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Web Based Academic Support in Teaching Mathematics During Pandemic

Dr. S. Venkataraman[1] and Dr. Deepika[2]
[*1]*Discipline of Mathematics, School of Sciences, Indira Gandhi National Open University, New Delhi*
[21]*Discipline of Mathematics, School of Sciences, Indira Gandhi National Open University, New Delhi*

Abstract
Mathematics is generally acknowledged to be a difficult subject. In March, 2020, when lockdown was imposed in India for controlling the spread of Covid 19, the anxiety levels of the students of Mathematics increased due to the lack of the usual institutional support through Counsellors at the Study Centre which were shut down during the lockdown. In the absence of the regular support through counselling and regular interaction with the peer group, the faculty at the headquarters had to come up suitable means for mitigating the problem. The Self Learning Materials, which could not be sent to the students due to the lockdown, were made available in the web based platform, Web Enabled Academic Support (WEAS). Also, to reduce the anxiety of the students, we disseminated information regarding important matter like submission of assignments and Term End Examination through this platform. We also interacted with the students with the interactive video streaming platforms like Google Meet and Youtube live stream. In this article the authors share their experience in providing students through the Web Enabled Academic Support (WEAS) platform created by IGNOU and through video streaming platforms like Google Meet and Youtube live stream during the pandemic.

Keywords: *online, self learning material, open and distance learning, web enabled academic support, pen tablets*

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I. INTRODUCTION

The Covid pandemic spread throughout the world in the end of 2019. The first case in India was reported in the end January. As the situation worsened the Government of India imposed a lockdown from 25th March, 2020. Because of the severity of the situation, there was little hope that the lock down will be lifted any time soon. The educational institutions were shutdown. Also, some the educational institutions became Covid treatment centres.

One consequence of this was all the study centres of Indira Gandhi National Open University (IGNOU), which are housed in higher educational institutions, were also shut down. Because of this the students were unable to go to the study centres for counselling sessions. Also, there was lot of uncertainty regarding the submission of assignments, conduct of counselling sessions for theory as well as practical courses, project supervision, etc. There was also uncertainty about conduct of term end examinations. All this resulted in lot of anxiety and tension to the students.

The phenomenon of Mathematics anxiety is well documented. In [2], the authors describe the impact of Mathematics anxiety on the cognitive processes and other aspects. According to them,

> *Overall, math anxiety causes an "affective drop," a decline in performance when math is performed under timed, high-stakes conditions, both in laboratory tests as well as in educational settings. This means that math achievement and proficiency scores for math-anxious individuals are underestimates of true ability. The primary cognitive impact of math anxiety is on working memory, particularly problematic given the important role working memory plays in math performance.*

Thus, the already existing Mathematics anxiety was aggravated by the prevailing situation. Also, the students who visit the study centre, get an opportunity to interact with other students. The importance of social interaction in improving learning outcomes in Mathematics is also well documented. See for example [1]. According to them:

> *Mathematics learning achievement is influenced by the internal and external factor of the students. One of the influencing external factors is social interaction with friends in learning activities. In*

> *modern learning, the learning is student-centered, so the student interaction is needed to learn about certain basic competence. Potential and motivation of students in learning are expected to develop with good social interaction in order to get maximum results. Social interaction is an important aspect of learning Mathematics because students get the opportunity to express their own thoughts in order to encourage a reflection on the knowledge they have.*

Some of the study centres and regional centres of IGNOU took the initiative and conducted counselling sessions.

In this situation, the need for online support became essential and a challenge too. Through this article the authors would like to highlight the efforts made by them along with the challenges and corresponding responses in teaching mathematics at undergraduate and postgraduate level in open and distance learning (ODL) system.

II. WEB ENABLED ACADEMİC SUPPORT

In this uncertain situation, only web-based support could be the means to provide much needed support the learners. There is already lot of literature available on the efficacy of web-based support for online learning. According to the [14], key benefits for the web based support are

- *access to a large number of teaching materials,*
- *increasing the clarity of explanation and learning effectiveness,*
- *student motivation and proactive approach,*
- *individual approach to instruction,*
- *possibility to test student knowledge and skills,*
- *availability and low cost.*

Another study by [11] highlights the importance of web based support in the following way:

> *The e-learning teaching method breaks with the classic stereotypes of teaching and learning processes, since it modifies the spaces and time of training, allowing the development of the pedagogical act in any place and at any time.*

National Centre for Innovations in Distance Education (NCIDE) was already supporting some programmes through Web Enabled Academic Support (WEAS). The WEAS platform provided self learning material, assignments which are an important part of continuous assessment in IGNOU evaluation system, supporting videos, a discussion forum and important notifications related to examination, forthcoming online counselling sessions and assignments to the learners. The list of features of the WEAS portal is shown in Fig. 1.

Fig. 1: Web Enabled Support System

It was decided to make use of this platform to provide academic support to the students enrolled in the Mathematics courses of the B.Sc.(G), B.A.(G) under the Choice Based Credit System (CBCS) as well as the students of the M.Sc.(Mathematics with Applications in Computer Science). Accordingly, the NCIDE was approached for support and training for developing the platform and related maintenance. After training on creation and maintenance of WEAS web pages, it was possible to quickly set up WEAS pages for both the Postgraduate as well as Undergraduate programmes.

The platform was made available to the students and the response has been encouraging. The statistics collected using a hit counter is shown in Fig. 2. According to the hit counter installed on the webpage, during last two months 86.8% of the visitors are returning visitors. Only 13.20% of the visitors are first time visitors. The higher percentage returning visitors shows that the visiting students found the page useful and informative.

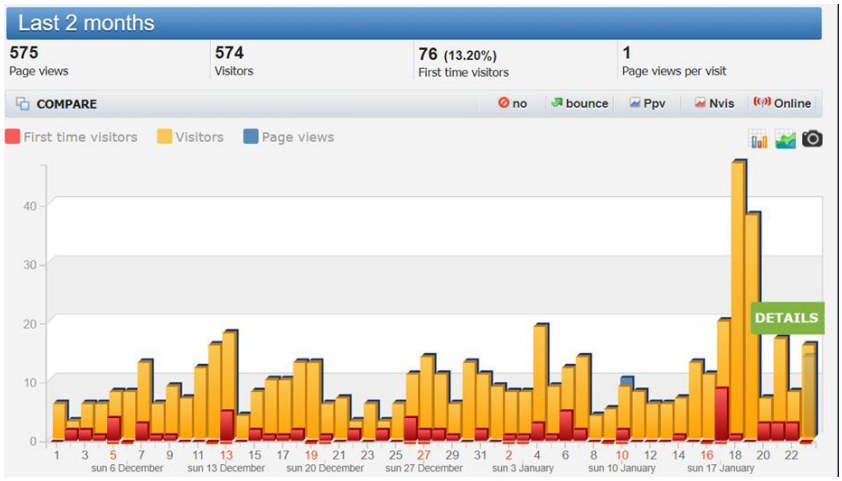

Fig. 2: Access Statistics of WEAS Page

The anxiety of the students was reduced because of availability of all the course material in the WEAS portal. According to [15],

> *"Web delivery reduces delays in making study materials available to students. Since all course material is put on the Web for downloading by students, printing and associated costs of storing and distributing printed materials will be reduced. For up to date Web-based resources to be accessible for learners at all times, it is anticipated that effective Web administration will become a major concern."*

Another facility made available through WEAS was a discussion forum. This enabled the students to post queries related to the course material and also administrative matters like examination dates, submission of assignments etc. The mathematics faculty members also joined discussion forum as members and responded the queries raised. It was helpful in reducing the anxiety of the students regarding issues like assignment. With this issue taken care of, the students turned their attention to academic matters and we received a lot of queries and requests for clarification of portions of the study material that the students found difficult to understand.

Most of the interaction through WEAS was in the asynchronous mode. However, the students expressed a strong desire for synchronous online interaction. For this purpose, the Mathematics Faculty approached NCIDE, for training in online teaching tools like Google Meet and Youtube live streaming and the centre provided training to the faculty in these areas.

Interaction through Google Meet

An orientation meeting for the students of the Postgraduate programme in Mathematics, the Master of Mathematics(Applications in Computer Science), (M.Sc (MACS)) was conducted using Google meet. The purpose of the meeting was to orient the students regarding IGNOU like the credit system, assignments, conduct of computer based practicals. We also informed them about WEAS. A google form was shared asking for the general feedback regarding online interaction. In this there were several questions on the ways they would like to interact with the faculty. One of the questions asked which of the three softwares, Google Meet, Skype and Zoom, are they familiar with for video interaction.

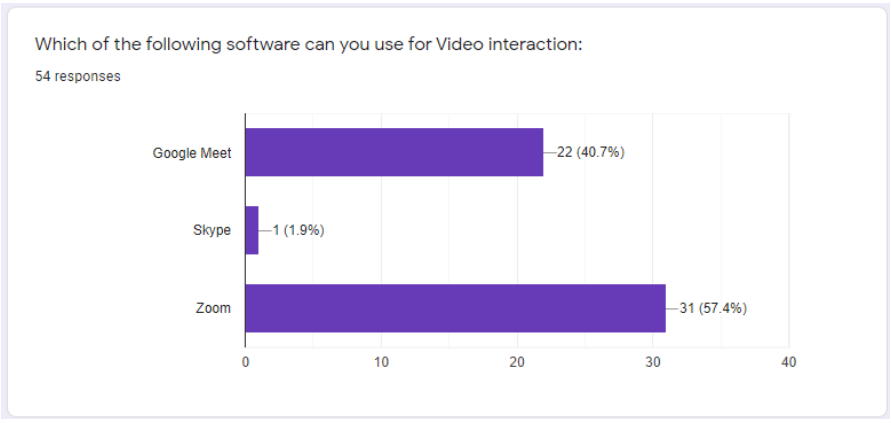

Fig. 3: Data about platforms

As shown in Fig.3, 54 responses were received, out of which more than 40% said they are familiar with Google meet and 57.4% said they are familiar with Zoom. Asthe University was using G-Suite, we continued to use Google meet for interacting with M.Sc.(MACS) students. Since the enrolment was fixed and under the limit set for the number of participants, all the students could participate and ask question. Because of this, the levels of interaction in these sessions were quite high and we could reproduce to a large extent the face-to-face interaction available in the classroom. We were able to share the screen and used One Note or used Power Point as per requirements.

Interaction through YouTube live streaming

The enrolment in the undergraduate programme was of the order of 5000 and the limit on Google live streaming was 1000. So, we used Youtube live streaming to interact with these learners. The sessions are recorded automatically and can be edited later. The sessions of half an hour length. Usually two of us were online, one presenting, the other answering the queries and doubts of the students. We found this a satisfactory arrangement. If the presenter breaks the presentation to clarify the doubts sometimes, the flow is interrupted. However, the interaction in YouTube live stream was limited to posting comments. Mathematical doubts are hard to communicate through comments because there is no provision for inputting Mathematics symbols.In the case of sessions where Mathematics content was delivered this was not enough. Google meet allows window sharing, sharing a Chrome tab and full screen sharing. There are other white board softwares available and they can be used by sharing the window or screen. Some of the options are the Windows White board, freely available in Windows 10 and used in Microsoft Teams, Openboard software and OneNote software that is freely available in Windows.

Here we are summarising all the pros and cons of each of the platform and tools in the Table 1 and Table 2 respectively.

Table 1: Platforms

S.No.	Features	YouTube	Googlemeet	Google meet live stream
1.	Limit on the number of participants	×	✓(250)	×(1000)
2.	Two way interaction through video	×	✓	×
3.	Two interaction through audio	×	✓	×
4.	Interaction through chat	✓	✓	×
5.	Screen Sharing by the presenter	✓	✓	✓
6.	Screen Sharing by the other participants.	×	✓	×
7.	Interaction with Peer group	Only through Chat	✓	Only through Chat
8.	Ease of use	×	✓	✓

Table 2: Features of the Tools used

S.No.	Features	Windows white board	OpenBoard	OneNote
1.	Annotation using pen	✓	✓	✓
2.	Insert images	✓	✓	✓
3.	Insert pdf files	✓	✓	✓
4.	Convert to PDF	×	×	✓
5.	Convert to Image	✓	×	✓

The use of technology in teaching-learning Mathematics in ODL system was a mix use of various tools and techniques. Such type of arrangement has also been highlighted by [4],

> *In this phase of technological development, communication that involves different computer platforms, e.g. LMS and social media, is a combination of icons, videos, regular writing, orality, images, graphs and video-clips that seems to bring a new consequence to mathematics education.*

The increasing access to web access devices like laptops, mobiles and tablets has made teaching online more and more feasible. However, there are many challenges in teaching Mathematics online.

III. CHALLENGES AND RESPONSES

Mathematics is a subject where the functions need to be visualised through their graphical representation. In literature there is a study [16], in which two models have been shown. In first model, one of the teachers worked with graphing calculator and in the other model the other teacher worked with the graph plotting package. They have compared the whole process at micro level and highlighted the importance of the mathematics teacher's choice and use of both digital and non-digital tools. According to the study [17], the teachers with the help of appropriate graphing softwares can,

- *establish a coherent resource system*
- *adapt formats for classroom activity to capitalize on the interactivity of the software*

- *extend curriculum scripts to encompass these features*
- *rework lesson agendas, both to include introduction to computer graphing and take advantages of the resulting saving in time.*

Godwin & Sutherland's paper emphasises the way in which teachers played "a vital role in orchestrating and structuring classroom activities in such a way as to support students to focus attention on appropriate mathematical ideas" (p. 132) and the way in which this creates "an emergentand collective… community… in which knowledge construction

converges to some acceptable 'common knowledge'" (p. 150). In particular, they note how, in both lessons (with or without the use of graphing devices), teachers introduced critical attributes of the graph types through considering a succession of parameterised sub-families, with the graphing technologies used to give students the power to experiment with many members of each sub-family within a relatively short period of time. Our

study complements this work by incorporating a stronger teacher perspective into the overall analysis of technology-supported classroom practice, and by extending analysis of the specific handling of graph types to bring out the interaction between technological affordances, task designs, and teaching actions. One of the challenges was to reproduce online the important and essential aspects of the classroom interaction that takes place.

According to [7]:

> *"The instructors who frequently use the board when teaching a mathematics course in the face-to-face learning environment stated that the use of digital pen in the online learning environment may replace board and chalk, thus providing the familiarity of the traditional education environment. They particularly emphasized the importance of the use of digital pen in the online mathematics course. In addition, they commented that online mathematics courses taught without digital pen might decrease student participation and the quality of the course and prevent students from seeing the process steps of the problem solving."*

A considerable amount literature on the efficacy of various tools for online teaching already exists. Some of the tools used for online interaction are digital white board, Ipad, PCs with digital pens etc. Tools like digital whiteboard and PCs with digital pen are very expensive and it is not possible for the individuals confined to their homes due to the pandemics to acquire these tools and use them. So, we had to look for tools that are affordable as well as accessible.

According to [5],

> *"Production of PowerPoint slides in mathematics is possible but time consuming and allows little flexibility when problem solutions are prepared before class, not allowing modification in class. Tablet PCs with their capacity to create electronic handwriting can transform the lecture experience. Teachers can now face a class, display questions and step by step solutions clearly to all students, respond quickly to unplanned student questions and most importantly record all details of a lecture using screen capture and voice recording software."*

Also, according to [9], who used the MSN messenger along with Tablet PC with an electronic ink function

> *"When asked if they could imagine doing the tutorial without handwriting, they said it would have been difficult. While the tech-savvy Discrete Mathematics students used the handwriting feature nearly as much as the instructors, the Data Analysis students did not and commented that it was difficult to use. One Data Analysis student stated that it was difficult to use the handwriting tool with a mouse because she was left-handed; however, she was the student who used it the most. All students agreed that while they may not have been comfortable writing themselves, they were comfortable reading what was written in electronic ink. Furthermore, they appreciated the fact that it was most useful for graphs and diagrams; moreover, it effectively replaced verbal explanations that would have involved terminology that students were still struggling to retain."*

According to [12], who used Macromedia Flash based solution to teach Economics and Statistics online

> *"The online student may phone, email, or engage in a discussion board or instant message with the professor. This may be adequate in some disciplines and some circumstances, but is lacking of utility in the highly visual disciplines such as math, statistics and economics where the written equation and the drawn graphic are often utilized to answer students' questions. What is needed is to combine these features with a free writing and drawing surface that is integrated with the other communication technologies in a simple to use format requiring no special skill or significant client on the users part."*

We found it convenient to use pen stylus both for online and offline teaching. When students post a doubt from a page in the course material in the discussion forum, we could quickly print the page to One Note, use pen stylus and annotate the page mentioned in the doubt, convert to PDF and email to the student.

We feel that Ipad with an apple pencil is also an extremely useful teaching tool. The apple pencil is much smoother than the pen stylus. The handwritten notes come out much better because of this. Also, teachers may find apple pencil much easier to use than the pen stylus. However, the costs are quite high in the Indian context. Ipad together with apple pencil costs nearly as much as a mid-range Windows laptop. This may be a barrier for adoption in the Indian context.

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