29,33, 35,42,43,44,45,46,47,48,49,50]. Zhao, Seibert, and Hills evaluated various models for the prediction of entrepreneurial intention found that the impact of all factors on entrepreneurial intention is fully mediated through self-efficacy. The models proposing the direct influence of education, risk propensity, and gender on the entrepreneurial intention were empirically disproved[51]. High entrepreneurial self-efficacy on the other hand was found to increase the perception of venture feasibility and opportunity[12] thereby not only directing entrepreneurial behavior but also influencing venture growth and success[52].

As perceived entrepreneurial self-efficacy has emerged as the most critical construct for determining entrepreneurial intention and entrepreneurial behaviour, and appropriate measurement of entrepreneurial self-efficacy can play a determining role in entrepreneurial studies. The impact of various interventions for enhancing and promoting entrepreneurial behaviour can be measured through observing the change in entrepreneurial self-efficacy.

Future Direction:

As the research highlights the significance of entrepreneurial self-efficacy in predicting entrepreneurial behaviour, a robust instrument for measuring self-efficacy would play a critical role in the entrepreneurship research domain. The existing instruments of entrepreneurial self-efficacy may be reviewed to analyze the advancement of research in that area and the need for further refinement and adaption of self-efficacy instruments.

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Virtual Classrooms: Challenges handled by the Schools and Muslim Girls in COVID-19 times: A Study of 10 Muslim Managed Schools of Vadodara

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Abstract

The pandemic Covid-19, that the world is facing has terrifying and severe impact which has stunned the entire world, distressing all the sectors of the economy. According to the UNICEF report[1], the coronavirus pandemic will badly affect over 290 million students across 22 countries.

With each passing day, with no direct solution to break the pandemic of Covid-19, the educational sector not only will have a temporary impact on the continuity of education for 285 million[2] Indian students but also will provoke a comprehensive economic and societal consequences. The structure of teaching and learning are very much affected by these closures and lockdowns. To combat with the situation, digital education only seems to be a practical option, till the classrooms recommence, which is initiated by the schools to ensure the continuity of education among the students.

Bearing in mind the participation of students in virtual classes, the participation of female students in Indian context, is limited as compared to the male students, and more precisely the participation of females belonging to the Muslim minority is an issue of concern, where the educational progress of Muslim girls is much lower according to the statistical Census data 2011.

This paper addresses the issues, challenges and measures adopted by the Muslim managed schools in Vadodara city, to support and to ensure continuity of education of Muslim girls studying in their higher secondary classes and the problems encountered by the Muslim girls in attending simulated teaching – learning process.

Keywords

Virtual Classes, Pandemic, digital education, higher secondary

Introduction

Covid-19 pandemic that the entire world is facing today is one of the largest public health risks, which has led its impact over, all the sectors of the country including education. The world saw that the pandemic has affected 185 countries[2] of the world by the period of March 2020. Because of the hit of the pandemic situations, majority of the countries had to momentarily shut down its educational institutions such as schools, colleges and universities. The prolonged shut down of the schools and universities has affected the educational system as a whole. The influence of this shut down and closures of the educational institutions will leave a deep effect among the nations wherein the education as a sector is handling the situations of high dropout rate among its students. This epidemic situation, has called for re-evaluation of our educational system, which demands for a comprehensive and inclusive education system. The situations have also laid down its long-term effect on the social institutions as well, which is a cause for social inequalities. The lockdowns and closures of schools have resulted in increase in dropout rates of girls. According to the Plan India's Executive Director in his interview with the Hindustan Times, published on 13th June ,2020 "The lockdown is burdening girls with household chores and sibling care,"Additionally it was stated thatincrease in dropout rates of girls from schools will also leads to increase in social problems like early marriages and child labor.

Explicitly, focusing on the educational status of Muslim girls, many earlier researches done in this context have portrayed the lower educational status among Muslim girls. Hasan and Menon[3] in their research volume, titled, "Unequal Citizens: A study of Muslim Women in India", the highlights the major problems impacting the lives of Indian Muslim women, the authors says that the Muslim community is of the belief that educating a girl child in the family will not be beneficial to the family. Additionally, the authors write parental attitude among Muslims is a responsible factor, for not sending their daughters for

education, as they are of the belief that it would be difficult for the parents to find a suitable marriage partner for the educated girl.

Recognizing the difficulties in the education of Muslims in India and suggest some recommendation so as to improve the educational status among Muslims, the study by Shazli and Asma[4] points that Muslims in India lag behind in many aspects like education, employment and associate the lack of education as the responsible factor for backwardness among Muslim community. The significant researches[5-9]done in this context, discloses that the cause of the educational backwardness among Muslim females is due to various sociocultural beliefs and practices, gender inequalities, teaching – learning process in schools. Amidst this situation of covid-19, wherein there is a rise of increase in the problems like poverty, unemployment among various families, which has hampered the educational progress of children within these families. On one hand, there is loss of family income for many families, many earning members of the family are searching new ways and means of earning their living, to satisfy the needs of themselves and their dependents, which ultimately has laid down its impact on the educational status of girls, specifically those from Muslim community, where education of girls is yet not considered as primary, In this pandemic situations , many girls have to compromise with their education, they are expected to participate in the household responsibilities and sibling care, because of the closure of schools and on the other hand the educational institutions are trying their best to retain students with the school, ensuring the students do not leave the schools because of financial constraints in the family, using digital platform for conducting online classes so as to keep the academic pace. The government through its policies have instructed the school authorities not to demand for fees from the parents.

The previous research as quoted above on the educational development of Muslim girls is demonstrating the issues such as lack of education and awareness among Muslims; the attitude of parents towards the education of their daughters; as the responsible factors for the lower educational position. Considering these situations, the contemporary paper looks in to the issues and challenges faced by the school authorities to continue their academic work through using digital technology on one hand, while on the other discusses the problems handled by the Muslim girls studying in higher secondary classes in the selected schools for the study.

Objectives of the study

1) To find out the measures adopted by the Muslim managed schools in recommencing the academic work for higher secondary classes in COVID times.
2) To understand the issues faced by Muslim girls in attending virtual classes.
3) To explore the challenges faced by the School authorities to conduct the online classes.

Size of the Sample

For Schools: Using stratified sampling method, the study was undertaken in 10 Muslim managed schools of Vadodara. Further explaining, total number of schools managed by Muslim trusts/ organizations or administrative bodies in Gujarat, the number of Muslim managed schools were stratified, further from the total number of schools, the number of Muslim managed schools with higher secondary section were stratified, which is diagrammatically explained in Figure-1.

For Muslim girls studying in Higher Secondary Classes:

Convenient sampling technique was used to identify the girls, from each school the sample size of 3 girls were chosen, hence in total 30 Muslim girls from 10 selected schools under the study were interviewed.

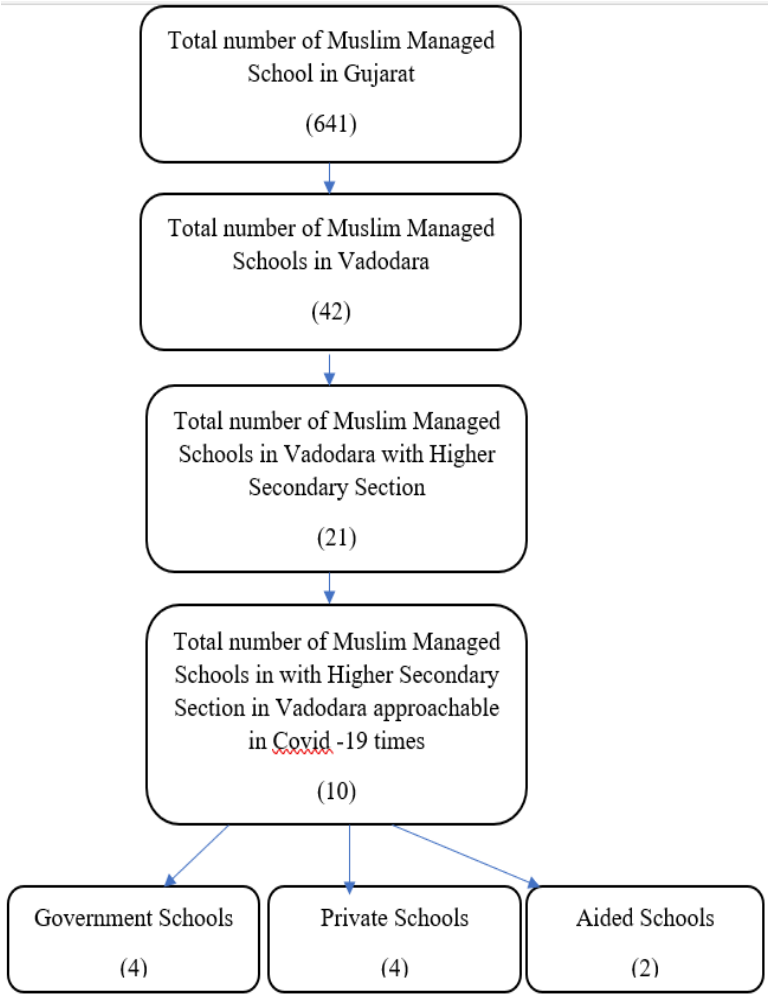

Figure 1:Showing the stratification of the sample

Data Collection tool and process

The researcher had telephonically contacted the head of the schools with prior appointment and informing them about the purpose of data collection, using an unstructured interview schedule with open ended questions. Similarly, the responses from the Muslim girls were also telephonically steered, with their prior consent through convenient sampling.

Duration of the Study:

The collection of information and documenting the case studies were undertaken during the period of March 2020 onwards.

Ethics followed in conducting a research

1) The data shared by the respondents are documented as narrated by them,
2) Confidentiality of the respondents is preserved by not citing their names in the case studies.
3) Confidentiality of the respondents is preserved by not naming the schools

4) Respondents were well informed in advance about the purpose of collecting the data.
5) Respondents were interviewed taking prior appointments.

School- A

School A, which is a government school situated in a sub-urban locality towards the East direction of the Vadodara city. The schools cater to the student population both boys and girls, belonging to the lower- and middle-income group families from the surrounding localities and other parts of the city as well. Initially the school planned to conduct the classes using the Google Meet application, however, the mode was not feasible.

Challenges faced by schools in conducting virtual classes

The problems that the school teachers faced was lack of smartphones with the students and also the unavailability and non affordability of internet facilities. It was reported that there is only one smart phone in the family and the phone is usually with the father. Since the phone is not at home, the students could not participate in the scheduled online classes. To overcome this issue, the teachers began to record their videos and started sending it to the students of their classes on the What's App group. So, the children can download the videos sent by their teachers and study, whenever the phones are accessible to them at home. The school authorities had a difficult time in the initial phase, as the teachers were not acquainted with the online teaching methods, hence it was a difficult time for teachers also to learn and conduct online teaching classes.

Participation of Muslim girls in virtual classes

Particularly focusing on participation of girls in online classes, the teachers reported that only 20-30% girls participated in the online classes, as it was not feasible for girls to participate in the online google classes because of household chores and lack of availability of phones at home. On deriving Muslim girls' responses from the school, the girls said that they cannot have a separate phone hence they cannot attend the classes, if the phone is not available at home. Moreover, some girls also shared that they are not able to attend the classes, as they have to help their mothers in the household chores.

Thus, because of the lack of availability of the smart phones at home, due to lack of income of the parents to afford a distinct phone for the education of girls, and responsibility of the domestic work, girls were not regular in their virtual classes, which has affected their education.

The attendance and regularity of the Muslim girls remains an issue in the school, regardless of various facilitative measures from the school authorities.

School-B

School B located in the East direction of Vadodara city, which is a Gujarati medium school only for girls. The schools also have adopted the online teaching methods, wherein the classes are conducted by using Zoom application for standard XI to XII.

Challenges faced by schools in conducting virtual classes

The school lacks the Wi-Fi internet facilities in the school, and hence the teachers were using their own mobile data pack to conduct their own classes. It was stated that in the initial stage, training of the teachers on using zoom platform for conducting the classes was undertaken and then the teachers began to use the application for the teaching purpose.

Participation of Muslim girls in virtual classes

Participation of girls were described as 30-40% in the online class, stating the inaccessibility of the mobile phones. Some parents could not afford an additional mobile phone which can be kept at home for the online teaching learning. Some girls shared that they do not have a separate room in their house, wherein they can sit and attend their class-thus because of the surrounding disturbances, they were not attending the online classes. Thus, it can be inferred that in this school as well the academic performance of the Muslim girls was affected.

School -C

Towards the North direction of the city area, School C is conducting the online classes in adopting three different ways: a) Through What's App group b) Through Google Meet c) Through You Tube Videos.

Challenges faced by schools in conducting virtual classes

It was described that the teachers began by using Google Meet application, but the outcome was not productive as the participation of the students were minimal, as the student population comprises of lower- and middle-income group families, hence there was inaccessibility of phones with students both with boys and girls studying in the school. Dealing to resolve this issue, the school authorities instructed school teachers to make short videos and post them in the What's-app group, so created as per respective subjects.

Another alternative the schools were given the task of uploading the videos on the official YouTube channel, so that the children can download the videos as per their time and space.

The school authorities also suggested giving hard copy of the assignment as another alternative for those students who were unable to use any of the above alternative. Herein, children were called up of course- with strict instruction of not coming in groups and collect their assignment copies from their subject teachers.

The authorities also reported, that the expenses of the stationery and other related expenses are borne by the school authorities from the Zakat fund- The Fund that is collected by the Muslim trust/ organizations during the holy month of Ramzaan.

Participation of Muslim girls in virtual classes

With special focus on girl's participation, 36-40% of girl's participation was noted, the reasons shared was the responsibilities at the domestic front, sibling care as well as the inaccessibility to the smart phones/ technological gadgets at home. Since, majority of the student population were from the lower- and middle-income group families, the non affordability was also a contributing reason hampering the educational advancement of the Muslim girls in the school, irrespective of the tremendous effort put in by the school authorities- to an extent of reducing the burden of stationery expenses from the students and managing from the available funds.

School-D

Challenges faced by schools in conducting virtual classes

School D, a private school, towards the North direction in Vadodara city. The teachers of the school described that like other schools, the school also has initiated online teaching learning, but the school authorities started receiving complaints from the parents and the students. Students were not able to participate in the class, due to lack of facilities at their end. There were many complaints received from the parents, stating that they have more than two or three children studying and since all the classes are conducted online, parents are not able to afford the cost of new smart phone or even the internet connection as well. It was stated that the school is struggling with the online teaching methodologies and the teachers are also not satisfied with the approach adopted. About the participation of students, there was nearly 10-15% of students participating in the classes. After the detection Covid-19 cases, the school teachers were also hesitant to come to school and the school had declared work from home for teachers as well.

Participation of Muslim girls in virtual classes

On taking responses from girls, most of the girls shared that they have the younger siblings studying, and in order to help their younger siblings and to facilitate then in attending their own virtual classes, they had to forego their own class schedules. Some girls responded that because of the financial scarcity in the family, parents are not able to make internet facilities.

School- E

The School E caters to student population from middle and upper middle-income group families. It was specified that the school had initiated online classes from the month of April 2020. Along with the online classes, the teachers were also engaged in one- to one counselling to students of the school telephonically and through Zoom application. To ensure, the educational status of students, online meeting was conducted with parents.

Challenges faced by schools in conducting virtual classes

Like other schools, this school has also faced challenge wherein parents have complaint that they are not able to afford an android phone and the internet data for their children, as they have more than two to three children studying. Another challenge faced by the authorities that students living in joint families do not have a separate area for their online classes, and hence cannot purely concentrate in the classes.

Participation of Muslim girls in virtual classes

Particularly focusing on girl's participation, it was stated that 95% of the girls were having access to technological facilities and were able to use it conveniently. They shared that the they were regular in attending their virtual classes and was very suitably able to handle the online classes. This shows that in this school, the Muslim girls were able to participate regularly in the online classes, whereas, some girls shared that the only problem that they face is lack of separate space for attending the online classes in their house.

School- F

The School F, situated in a sub-urban locality in the western part of the Vadodara city, also had initiated the academic classes through Zoom application.

Challenges faced by schools in conducting virtual classes

Deriving the response from this school also encountered similar problems of not having access to smartphones for children and hence the teachers, then adopted What's App option, where they recorded their videos and send it to all the students of their classes.

Participation of Muslim girls in virtual classes

This school had also witnessed less participation from the girls of about 5-10 %, as majority of the girls did not have access to mobile phones with them.

School- G

School G, in the west direction of Vadodara city, manages its online classes of secondary and higher secondary classes from standard IX to XII and send the PDF documents to the parents of the students of the primary classes.

Challenges faced by schools in conducting virtual classes

The school authorities have also received complaints from parents to not conduct online classes and to adopt some other mechanism. Parents are unable to afford the phones and the internet data packs for the children, as there are 2-3 children studying in the school. It is difficult for them to manage with the schedule of the online classes, especially in case of family with more than one child. Teachers were also trained for conducting classes, but for the trust it is also difficult to carry out the salary expenses of the teachers, as the school cannot ask for fees from the students.

Participation of Muslim girls in virtual classes

Participation of girls in online classes is less, because of domestic responsibilities as one reason, and in cases where there are younger siblings, and because of lack of access to technology by parents, the girls at the cost of missing their classes, help their younger siblings.

School- H

Challenges faced by schools in conducting virtual classes

The School H, in the rural area of Vadodara city has not yet began with online classes as student's population are not having access to the smart phones and the teachers are also not acquainted with online teaching methods. The school distributes teaching pamphlets to the students and gradually some teachers send video recording through the What's App group to the students, yet they have not started with online teaching classes.

Participation of Muslim girls in virtual classes

On deriving the reviews, it was found that, since majority of the girls from the rural areas, there were internet connectivity issues. Hence the school did not conductany online classes, but with the study materials distributed by the school and the girls pursued their studies.

School-I

School I, in rural locality of Vadodara, is managing its online classes during Covid- 19 period by sending videos through What's App group for the primary section, created separately for boys and girls according to their classes. For secondary classes, Google meet application is used by the teachers for conducting the online classes. For the Higher Secondary classes, YouTube is used and the link for the same is shared to the students through their What's App group.

Challenges faced by schools in conducting virtual classes

Irrespective of various mediums adopted for the different classes, it was narrated that the teachers and the management are also facing challenges as the students especially girls are not techno savvy and there is always a disturbance in classes as there is low internet connectivity in the village. There are also students whose parents cannot afford the electronic accessories; hence it is difficult for the authorities to meet with the individual differences. With specific emphasis on participation of students, it was stated students who have access to technological facilities, do participate in the classes and are able to utilize it effectively.

Participation of Muslim girls in virtual classes

On taking reviews of Muslim girls, pertaining to the participation of in virtual classes, majority of the girls shared that they were not able to attend the online classes as they do not have access to smart phones and there is always an internet connectivity issue in the village, hence the process of virtual classes was not having smooth process, resulting in less participation of Muslim girls.

School- J

The School J, in rural region of Vadodara city, also runs the online classes through What's App group and You tube for the higher secondary classes.

Challenges faced by schools in conducting virtual classes

Particularly for the challenges faced, it was stated that the during the lockdown phase, there was no income for some families, and it was difficult for parents to afford the smartphones and the internet data packs. Thus, majority of children were not able to attend the online classes. The teachers also have taken up counselling facilities with the parents of the girl students studying in higher secondary classes, as the girls' participation is less due to increase in responsibilities at domestic front. But because of the non affordability of the parents, there was no consistency or scheduled followed in the virtual classes, the students were using government of Gujarat telecast on DD Girnar for studying various concepts.

Participation of Muslim girls in virtual classes

From the review, it was observed that majority of girls pursued their education from the telecast on DD Girnar and no online sessions were undertaken by the schools.

Comparative view of all the Schools Chosen for the Study

No	Type of School	Approach adopted	Challenges encountered
1	Government	Recording of videos by teachers and sharing on the What's App of children, so that they can watch the videos when phone is accessible	1) Lack of smartphones at home, phone is with parents and unaffordability of parents. 2) Because of the lack of availability of the smart phones at home, due to lack of income of the parents to afford a distinct phone for the education of girls, and responsibility of the domestic work, girls were not regular in their virtual classes, which has affected their education.
2	Government	Zoom application for secondary and Higher	Teachers were not trained for online teaching.

		Secondary classes	30-40% girls participated in online classes. Inaccessibility of mobile phones with girls Lack of separate space for attending classes
3	Government	Through What's App Through Google Meet Uploading YouTube videos Hard copies of the assignments	36-40% girls participated in online classes. Inaccessibility and unaffordability of mobile phones
4	Private	Online classes	Parents complaint lack of mobile phones, as there are more than two children in the families and cannot afford to have new phone for the classes. Financial scarcity, sibling care and domestic responsibilities
5	Private	Online classes	Many complaints by parents for not being able to afford phone for each child in case of more than 2 children Girls living in joint families were not getting a

			separate space for their online classes.
6	Private	Online classes	5-10% of girls' participation, majority of girls did not have access to the smart phones
7	Private	Online classes	Complaints by parents for not being able to afford phone for each child in case of more than 2 children. Participation of girls is less, to help their younger siblings in their online classes and missing their own.
8	Private	No online classes Distributing study materials	Lack of access of mobile phones.
9	Aided	What's App videos	Lack of mobile phones and low internet connectivity
10	Private	What's App videos	Lack of mobile phones at home. Participation of girls is limited due to domestic responsibilities.

Table 1: Comparative view of Schools under study

Findings of the Study:

Findings related to the Schools:

- From the findings of the 10 schools of Vadodara city, chosen for the study, it can be said that all the schools, whether private or government has adopted different online teaching methodologies.
- Another applicable finding that the paper suggests that some of the schools were not properly well equipped with the technological facilities- hence the teachers had to use their own internet plans to conduct the virtual classes, this finding is in support with the study done by Islam and Midya[10]explaining that meagre infrastructural amenities within the schools are accumulating lower academic performance of the students.
- Widely, the schools chosen for the study were facing the principal challenge that is lack of student's participation in virtual classes due to loss of income of parents wherein parents are not able to afford the android phones and the expenses of the internet data packs.
- The response derived from the school authorities show that the school authorities have tried various measures, for the continuation of the academics, yet are facing challenges in organizing and getting maximum students participation in virtual classes.
- The paper also suggests that there was only one private school, out of all the schools chosen for the study, which were able to fetch optimum participation in virtual classes from all students including girls and were able to manage efficiently their academics in online classes.
- The school authorities are also very much aware and are concerned about the girls studying in higher secondary classes, and hence, they have adopted counselling services for the parents and for the girls themselves so as to retain these girls in schools.

Findings related to Muslim girls of Higher Secondary Classes.

- The responses from the Muslim girls, show that in majority of the schools covered under the study, participation of girls in online classes is less, because of increase in responsibilities in household and sibling's care.

- The responses derived from the 30 Muslim girls studying in Higher Secondary classes indicates that the students are not having access to or are not able to utilize the online teaching methodologies, which is affecting their overall performance.
- From the reply of Muslim girls interviewed for the purpose of the study, it can be said that these girls were not satisfied with this entire process of virtual classes, as they are unable to concentrate during their classes, which has its impact in their subject clarity.

Conclusion

- The findings of the study reflect lesser participation of Muslim girls in the online classes due to reasons like reduce of family income because of prolonged lockdown and hence parents are not able to afford the digital platform for education. As noted in many cases, the number of children is more in the family and thus it becomes very difficult to manage the online classes as they cannot afford to have the gadgets to facilitate the children's education. In majority of the cases, it is also seen that the girls are more pressurized of managing the household chores at home and at the same time helping their younger siblings in their online classes, and thus they miss out their own classes.
- The previous researches undertaken in the area of education of Muslim girls points that the educational progress among the Muslim community is lower, the magnitude of which has seen to an increase level from the findings of the paper during this Covid-19 pandemic situations.
- Amidst this situation, it is very important to advocate as well as to do counselling to the parents pertaining to the girl child education by the teachers, the school authorities, the educationist from the community, so as to reduce the number of girl's dropout from the schools. Simultaneously the school authorities, the community activists, the educationist should identify and try to help such families by supporting them financially from the Zakat funds that they cater to in the holy month of Ramzaan, because keeping girls in schools is equally important as spreading awareness on health and hygiene and to prevent the spread of Covid-19.

Acknowledgement

The study undertaken for the research paper is supported by the Head of the Schools, the Teachers in the selected schools. Acknowledgement is extended to the girls participating in the study for spending their time and responding to the researcher's question.

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Annexure-I

Dear Sir/ Madam,

Request you to provide me with following details as the researcher is writing an academic paper on. Muslim Girl's Education in COVID-19 times: Few Case Studies from Vadodara. To assure you, all the information will be used only for the academic purpose only.

1) What measures are taken by the school authorities to support the education of girls studying in higher secondary classes during COVID-19?

2) What are the challenges faced to support education of girls studying in higher secondary classes during COVID-19?

3) Are these girls having access to the technological facilities? If yes, are they able to utilize these facilities?

4) Your Suggestions/ remarks/ observation that could be of help for the researcher. (You can also share few of your experience)

A Study of Value Inculcation Practices for Secondary School Students

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Abstract

India is rich in cultural heritage and is a country with an ancient civilization so well known for its well defined system of education. Education is perceived as a means of ensuring the future well-being of student's according to Professor Fancy education as the processes of remarking experience, giving it a more socialized value through increased individual experience, by giving the individual better control over his powers. Value education must be integral to the whole process of education and can't be imparted as a separate bit of education; the whole education should be value oriented. The purpose of value education is to develop integrated and balanced personality. Values are not born in nature. They are acquired and inculcated. Education is closely associated with values and must develop in learners' caring, co-operation and respect for one another. Our educational policies and the curriculum framework all along have emphasized the need for value education co-curricular activities play a very important role for inculcation of values in the school students. In this research paper researcher discusses about how value inculcation practices done by school teachers through co-curricular activities among the school students.

Key words: Inculcation values, value education, co-curricular activities.

Introduction

The purpose of value inculcation is to develop all round personality development of the students. Values are acquired and imparted.[1] The family, its atmosphere and traditions, Sanskara along with humanitarianism play a very important role in value inculcation in our

students and us. The National Policy on Education (NPE 1986) states: that education as an organized social system and an important function in the development of moral values, spiritual values and aesthetic values, and nobody can deny that teachers have a very crucial role to play in the achievement of this objective.[2]

We can inculcate values in our students in various ways. In the beginning, very simple human values like love, truth, peace, and punctuality can be introduced among the students.[3] These values can be practiced in the classroom through curricular and co-curricular activities. Co-curricular activities employ a vital place in teacher education. Education is essential for all round development of a child. Education has always been integrated with society. It has both a personal and social dimension, they are inseparable.[4] Gujarat Secondary and higher secondary education board too introduced the CCE/SCE. One of the main aims of SCE is to evaluate scholastic and co-scholastic proficiency. Co-scholastic proficiencies include life skill, attitudes and values, literary and creative skills, scientific temperament, aesthetic skill, performing art, and sports.[5]

The present Study is an attempt to study value inculcation practices for adolescents in government secondary schools in Aspirational districts of Gujarat**.**

What is Value Inculcation?

Fixing up of values in mind is value inculcation approaches of value inculcation are:

- Direct approach- inculcated through curriculum and class room instruction.
- Indirect approach- inculcated through co-curricular activities plays, movies, telling stories, dramas, cultural activities and incidents.
- Incidental approach is the most effective approach.
- A person inculcates certain values through his/her real life experiences.
- Inculcation of values happens incidentally.[6]

Value Inculcation Practices

Co-curricular activities are very important sources of values inculcation. These activities, often voluntary, are taken up with involved participation and are therefore highly refreshing and creative. The informality and openness generated by these activities help the child to come in close contact with the teachers and their peer group several times, and it just creates the healthy and natural environment for inculcation of values among learners.[7-8]

The inclusion of co-curricular activities in teaching learning process is such that it is possible through them to effectively achieve physical, intellectual, emotional wellbeing and ethical integration's-curricular activities, is based on activities, provide maximum participation among students. The atmosphere played a very vital role and helps in learning experiences in a creative manner.[9-10]

Co-curricular activities are to be organized in different ways, e.g., in the classroom, in the school as well as in outside of the classroom activities. Classroom is a small organization of the school in a larger school perspective. It provides the opportunity of its all members to grow. A lot of value practices for inculcation of values among students can take place. Personal attachment, charisma and the body language of a class teacher can effectively isolate the class from many negative influences.[11-12]

About Aspirational Districts

The Government of India has launched the 'Transformation of Aspirational Districts' initiative in January, 2018 in 117 districts with a vision of a New India by 2022 by improving India's ranking under human development index, raising living standards and ensuring inclusive growth of all its citizens. The identified districts are eligible for enhanced funding and priority allocation of various initiatives undertaken by the department and ministry. The three critical components of the programme are convergence (of Central & State Schemes), Collaboration (of Central, State level 'Prabhari' Officers & District Collectors) and Competition among districts driven by a mass movement.[13]

ADP focuses on five main themes – Health & Nutrition, Education, Agriculture & Water Resources, Financial Inclusion & Skill Development, and Basic Infrastructure. These five identified thematic areas are further broken down into 49 indicators. The reason why the programme includes these particular themes is that they directly impact the quality of life as well as the economic productivity of citizens. The salient feature of this programme is that NITI Aayog in collaboration with the Planning Department.[13]

Selection Criteria for Aspirational Districts

Health & Nutrition, Education, Agriculture & Water Resources, Financial Inclusion & Skill Development and Basic Infrastructure have been identified as core areas of focus of this programme. Each of the above focus areas have been represented through 11core indicators

and measurable outcomes. Weight ages too have been accorded to these areas at 30% for Health & Nutrition, 30% for Education, 20% for Agriculture and Water Resources, 10% for Financial Inclusion and 10% for Skill Development and Basic Infrastructure. A composite index was arrived at considering the above mentioned indicators and the districts were ranked based on it. This exercise resulted in identification of 117 Aspirational Districts which had huge potential for transformation and had somehow missed the fruits of equitable and homogenous development work.[13]

The education sector focuses on *learning outcomes* (transition rate from primary to upper primary, and subsequently to secondary schooling, average scores in mathematics and languages and so on) as well as infrastructural (toilet access for girls, electricity supply, drinking water, etc.) and institutional indicators (pupil teacher ratio, timely delivery of textbooks, etc.). Considering the importance of education in enabling development, it commands a weight age of 30 percent – similar to that of health. Unlike health, none of the districts have managed to achieve their set targets on an average in the education sector. All of the Tier 1 districts, however, were merely 5 to 10 percent away from their respective targets over the last year.

The Aspirational Districts programme (ADP) and Sustainable Development Goals (SDGs) both emphasize on the provisioning of basic services through sustainable means to the most marginalized communities and people. As discussed earlier, the focus of ADP revolves around six domains: • Health • Education • Agriculture and Water Resources • Skill Development • Financial Inclusion • Basic Infrastructure

The Aspirational districts programme aims to improve the socio-economic status of various districts, selected by the central government across states. After the National Achievement Survey's startling results, Prime Minister Narendra Modi had chosen 117 districts and declared eight indicators. Out of these 117 districts, Gujarat's Narmada and Dahod were selected. In the June report, Dahod emerged as the top district among 117, whereas Narmada was ranked thirteen.[13]

Objectives

The study is based on below objectives:

1. To identify the values associated with the activities conducted in secondary schools of Aspirational districts of Gujarat.
2. To study the strategies followed in secondary school of Aspirational districts of Gujarat for inculcation of values
3. To find the effectiveness of various strategies follows for inculcation of values among secondary school adolescents of Aspirational districts of Gujarat.
4. To suggest innovative strategies for value inculcation among secondary school adolescents as perceived by the teachers and academic leader /experts.

Research questions

The following research questions were proposed to achieve the objectives of the study:

1. What type of values is associated with the co-curricular activities conducted in the school students?

2. What are the strategies followed to inculcate values through co-curricular activities and how effective are they?

Results and Discussion

Mode of Value Inculcation in the classroom by teachers				
Classroom Activities	**YES**	**%**	**NO**	**%**
1. Through Drama	45	90	5	10
2. Role play/folk dance	48	96	2	4
3. Through Poster Competition	33	66	17	34
4. Expert Talk	2	4	48	96
5. Value Clarification	18	36	32	64

Table 1: Mode of Value inculcation in classroom by teachers

From the table no. 1, the mode of value inculcation in the classroom by teachers was found – teachers were conducted

- drama/mono acting
- Role play/folk dance,
- Poster competition,
- Organized special talk on special days

- Conducted case studies/ situation analysis for value clarification to inculcate values among adolescents in government secondary schools.

Value Imparting in the classroom by teachers				
Classroom Activities	**YES**	**%**	**NO**	**%**
1. Checking the personal cleanliness of students from time to time	46	92	4	8
2. Involving children in maintaining cleanliness in classrooms and school surroundings	44	88	6	12
3. Encouraging good eating habits in school and at home	33	66	17	34
4. Greeting Teachers when he/she enters the classroom	12	24	38	76
5. Stand while talking to teachers	36	72	14	28
6. Involve children in maintaining cleanliness of the campus	41	82	9	18
7. Story telling	38	76	12	24
8. Dramatization	23	46	27	54
9. Scouting ,Guiding	26	52	24	48
10. Adventure clubs	17	34	33	66
11. Yoga, meditation	46	92	4	8
12. Patriotic songs	26	52	24	48
13. Explaining rules and regulations of school discipline	5	10	45	90

Table 2: Inculcating Values in classroom through various classroom activities by teachers

From above table no.2, it can be said that ninety-two percent of the teachers were of the belief that checking personal cleanliness of students from time to time and yoga, meditation were effective classroom activities for imparting values. Seventy-six percent of teachers responded that story telling was also effective activity for inculcation of values among adolescents; while fifty-two percent of the teachers opined that activities, like encouraging good eating habits in school and at home, were found very effective for inculcation of values in the classroom.

Value Imparting in the classroom by teachers				
Classroom Activities	**YES**	**%**	**NO**	**%**
1. Debate and discussions	36	72	14	56
2. Celebration of different religious festivals	44	88	6	12
3. Sports and games	33	66	17	34
4. Cultural Programs	12	24	38	76
5. Prayer Assembly	48	96	2	4
6. Shramdaan	11	22	39	78
7. Social service	38	76	12	24
8. Celebrations of birthdays of great men	23	46	27	54
9. Participatory programs	26	52	24	48
10. Anti-illiteracy drives	7	14	43	86
11. Campaigns against diseases	15	30	35	70
12. Seminars, workshops	16	32	24	68
13. Field visits	44	88	6	12

Table 3: Inculcating Values in classroom through various classroom activities by teachers

From above table no.3, it can be said that ninety-six percent of the teachers were of the belief that prayer assembly is effective classroom activity for imparting values. Eighty-eight percent of teachers responded that celebration of different religious festivals were also effective activity for inculcation of values among adolescence. While seventy-two percent of the teachers opined that activities like debate and discussion for inculcation of values in the classroom were very effective. While sixty-six percent of the teachers opined that activity like competitions on sport and games were also good for imparting value inculcation in the classroom.

Major findings

1. Ninety-two percent of the teachers were of the belief that checking personal cleanliness of students from time to time and yoga, meditation were effective classroom activities for imparting values.
2. Seventy-six percent of teachers responded that story telling was also effective activity for inculcation of values among adolescents.

3. Fifty-two percent of the teachers opined that activities, like encouraging good eating habits in school and at home, were found very effective for inculcation of values in the classroom.
4. Seventy-two percent of the teachers opined that activities like debate and discussion for inculcation of values in the classroom were very effective.
5. Sixty-six percent of the teachers opined that activity like competitions on sport and games were also good for imparting value inculcation in the classroom.
6. Eighty-eight percent of teachers responded that celebration of different religious festivals were also effective activity for inculcation of values among adolescence.
7. Total twenty values associated in different classroom activities (total 18 activities) practiced by teachers in classroom were found.

Suggestions for schools for inculcating values among the School Students

The following initiatives, activities and programmes should be organized in the school to inculcate the values among the school students, so that they can apply these values to their real life situation.

1. All the teachers should act as role models to the students in practicing environmental values.
2. Awareness programmes should be organized on health and environment and population education.
3. The community and social issues should be brought to the notice of all the students to develop awareness among them.
4. The physical and health education should be given due importance.
5. Community singing programmes, national integration camps, the NSS, NCC, and Scouts and Guides activities should be organized.
6. Work experience and SUPW activities develop a positive value towards the work culture, dignity of labour and the proper utilization of the leisure time- these should be given due importance.
7. Arrange school sanitation drive or activities.
8. Arrange different kinds of co-curricular activities, like world environment day, world health day. etc.

Following Values are inculcated through appropriate activities by teachers		
No.	**Activities**	**Name of Values associated**
1	Prayer Assembly	cooperation, honesty, punctuality
2	Celebration of National Festivals	national integration
3	Thought of the Day	simplicity, honesty, punctuality
4	Celebration of Environmental Day	save tree, protection of environment
5	Educational Visit	cooperation, national integrity
6	Van Mahotsav	save tree, protection of environment
7	Drawing Competition	discrimination of right or wrong
8	Sports Meets	sportsmanship's, cooperation
9	Cultural Program	kindness
10	Checking the personal cleanliness of students	cleanliness and hygiene
11	Involving children in maintaining cleanliness in classrooms and school surroundings	cleanliness and hygiene
12	Encouraging good eating habits in school and at home.	cleanliness and hygiene
13	telling stories	truthfulness
14	Explaining rules and regulations of school discipline	obedience
15	Voluntary services during functions	faithfulness
16	Scouting, guiding, adventure clubs	courage, services to others
17	Interest to do work in time	sense of duty and responsibility
18	Debates and discussions	discrimination of right or wrong

Table 4: Values inculcation through activities

Total twenty (20) values associated in different classroom activities (total 18 activities) practiced by teachers in classroom were found. Through these classroom activities teacher can impart values among students.

Conclusions

The values present a true perspective of the development of any society or nation. They tell us to what extent a society or nation has developed itself. But today we are facing the problem of value degeneration. According to Reddy the main causes of value degeneration

are – lack of respect of human life, lack of respect for authority, rules and regulations, crime and corruption, abuse of alcohol and drugs, abuse of women and children. We know that today's children are tomorrow's citizens. Education through activities co-curricular activities can be the solution for all types of the problems. The main purpose of the present study is to see what value inculcation practices are held in school for providing value education and to study the perception of the teachers about the value education programs, so that a comprehensive idea of value education program can be known. Based on co-curricular activities, a teacher has to make suitable, appropriate time table to transact for those activities, motivate learner's participation in the class. Then these activities will have a wholesome effect and have very important educational values too. All the co-curricular activities should be organized with a commitment and devotion. Planning a logical programme based on different activities will strengthen abilities of self-expression, preparation for vocation, sentiment of loyalty, organizing ability, creativity, and constructiveness and maintain good relation between school and community.

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Fabrication of AA 6351 + 5% SiC Composite using Stir Casting Process

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Abstract

Present article attempts to fabricate Aluminum Matrix Composites(AMC) using stir casting process. The matrix phase of composite consists of commercially available AA 6351 whereas the reinforcement phase will be of Silicon Carbide (SiC). The distribution of reinforcement particles within matrix, presence of any casting defects, agglomeration of reinforcement particles and other characteristics of fabricated composites has been investigated using Optical Microscope (OM) and Scanning Electron Microscope (SEM). The results of microstructure investigation revealed homogenous distribution of SiC particles within aluminum matrix with some particle free region. Apart from this, article also discusses about measured hardness of fabricated composites.

Keywords

Metal Matrix Composite, Aluminum Matrix Composites, Stir Casting, Microstructure, Silicon Carbide (SiC)

Introduction

Owing to the research and development in last few decades, Metal Matrix Composites (MMC) has been identified as advanced material which has capability to replace the conventional materials[1]. Broadly, it can be said that MMC fulfills several needs of industries such as transportation, aerospace, aircraft, electronics, electrical power transmission and automobile. For instance, in F – 16 aircraft, the doors made up of aluminum are now being replaced with silicon carbide (SiC) reinforced MMC and by doing so, enhancement in fatigue life was

observed[2]. Apart from this, that MMC are used for fabrication of bicycle frames, diesel engine pistons, engine shaft, piston crown, components of brake, connecting rod, piston rings, cylinder liners, bearings, engine blocks, super conductors, and many more components[2-4].Due to several characteristics such as superior mechanical properties, higher strength, lower density, stable mechanical properties even at elevated temperature, better thermal properties, lower coefficient of thermal expansion, higher stiffness, better dimensional stability and many more, MMC have gained popularity in aforementioned industrial sectors[5-7]. Among several derivatives of MMC, particulate reinforced metal matrix composite finds wider application in engineering world[4]. In particulate metal matrix composites, light metals/alloys such as aluminum, magnesium, titanium, copper and many more acts as matrix phase whereas, particles of oxides, carbides, ceramics, organic compounds act as reinforcement phase[5, 8]. Among various combination of matrix and reinforcement, aluminum matrix reinforced with ceramic particles have been considered for present investigation. There exist several fabrication techniques such as centrifugal casting, squeeze casting, in-situ casting, powder metallurgy, diffusion bonding process and stir casting process using which bulk/volume MMC can be fabricated[9-13]. However, Brains et al.[14] and Taha[15]from their study reported stir casting process as simple, cost effect and comparatively cheaper procedure available for fabrication of MMC/AMC. Apart from this, it was also reported that stir casting process has capability of fabricating composites with complex shape without much constraints.

Surappa[16] and Soltani et al.[17] reported stir casting process to be better in every aspect and industries can implement the same for fabrication of MMC. Lee et al.[18] investigated the interfacial reaction occurred during fabrication of B_4C/AA 6061 using stir casting process. It was reported that interface of B_4C/Al showed presence of Al_4C_3/Ti, chromium diboride, magnesium oxide and TiB_2 precipitates. However, the interface didn't revealed presence of any deleterious precipitates such as AlB_2 or Al_3B_4.It should be noted that these deleterious precipitates formed in composites adversely affect the mechanical properties. Yu et al.[13] developed a stir casting route to fabricated large scale AA6061 + 31% B_4C composites and investigated the effect of process parameters on microstructure and mechanical properties of fabricated composites. For successful fabrication of AMC, vacuum stirring, reinforcement particles feeding and ingots cooling were the dominating criteria. Results of Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD) revealed presence of B_4Cparticleswhich were embedded and homogenously distributed in aluminum matrix. Along with this, presence of

Mg_2Si was also reported. On comparing the tensile strength of AA 6061 + 31%B_4C with AA 1100 + 31%B_4C, enhancement in tensile strength by 112.5% was observed for AA 6061 + 31%B_4C composites due to higher strength of matrix. Rajendran and Suresh[19] fabricated hybrid composites in which aluminum alloys were reinforced with Silicon Carbide (SiC) and fly ash. Considering different weight fraction of SiC and fly ash, six different combination of AMC was fabricated. Due to variation in weight fraction of SiC and fly ash, different composition revealed variation in grain size and distribution of reinforcement particles. However, aluminum alloy reinforced with 10% SiC and 10% fly ash revealed proper grain growth with homogenously distributed SiC particles. Due to the same, enhancement in mechanical properties was reported. For all fabricated composites, thermal conductivity was found to be higher than 400 W/m.K, which was also matching the value required for engine block. Similarly, there exist several articles related to fabrication and characterization of stir cast AMC[20-22].

Present article focuses on fabrication of mono AMC using stir casting process. The article discusses about the fabrication procedure adopted for fabrication of AA 6351 reinforced with 5% weight fraction of SiC. The presence and distribution of SiC particles was observed using Optical Microscopy (OM) and SEM. Along with microstructural studies, hardness of fabricated composites was also investigated.

Experimental

Stir casting route was considered for fabrication of AMC. Experimental setup of stir casting process majorly consist of two components i.e. furnace and stirrer. Furnace used for melting matrix material is shown in figure 1. For the matrix material commercially available AA 6531 rods having 25.4 mm in diameter and 1000 mm in length has been considered. The chemical composition of AA 6351 is represented in table 1. For present study, AA 6531 matrix was reinforced with 5 % weight fraction of SiC having particles size of 100-120 μm.

Figure 1: Electrical Furnace used for melting matrix material

Elements	Si	Mg	Mn	Fe	Zn	Ti	Cu	Cr	Al
Amount (%)	1.2	0.67	0.58	0.5	0.2	0.2	0.1	0.05	Remaining

Table 1: Chemical Composition of AA 6351-T6

For fabrication of AA 6351 + 5% SiC, rod of AA 6351 was cut into small pieces, each having length of 100 mm approximately. Cut pieces of matrix weighted and a batch of 1000 was formed. Similarly, reinforcement particles were weight as per the weight fraction of reinforcement to be incorporated in matrix material i.e. 50 g. Figure 2 represents the batch of aluminum matrix and corresponding reinforcement particles. Before melting, the electric furnace was preheated to 180 °C and then the crucible consisting of matrix was inserted in furnace. The aluminum matrix was then heated up to 780 °C, which is higher than the melting point of aluminum. On successful melting, the molten matrix was stir in a manner such that vortex was created. In the meantime, SiC particles were preheated to 350 °C for 15 minutes and were added to the vortex created in molten aluminum. Along with SiC particles, 1 % of magnesium was also added to molten matrix. Addition of magnesium acts as wetting agent between matrix and reinforcement and thus improved the wettability. Wettability enables the molten aluminum matrix to maintain the contact with solid surface of SiC particles. The molten mixture was stir for 5 minutes at stirring speed of 300 rpm, as represented in figure 3. The stirrer was having 4 blades and angle between two blades were 60°. After stirring, slag formed on the top surface was removed and the molten mixture was poured into mould. Design of

mould was such that the solidified cast component will have dimension of 100 × 100 × 10. On solidification, cast component was removed from mould.

Figure 2: Aluminium alloy and SiC particles as per weight fraction

Figure 3: Stirring of molten composite

Microstructural characteristics of fabricated composites were investigated using OM and SEM. The specimen required for each investigation was cut from fabricated and polished as per standard metallurgical procedure. For etching, Keller's reagent was prepared by mixing distilled water, nitric acid, hydrochloric acid and hydrofluoric acid in proportionate quantity. Keller's reagent was then applied on polished surface of specimen at room temperature and was dried out before microstructure examination.

Results and Discussion

To understand the distribution of reinforcement particles in aluminum matrix, microstructural investigation of fabricated AA 6351 + 5% SiC was performed. Figure 4 represents micrograph image obtained using OM. In the micrograph, the rounded black spots embedded in aluminum matrix represent SiC particles. It can be observed that those SiC particles are uniformly distributed within the matrix of aluminum. The preheating of reinforcement particles has proven beneficial and due to the same, reinforcement particles were found to embed within aluminum matrix. The preheating of SiC particles not only helps in removing the moisture from

reinforcement particles but also avoids the thermal mismatch between molten aluminum and SiC particles. Also, the addition of SiC particles directly into vortex formed in molten matrix has proven beneficial towards homogenous distribution of SiC. Additionally, addition of magnesium as wetting agent had helped in enhancing wettability between matrix and reinforcement. It has been reported that addition of wetting agent and preheating of reinforcement particles tends to remove impurities, desorption of gas, avoids settling of reinforcement particles and alters the surface composition due to formation of oxide layer on surface[23].

Figure 4 represents dendritic like structure which were formed during solidification phase. Aluminum alloys are known for higher cooling rate and provides enough undercooling. This undercooling will increase nucleation site with reduction in dendritic arm spacing. Small nuclei formed during nucleation will mechanically block each other during growth process and thus results in fine and uniform dendritic structure. On higher magnification, as represented in figure 5 it was observed along with SiC, the fabricated composites were found to have Mg_2Si and Al-Mg-Si phase. The thin, black and needle shape phase in microstructure represents Mg_2Si. These Mg_2Si phase were observed near Al/SiC interface or were embedded in α-Al. Apart from this, slightly transparent phases present in microstructure of AA 6351 + 5% SiC represents ternary eutectic phase i.e. Al-Mg-Si. Similar observations were also reported by other researchers[24-26].

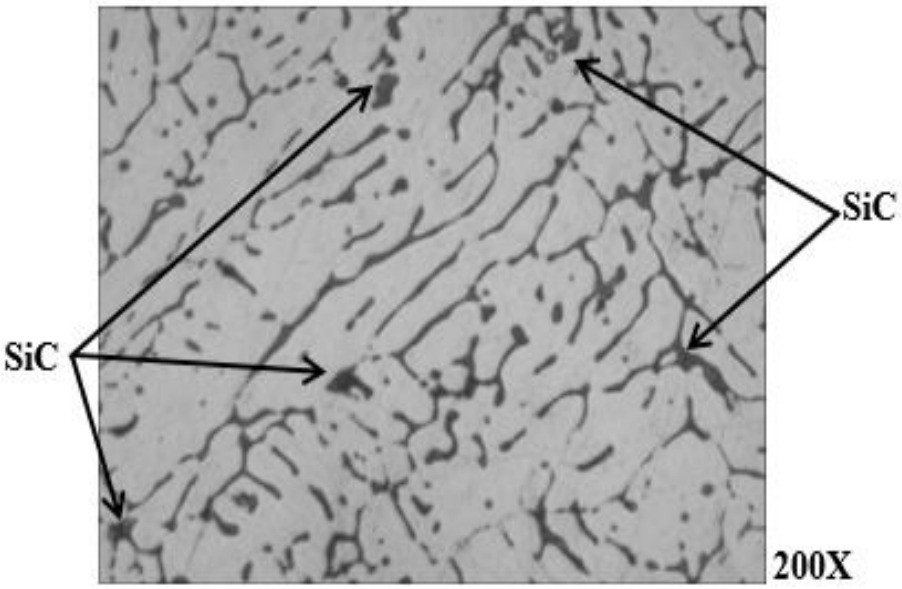

Figure 4: Optical Microscopy (OM) of AA 6351 + 5% SiC

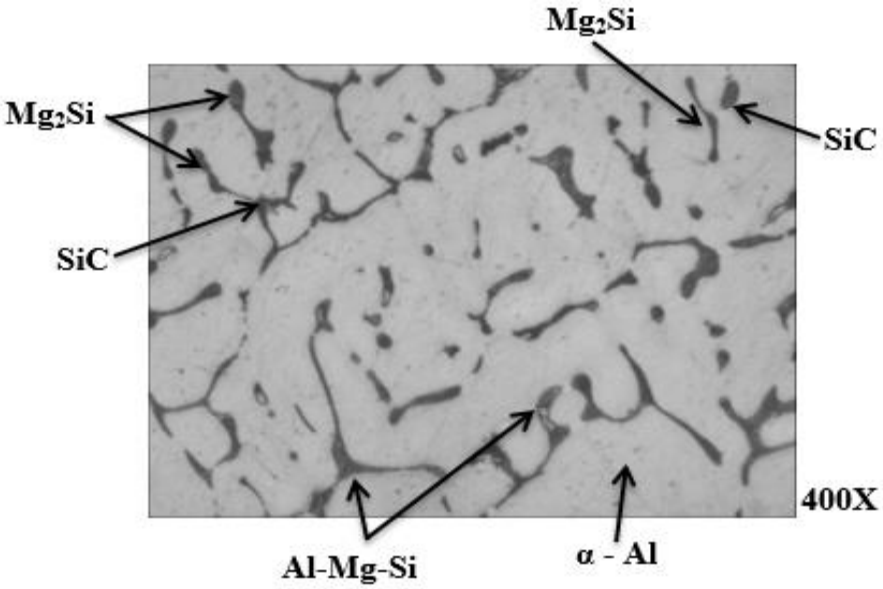

Figure 5: Presence of SiC, Mg_2Si and Al-Mg-Si in AA 6351 + 5% SiC observed using Optical Microscopy (OM)

Similar phases were reported from SEM images of AA 6351 + 5%SiC composites. Apart from this, SEM image represented in figure 6 also revealed few particles free region. Particle free regions can be observed due to lower weight fraction of reinforcement particles. Similar observation was also reported by Shabani et al.[27] and Raj and Thakur[28]. Raj and Thakur[28] also reported that increase in weight fraction of reinforcement particles reduces the particle deficient region and causes uniform/homogenous distribution of reinforcement particles. Figure 7 represents SEM images taken at higher magnification. Even at higher magnification, SEM micrographs of fabricated composites didn't reveal any presence of clusters/agglomeration of SiC particles. Earlier it has been reported that increase in weight fraction of reinforcement particles tends to generate few clusters/agglomeration of reinforcement particles. Due the stirring, reinforcement particles tends form clusters with matrix which is termed as agglomeration of reinforcement particles. Increase in weight fraction of reinforcement particles tends to increase the density difference which makes stirring difficult. This difficulty in stirring restricts the motion of reinforcement particles within molten matrix and thus results in agglomeration of reinforcement particles. Apart from this, SEM micrograph didn't reveal presence of any deleterious phase which affects mechanical properties of fabricated composites. The hardness test was conducted at a load of 62.5 Kg with a dwell period of 2.5

sec. Due to addition of SiC particles in AA 6351 alloy, enhancement in hardness of fabricated composite was observed. The measured hardness of AA 6351 was 54 HB and that of AA 6351 + 5% SiC was 61 HB. The ceramic particles are known for their hardness and thus addition of SiC particles in light weight alloys tends to enhance the final hardness of composites. Along with this, the enhancement in hardness was observed due to absence of any casting defects, agglomerated SiC particles and deleterious phase.

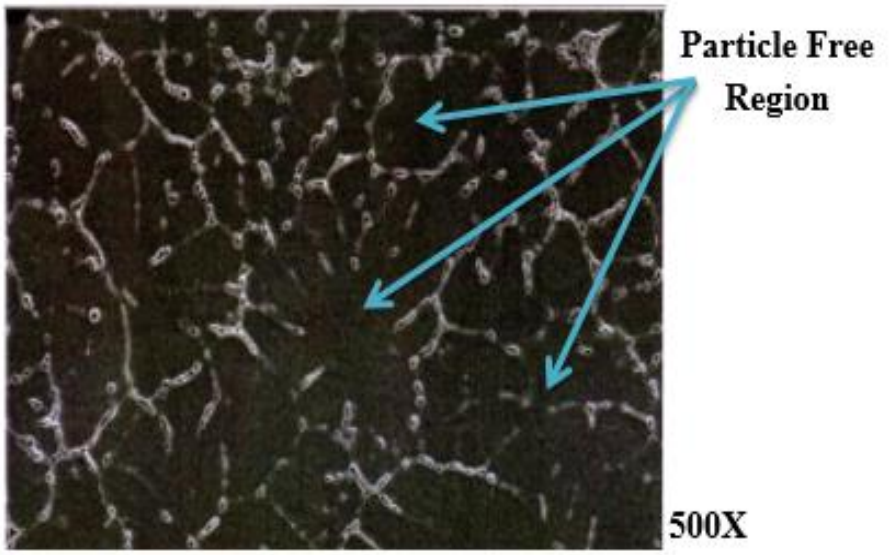

Figure 6 : SEM Micrograph of AA 6351 + 5% SiC

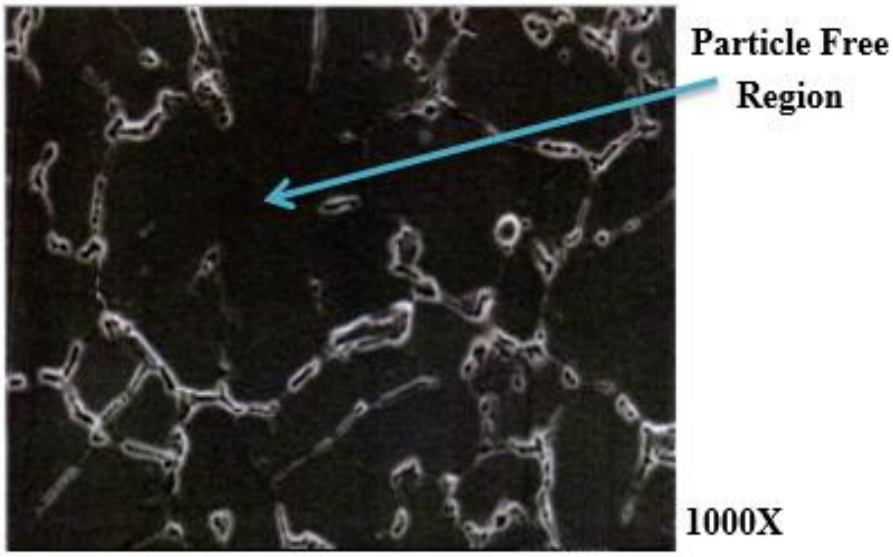

Figure 7 :Cluster free microstructure of AA 6351 + 5%SiC observed in SEM micrograph of AA 6351 + 5% SiC

Conclusion

The present study can be concluded as follows:

- Stir casting process possess potential to fabricate AMC with matrix of AA 6351 and reinforcement phase of Silicon Carbide (SiC). However, it becomes necessary to have control over several process parameters such as stirring speed, stirring time, stirring temperature and melting temperature of alloy.
- Optical Microscopy and Scanning Electron Microscopy reveled presence of SiC particles which were embedded in aluminum matrix. Owing to preheating of SiC particles and addition of magnesium as wetting agent, proper interfacial bonding between matrix and reinforcement along with homogenous distribution of reinforcement particles was reported. However, due to lower weight fraction of reinforcement particles, some particles free regions were observed.
- Enhancement in hardness of fabricated composite was observed due to addition of SiC particles and absence of agglomeration/clusters of reinforcement particles, presence of deleterious phase and casting defects such as void, grooves or tunnel defects

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