3.3.3 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during year.

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2.	Managerial Economics
3.	Business Enviornment
4.	छत्रपती शाहू महाराजांची राष्ट्र उभारणीतील भूमिका
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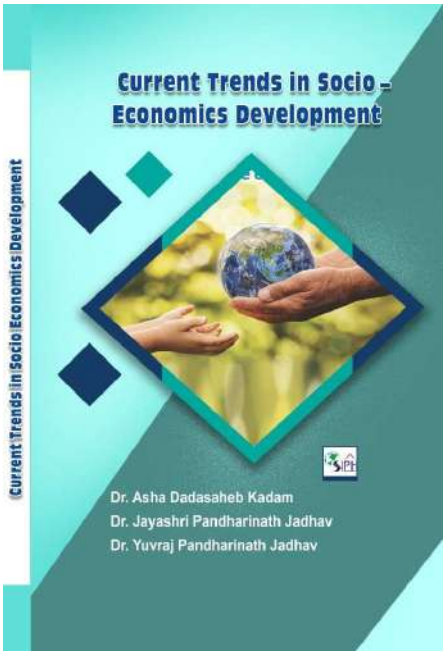

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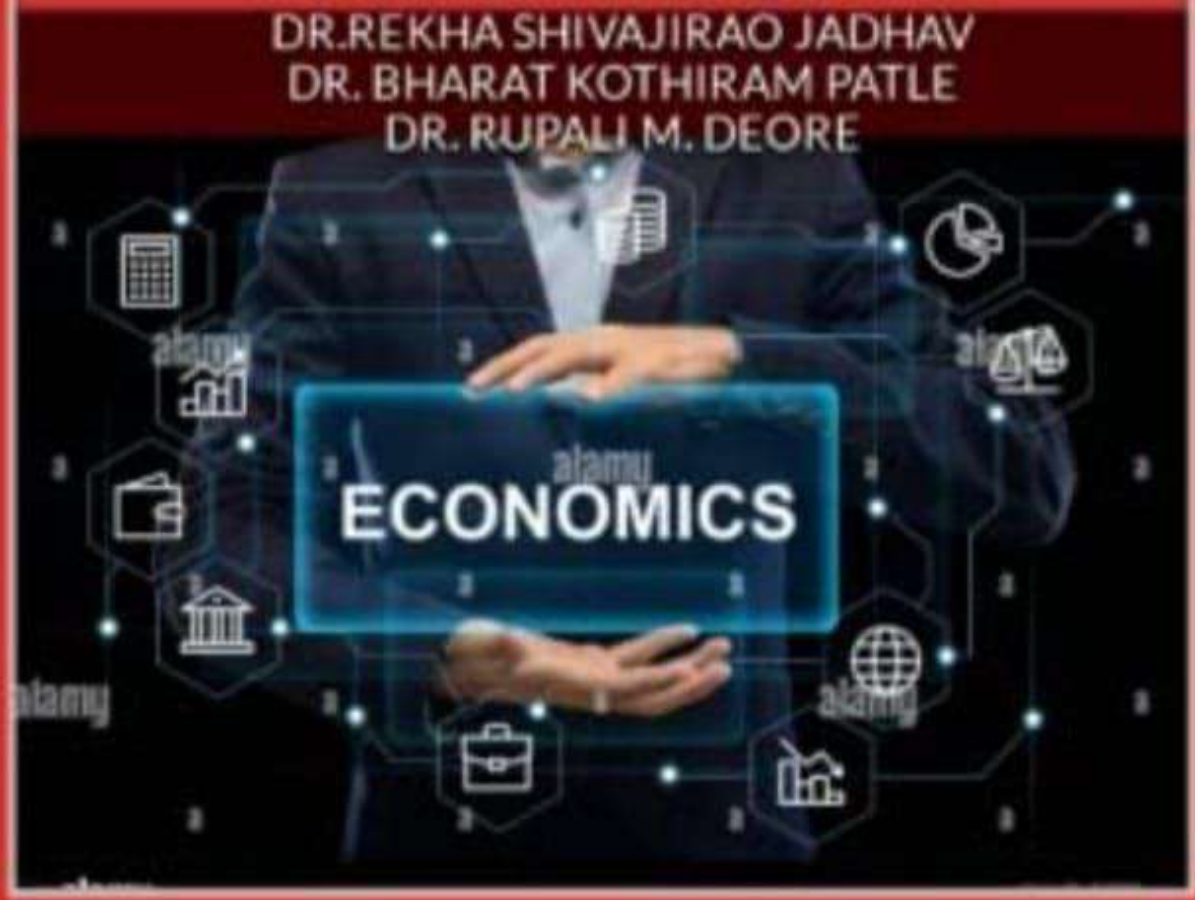

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Dr. Mrunal A. Bhardwaj is a Vice Principal, Dean Humanities

छत्रपती राजर्षी शाहू महाराजांची राष्ट्र उभारणीत भूमिका

संपादक

प्राचार्य डॉ. महादेव गव्हाणे

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१२

राजर्षी शाहू महाराजांचे शैक्षणिक कार्य

□□□

डॉ.रमेश जगन्नाथ निकम

महाराष्ट्र राज्याच्या इतिहासात छत्रपती राजर्षी शाहू महाराजांचे योगदान महत्त्वपूर्ण राहिले आहे. इतर राज्यांच्या तुलनेत महाराष्ट्र हे सर्वच बाबतीत पुढारलेले राज्य आहे.शिक्षणासंबंधी महाराष्ट्र राज्य नेहमीच अग्रेसर राहिले कारण महाराष्ट्रात महात्मा फुलेंनी शैक्षणिक जागृतीची चळवळ हाती घेतली.त्यानंतरच्या काळात हाच विचार शाहू महाराजांनी पुढे चालविला.शाहू महाराज राजे असल्याने त्यांनी शिक्षणाला राजाश्रय मिळवून दिला.त्यांनी आपल्या सत्तेचा उपयोग करून मागास उपेक्षित समाजाला शिक्षण देऊन त्यांच्यात जागृती निर्माण केली.शाहू महाराज स्वतः पुरोगामी विचाराचे वाहक होते. समाजातील अंधश्रद्धा,वाईट चालीरीती,अनिष्ठ रूढी परंपरा इत्यादी समस्यांचे अज्ञान हेच एकमेव कारण आहे असे ते मानत. समाज अज्ञानी असल्याने दारिद्र्यात अडकला आहे. गुलामगिरीपेक्षा सामाजिक शैक्षणिक मागासलेपण हे जास्त घातक आहे. याची त्यांना जाणीव होती. त्याकाळी शिक्षण हे फक्त उच्चवर्णीयांनी पुरतेच मर्यादित होते. स्त्रीशिक्षण तर गुन्हाच समजले जात असे. शाहू महाराजांनी समाजातील अज्ञान अंधश्रद्धा अनिष्ठ रुढी परंपरेला छेद देऊन लोकांच्या जीवनात शिक्षणाची ज्योत लावून त्यांच्या जीवनातील अंधार दूर केला. शिक्षण हे समाज विकासाचे,राष्ट्र विकासाचे महत्त्वाचे साधन होय.म्हणून शिक्षणाशिवाय तरणोपाय नाही.हे शाहू महाराजांनी वेळीच ओळखून त्यासाठी आग्रही भूमिका घेतली.

राजश्री शाहू महाराजांचे शैक्षणिक कार्य :-

सक्तीचे प्राथमिक शिक्षण: छत्रपती शाहू महाराजांच्या मनात लोकांविषयी कणव होती. लोकांची स्थिती सुधारली पाहिजे,हेच त्यांनी आपले ध्येय मानले.त्यामुळे समाजातील सर्व घटकांना साक्षर करण्यासाठी आपल्या संस्थानात प्राथमिक शिक्षण सक्तीचे केले. शिक्षण हे समाज परिवर्तनाचे साधन मानून त्यांनी प्राथमिक शिक्षणावर भर दिला. ते केवळ विचार मांडून थांबले नाही तर त्यांनी प्राथमिक शिक्षण सक्तीचे करण्याचा कायदा केला. अशा स्वरूपाचा कायदा

करणारे कोल्हापूर संस्थान हे भारतातील पहिले संस्थान होते. त्याचबरोबर त्यांनी माध्यमिक व तंत्र शिक्षणालाही महत्त्वाचे स्थान दिले.

माध्यमिक शिक्षण व उच्च शिक्षण :- शाहू महाराजांनी प्राथमिक शिक्षण प्रमाणेच माध्यमिक व उच्च शिक्षणाला महत्त्वाचे मानले.उच्चवर्णीयांसाठी वेगळ्या शाळा आणि अस्पृश्यांसाठी वेगळ्या शाळा ही पद्धत त्यांनी बंद केली. एकाच शाळेत सर्व जाती धर्माचे लोक शिक्षण घेतील अशी व्यवस्था त्यांनी केली. आपल्या संस्थानातील गरीब होतकरू विद्यार्थ्यांच्या शिक्षणासाठी त्यांनी शिष्यवृत्ती दिली. परदेशी शिक्षण घेण्यासाठी मदत केली. त्याकाळात कोल्हापूर संस्थानात शाहू महाराज शिक्षणावर एक लाख रूपये खर्च करीत होते.

दलितांसाठी मोफत शिक्षण:-

२४ नोव्हेंबर १९११ रोजी शाहू महाराजांनी आदेश काढून संस्थानातील सर्व अस्पृश्य वर्गास सर्व प्रकारचे शिक्षण मोफत करण्यात आले. त्याचप्रमाणे दलित समाजातील दैन्यावस्था विचारात घेऊन त्यांच्या शिक्षणास उत्तेजन दिले. यासाठी त्यांना पुस्तके, वह्या, पेन्सिल, पाटी मोफत देण्यासाठी काही रक्कम मंजूर केली.

कोल्हापूर संस्थानात दलितांसाठी चालणाऱ्या शाळांची संख्या

अ.नं.	वर्ष	शाळा
१.	१९००-१९०१	०६
२.	१९०६-०७	१२
३.	१९०९-१०	२२
४.	१९१२-१३	२७
५.	१९१७-१८	२२
६.	१९१८-१९	१९

(संदर्भ कोल्हापूर संस्थानाचा सर्वसाधारण प्रशासन अहवाल १९०० -०१ ते १९१८-१९)

स्त्री शिक्षण :-

पूर्वीच्या काळी बालविवाह प्रथा होती ही प्रथा नष्ट करण्यासाठी स्त्रियांना शिक्षण देणे शाहू महाराजांना आवश्यक वाटले. म्हणून शाहू महाराजांनी स्त्रीशिक्षणासाठी पुरोगामी निर्णय घेतले. संस्थानातील स्त्रीशिक्षणाची व्यवस्था पाहण्यासाठी त्यांनी स्त्रीशिक्षण अधिकारी पद निर्माण केले. ही जबाबदारी त्यांनी रखमाबाई केळवकर यांच्याकडे सोपविली आणि मागास वर्गातील स्त्रियांसाठी १९१९ मध्ये कायदा करून मुलींच्या शिक्षणासाठी त्यांच्या राहण्याची व जेवणाची व्यवस्था सरकारकडून केली. त्यासाठी शिष्यवृत्ती पण ठेवली गेली.

मुलींच्या उच्च शिक्षणाबाबतही शाहू महाराज आग्रही होते. महाविद्यालयीन शिक्षण घेणाऱ्या विद्यार्थिनींना त्यांनी मोफत शिक्षण सुरु केले.कृष्णाबाई नावाच्या होतकरू विद्यार्थिनीला महाराजांनी मुंबईच्या ग्रँट मेडिकल कॉलेजला पाठविले.त्यानंतर त्यांना वैद्यकीय उच्च शिक्षणासाठी इंग्लंडला पाठवले. शाहू महाराजांनी त्यांची सून इंदुमती यांनाही शिक्षणासाठी प्रोत्साहन देऊन डॉक्टर बनविले.

कोल्हापूर संस्थानातील शैक्षणिक आलेख

अ.नं.	वर्ष	शाळा
१.	१८९३-९४	१९८
२.	१९०९-१०	२९३
३.	१९१०-११	३०१
४.	१९१३-१४	३६९
५.	१९२१-२२	४७६
६.	१९२२-२३	५५९

संदर्भ: कोल्हापूर आणि एस.एम.सी.संस्थानाचा शिरगणती अहवाल १९११ व १९२१

वसतीगृह स्थापना : शाहू महाराजांनी १८९६ मध्ये सर्व जाती जमातीच्या विद्यार्थ्यांसाठी एक वसतीगृह सुरू केले. परंतु त्यात केवळ ब्राह्मण विद्यार्थी प्रवेश घेत असत. परिणामी महाराजांनी प्रत्येक जातीतील विद्यार्थ्यांसाठी स्वतंत्र वसतिगृह स्थापन केले. त्यामध्ये मराठा बोर्डींग, जैन बोर्डींग, मिस क्लार्क होस्टेल, दयानंद होस्टेल, सारस्वत बोर्डिंग, कायस्थ प्रभु बोर्डिंग, देवांग बोर्डिंग, सुतार बोर्डिंग, मोहरी समाज बोर्डिंग, वैदिक स्कूल हॉस्टेल, वैश्य बोर्डिंग, जीनगर बोर्डिंग, आर्य समाज गुरुकुल, प्रिन्स शिवाजी बोर्डिंग इत्यादी वसतिगृहांचा समावेश होता. यावरून त्यांचा शिक्षण विषयक दृष्टिकोन दिसून येतो.

शिक्षक : शिक्षक हा अध्ययन-अध्यापन प्रक्रियेतील महत्त्वाचा घटक होय. शिक्षक गुणवत्तापूर्वक असेल तरच तो चांगले विद्यार्थी घडवू शकेल. यासाठी शिक्षक प्रशिक्षण आणि शिक्षकांसाठी प्रमोशन योजना सुरू करण्यात येऊन गुणवत्तापूर्ण शिक्षणाला प्राधान्य दिले. त्याचप्रमाणे शिक्षकांच्या प्रशिक्षणासाठी सहा महिने उजळणी वर्ग सुरू केले. प्रशिक्षणासाठी जाणाऱ्या शिक्षकांना निमपगारी रजा देण्याची तरतूद करण्यात आली.

कला शिक्षण :- डॉ.बाबासाहेब आंबेडकरांच्या शिक्षणासाठी शाहू महाराजांनी स्वत:हून मदत केली. केवळ समाज सुधारणेपुरता राज्यकारभार न करता महाराजांनी कलाक्षेत्राला देखील भरीव असे उत्तेजन दिले. त्यामुळे संगीत,

चित्रकला, लोककला या कलांचा विकास करण्यावर त्यांनी नेहमी भर दिला. त्यासाठी त्यांनी शाहीर, मल्ल, कलावंत यांना राजाश्रय दिला.

सारांश : शिक्षण हा जीवनाचा मूलभूत आधार आहे. शिक्षणापासून व्यक्ती स्वतःला वेगळे करू शकत नाही. म्हणूनच शाहू महाराजांनी सत्तेचा उपयोग वंचित, उपेक्षित समाजाला शिक्षण देण्यासाठी केला. समाजात जागृती घडवून आणली. यासाठी त्यांना उच्चवर्णीयांच्या रोषाला सामोरे जावे लागले, तरी पण त्यांनी आपले शिक्षण विषयक कार्य अविरतपणे सुरू ठेवले. शाहू महाराजांच्या मतानुसार अज्ञानात डुबलेल्या समाजात शूरवीर लढवय्ये कधीच निपजणार नाही. म्हणूनच त्यांनी सक्तीच्या शिक्षणाची आवश्यकता प्रतिपादित केली. बहुजन समाज शिक्षित व्हावा, याकरिता तंत्र शिक्षणाची संधी त्यांना मिळवून दिली. वंचित समूह शिक्षण प्रवाहात येण्यासाठी त्यांच्यासाठी स्वतंत्र वसतिगृह, शाळांची स्थापना, मोफत शिक्षण यासारख्या योजना त्यांनी प्रभावीपणे राबविल्या. एकंदरीत मानवी जीवनाशी संबंधित असलेल्या आणि ज्यांचा प्रभाव मानव विकासावर होतो अशा शैक्षणिक, सामाजिक वास्तवाचा महाराजांनी विचार केला. मानवाच्या सर्वांगीण प्रगतीसाठी शिक्षणाला पर्याय नाही, हे त्यांनी अचूक जाणले होते. त्यासाठी त्यांनी योग्य असे निर्णय घेऊन समाज जागृती घडवून आणली.

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डॉ.रमेश जगन्नाथ निकम
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श्रीमती विमलाबेन खिमजी तेजूकाया
कला, विज्ञान आणि वाणिज्य महाविद्यालय,
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Applications of Lua in LaTeX for Performing Standard Mathematical Operations

in the Three-day International Conference on Analysis and Applied Mathematics (ICAAM-2022) held at Ayya Nadar Janaki Ammal College (Autonomous), Sivakasi during 26th - 28th of April, 2022.

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Applications of Lua in LaTeX for Performing Standard Mathematical Operations

Chetan Shirore

Department of Mathematics, Institute of Chemical Technology, Mumbai.

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ABSTRACT

There is good scope to perform standard mathematical operations in LaTeX using Lua. This approach is suitable for performing standard mathematical operations in LaTeX as compared to other approaches such as using python or sagemath in LaTeX. No special environment is required for performing such tasks. The Lua Programs and user defined commands are introduced in this paper for performing standard mathematical operations in LaTeX. These commands can run in any environment (including mathematics environment). The core part of programming is done in Lua and tex file is to be compiled with LuaLatex engine. The time required for operations is no issue while compiling with LuaLaTeX. There is no need to install lua on users system as TeX distributions (TeXLive or MikTeX) come bundled with LuaLaTeX. The commands are useful to perform usual operations (addition, subtraction, multiplication, division, powers, roots etc.) in TeX file itself. The nesting of commands for multiple operations are supported. The programs and commands introduced in the paper can further be extended or modified by writing custom Lua programs.

KEYWORDS: LaTex, Lua LaTex

Traveling Wave Solutions of Fractional Differential Equationsarising in Warm Plasma

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ABSTRACT

The purpose of this paper is to study the fractional partial differential equations arising in warm plasma, which exhibits travelling wave solutions. Korteweg-De Vries and Kawahara equations are used to analyze magnet-acoustic waves in cold collision-

Azadi Ka Amrit Mahotsav

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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28-30 July, 2022

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He/She has presented paper entitled Applications of Lua in Latex for performing standard operations on complex numbers

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Convenor, ICMSA-2022
School of Mathematical Sciences,
S.R.T.M.University,Nanded.

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Implementation of New Education Policy 2020: Adaptation of Guidelines on NHEQF & Curricular Framework & Credit System for Four Year Undergraduate Programme (FYUP)

Editors

Kanade K. G.

Shaikh E. A. | Dange A. M.

Bhor A. K. | Ugale S. D.

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Kanade K.G.

Shaikh E.A.

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From Editor's Desk

Formal education is the thing that differentiate the human beings from the rest of living beings on this plant. The education, as a mean for survival in demanding, challenging and competitive world, need to be evolved to keep up with the economic and technological changes and job trends across the globe.

In recent years, there has been a growing interest in the concept of a four-year undergraduate program as an alternative to the traditional three-year program. The idea behind the four-year program is to provide students with a more comprehensive education, allowing them to develop a deeper understanding of their chosen field of study and prepare for a wider range of career opportunities.

The New Education Policy, proposed by the Government of India in 2020, had identified the need for this structural change, to move towards the modernization of higher education and provide a more well-rounded and valuable educational experience for students. However, the policy makers started sensitizing the stakeholders about the proposed changes in the curricular framework and seeking their feedbacks and suggestions to anticipate and identify the probable obstacles in its effective implantation.

As part of their initiative, the Savitribai Phule Pune University had sponsored a state level workshop on the theme of 'Implementation of New Education Policy 2020: Adaptation of Guidelines on National Higher Education Qualification Framework (NHEQF) and Four Year Undergraduate Programme (FYUP)'. The organizing committee of this workshop invited the insightful and critical views on the theme of the workshop from the stakeholders. With a rigours editorial process articles meeting the expectations are selected to be the part of this book.

The book is designed to include information on newly proposed national higher education qualification framework and curricular framework and credit system for four year undergraduate programme. It covers the information about major/core courses, minor courses, generic electives, skill-based and vocational courses, internships, projects, community engagement – features, goals, and credit weight assigned to them. The book also comments on how the provisions such as multiple entry and exit, digitalization of

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credits, promotion of ODL, cluster of colleges, and professor of practices can be effectively used to realization of the outcomes of FYUP.

The book highlights the importance of innovative and technology-based pedagogy for students' engagement. The book guides the readers on how the Outcome-Based Teaching-Learning and Evaluation process could shape the overall experience of the students and teachers in coming year.

The book is also provide information on stakeholder perceptions and concerns about the proposed changes in programme structure and the challenges in the effective implementation of FYUP.

We are thankful to the authors for their creative and critical contribution. We are also like to express our gratitude towards the chairman, secretary and joint-secretary of Rayat Shikshan Sanstha for their visionary guidance in adaptation to new development in the field of higher education. We grateful to the Hon. Diliprao Walse Patil, chairman of College Development Committee and the Prin. K.G. Kanade sir for their support in organization of this state level workshop. We are also thankful to the authorities of Savitribai Phule Pune University for partially sponsoring the publication cost of this book.

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ADAPTATION OF INNOVATIVE PEDAGOGY FOR EFFECTIVE IMPLEMENTATION OF NEP 2020

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Abstract:

The National Education Policy 2020 declared by the Government of India endeavours to achieve the holistic development and expertise in specialized fields of its young population by giving them the finest education to maximize its rich talents and resources. The present article aims to deliberate on the National Education Policy 2020 and discuss the need for and ways of adapting innovative pedagogy. The key focus is on discussing the strategies for effective learning of study material and avoiding rote learning; the development of life skills and soft skills of communication and teamwork; problem solving; critical thinking; and creative thinking. The author discusses various pedagogies suggested by educational psychologists that would be helpful in the effective implementation of the policy. The expected skills and abilities can be taught with the help of proven teaching strategies and by being innovative in modifying these strategies according to the needs of individual classrooms.

Key Words: National Education Policy 2020, Innovative Pedagogy, Educational Psychology

Adaptation of Innovative Pedagogy for Effective Implementation of NEP 2020

An investment in knowledge pays the best interest. India has had a very strong base of education since ancient times. Its Gurukul system was famous worldwide. It was one of the attractions for several foreign visitors. Modern India also recognizes the need for quality education. It seeks the achievement of full human potential, the development of an equitable and just society, and the promotion of national development through quality education. The National Education Policy 2020 mirrors these efforts.

The policy makers acknowledge that individual and societal welfare is at the core of country welfare and the welfare of the world. The finest edification is fundamental for developing and maximizing our country's rich talents and resources to achieve the aforesaid welfare. In the upcoming decade, the nation will be the top country in the world with a young population. It will turn out to be our biggest resource

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if we educate them appropriately. The National Education Policy 2020 endeavors to achieve this purpose.

Objectives

- To deliberate on the National Education Policy 2020
- To discuss the need for and ways for adaptation of innovative pedagogy.

As the policy is newly launched, research related to it is rare and scarce. The author of this article has attempted to contemplate the effective implementation of the policy with prior exposure to the research in educational psychology. The policy has a wide vision of holistic and multidisciplinary education that has deep roots and pride in India. It tries to do so by being more inclusive in its curriculum and by emphasizing extensive use of technology. But the present article mainly focuses on strategies for effective learning of study material and avoiding rote learning; the development of life skills and soft skills of communication and teamwork; problem solving; critical thinking; and creative thinking.

Discussion:

Pedagogy is an approach to teaching. The Merriam-Webster dictionary defines it as ‘an art, science, and profession of teaching.' Pedagogy characterizes an organized system of findings about educational processes and the results of these processes, as well as the conditions and factors that shape education. It also denotes the key mediators in the educational process. It formulates and defines norms, principles, and guidelines for education and upbringing by proposing theories and verifying them in practice. (Timofeeva et al., 2020)

The pedagogical approach of an educator directs his teaching strategies. It aims at liberal as well as vocational education. Liberal education focuses on developing human potential, while vocational education concentrates on the imparting and acquisition of specific skills. The New Education Policy 2020, declared by the government of India, focuses on both liberal and vocational education. It stresses the holistic education of students that would help develop all capacities of human beings, which includes qualities that will help individuals progress, e.g., intellectual, aesthetic, physical, and emotional advances, and the development of soft skills. But it is not only limited to individual development but also envisions his social development by stressing ethical and moral education. The policy gives importance to rigorous specialization in a chosen field of learning, i.e., vocational education.

So, educationalists need to adapt new teaching and learning methods to achieve the goals of liberal as well as vocational development. The question is what pedagogical methods would help achieve this twofold goal and how teachers can adapt them.

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Educational psychology can offer the best answers. The basic tenet of educational psychology is that teachers need to construct knowledge in students' minds, not simply impart it. The approach is known as constructivist theories of learning, which expect students to be actively participating in learning and continually checking new information against old rubrics and then revising rubrics that no longer work. Due to these reasons, constructivist strategies are often called student-centered education. In a student-centered classroom, the teacher becomes the "guide on the side" instead of the "sage on the stage," helping students to discover their own meaning instead of lecturing and controlling all classroom activities (Noddings, 2008; Weinberger & McCombs, 2001; Zmuda, 2008; Slavin, 2006). It is quite different from the traditional approach to teaching, where one-way communication was a way of teaching and students had to trust and follow the expertise of the teacher without much questioning or independent inquiry. The new Education Policy 2020 emphasizes student-cantered education.

The policy emphasis on conceptual understanding rather than rote learning entails the memorization of facts or associations. Conceptual learning involves students' engagement in quality learning experiences that are based on key concepts and central ideas. The students are likely to relate new information to the information they already have. Making learning relevant and activating prior knowledge can be very effective in conceptual learning. This can be achieved through the methods of advanced organizers, analogies, elaboration, and using conceptual models. One of the ways to increase students' understanding and reduce rote learning is through cooperative scripting. Several students find it difficult to study alone. They prefer to discuss the study material for better understanding. This longstanding practice has been formalized as an effective study method where students form pairs and alternatively summarize the sections of the material for one another. While one student of the pair reviews the material, the other listens and corrects any errors or slips. Then they switch roles and continue until all the material is covered. The research of O'Donnell (2006) and Keer and Vanderlinde (2013) has shown that students who practice this method learn and remember better than students who review on their own or simply read the material and their studies.

The policy accentuates life skills such as communication, teamwork, leadership, and resilience. Life skills can be taught indirectly while teaching regular subjects with innovative methods. For example, adapting cooperative learning methods will be helpful in teaching the specific subject as well as life skills, as the method is mostly based on peer assistance. Here, students work together in small and different ability groups and stay together in group for several weeks or months to help each other learn. They are usually taught specific skills that will help them work together well,

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such as active listening, giving good explanations, avoiding insults and criticism, and including other people (Slavin, 2006). The various types of cooperative learning methods are useful in teaching the different skills expected by the policy. For instance, Student Teams—Achievement Divisions (STAD) suggests making groups of four students with different abilities, genders, and ethnicities. After the presentation of a lesson by a teacher, students work together in their respective teams to ensure that all team members have grasped the study material. Finally, all students have to take individual quizzes on the material, where they cannot help each other. Apart from learning the syllabus material, students also learn cooperation, gender sensitivity, and ethnicity reverence, the values needed for their social development.

Likely, in the Teams—Games—Tournaments (TGT) Method, students play games with other teams to add points to their team scores. They can learn the importance of both cooperation and competition at the same time. Similarly, the Learning Together Model developed by David Johnson and Roger Johnson (1999) involves students working in heterogeneous groups of four to five members that are assigned a single task and receive praise and rewards based on the group's product. The model ensures team-building activities, one of the skills expected by the policy. The practice of other methods of cooperative learning, like Learning Together developed by David Johnson and Roger Johnson (1999), Peer-Assisted Learning Strategies (PALS), Informal Cooperative Learning Structures, and Project-Based Learning encouraged by John Dewey, an education reformer of the twentieth century, will also be a beneficial strategy in the effective implementation of the policy. The method of cooperative scripting mentioned earlier can also be very useful in developing the expected soft skills and people skills. The tutors can be innovative in modifying these methods according to the needs and situations of their classrooms. Though these methods are used in some educational institutions on a limited scale, their extensive use should be encouraged.

The policy also identifies problem-solving skills as an important soft skill to be learned. The learning cannot be said to be fruitful if students don’t attain the ability to solve problems with their learning. And importantly, the research of Fuchs et al. (2006) shows that the skill of problem solving can be taught and learned. For instance, the proven five-step strategy like IDEAL developed by Bransford and Stein (1993) can also be taught. The acronym IDEAL represents five steps to solving a problem. The letter "I’ in the acronym suggests the first step of identifying problems and opportunities; ‘D’ signifies the second step of defining goals and representing the problem; ‘E’ describes the third step of exploring possible strategies; "A’ denotes the fourth step of anticipating outcomes and acting; and "L’ calls for the final step of looking back and learning. The means-end analysis and other strategies of extracting relevant information from

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authentic sources, representing the problem by using diagrams and drawings, graphs, flowcharts, outlines, and other means of summarizing and depicting the critical components of a problem can also be taught (Jitendra et al., 2009; Van Meter, 2001). The strategies like incubation, suspension of judgment, appropriate climates, analysis, engaging problems, and feedback shall be taught to the students for fostering creative problem solving.

The policy acknowledges the importance of thinking skills and promotes critical thinking to encourage logical decision-making and innovation. The researchers have tried to develop and assess teaching strategies designed to increase students' general thinking skills. One of the approaches to teaching the skill is to integrate thinking skills into daily classroom teaching and thus create a "culture of thinking". The four-step process of stating, searching, evaluating, and elaborating can be used in classroom discussions on a particular topic.

The ability of critical thinking is crucial in making rational decisions about how to act in a particular situation and whether to believe or not in specific information. The ability can be improved with practice. Students can be provided with practice experiences by unravelling dilemmas, demonstrating logical and illogical arguments, showing valid and misleading advertisements, etc.

The various methods of conceptual learning and life skills as well as soft skill development discussed above can be helpful adaptations for innovative teaching.

Conclusion:

The New Education Policy 2020 can be effectively implemented with the principles and research in educational psychology. The expected skills and abilities can be taught with the help of proven teaching strategies and by being innovative in modifying these strategies according to the needs of individual classrooms.

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Current Trends in Socio – Economics Development

Dr. Asha Dadasaheb Kadam
Dr. Jayashri Pandharinath Jadhav
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First Edition

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ECOLOGICAL ASSESSMENT OF ALGAL FLORA BIODIVERSITY IN LENTIC HYDROSPHERE

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Biogenic Synthesis of Lead-Based Nanoparticles and Their Recent Applications

Khanderao Pagar, Suresh Ghotekar, Onkar Pardeshi, Shreyas Pansambal, Sachin Pawar, Jigna Machhi, and Balasaheb Pagar

Abstract Lead nanoparticles (Pb NPs) are a type of metallic NPs employed in diverse uses, including sensors, ceramics, glasses, pigments, batteries, and solar cells. The production of harmful chemicals and noxious contaminants is a major issue in the chemical synthesis of Pb-based NPs. Many research investigations on the eco-benign fabrication of Pb-based NPs employing microbial biomass and plant extracts without creating toxic waste have been performed to deal with these problems. Plants could be particularly useful for studying the biosynthesis of Pb-based NPs among green sources. The green synthesis of Pb-based NPs like Pb NPs, PbO NPs, and PbS NPs using diverse plant extracts and microbes in the absence of harmful capping agents has been discussed. The current advancement and future direction in the eco-benevolent production of Pb-based NPs are discussed in this chapter. Furthermore, the biosynthesized Pb-based NPs' uses have been highlighted.

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1 Introduction

Modern nanoscience has recently gotten a lot of popularity because of its revolutionary and future implications in diverse industries [1–5]. Nanotechnology is an interdisciplinary branch of research that covers the development, analysis, and application of nanomaterials [6–9]. Nanoparticle fabrication has a large surface area-to-volume ratio, which is responsible for important uses in food technology, optical devices, cosmetics, defense, textile industry, electrochemistry, pharmaceutics, space industry, optics, mechanics, sensors, water treatment and purification, catalysis, and electronics [10–25].

Nowadays, modern green nanotechnology has risen to prominence because it uses plant extracts and a variety of bio-materials to create a safer, cleaner, ecologically sound, and environmentally friendly alternative to traditional physiochemical approaches [26, 27]. The use of plant resources for NP synthesis does not require complicated methods. Green chemistry is a long-term replacement for traditional reduction processes that require natural chemicals with dual reducing and capping properties [28, 29]. Green synthesis approaches have advantages over physical and chemical synthesis because they are highly cost-effective and environmentally friendly for synthesizing NPs with high yield [30, 31]. In addition, plant extracts have frequently been used as abundant sources of phytomolecules, facilitating the creation of stable NPs that are free of harmful chemicals and have robust medicinal properties [32].

Lead is a p-block element typically applied in industrial uses and is generally detrimental to the environment and human health; it is especially fatal when consumed orally or inhaled [33, 34]. Lead-containing substances can have a variety of negative consequences, including oxidative stress [35], genetic toxicity [36], and neurological impacts [37]. Pb NPs perform an essential impact in electronic sciences, particularly sensors. Pb-NPs have been produced employing a variety of approaches, including UV-light reduction, reverse micelles, tetrazolium-based ionic liquids, and reduction of lead salts [38].

Due to its superior electrical, mechanical, and optical characteristics, lead oxide nanoparticles (PbO NPs) are commonly used in some fields, including gas sensors, colors, ceramics, glass, batteries, and semiconductors [39–43]. In addition, it is commonly applied in road construction, construction skeleton, and shipbuilding due to its antibacterial, rustproof, and anti-algae features [44, 45]. PbO is a semiconducting material with two separate crystal structures: tetragonal (litharge) and orthorhombic (massicot) [46, 47]. Tetragonal crystals have a red color with the α-PbO form demonstrated to be stable at lower temperatures, whereas orthorhombic crystals have a yellow color with the β-PbO form, that is, at higher temperatures. Also, PbO is a viable photovoltaic material [48] mostly used as an optically active semiconductor [49, 50] with band gaps of 1.92 and 2.7 eV. To date, PbO NPs have

been fabricated using a variety of approaches, including solvothermal method [51], chemical deposition [52], microwave radiation [53], sol-gel pyrolysis [54], thermal decomposition [49], aerogel decomposition [55], and sonochemical method [56]. Moreover, the lead chalcogenide of PbS possesses unique electrical and optical properties. Therefore, they have a variety of photonic applications in sensing, solar cells, light-emitting diodes, and photo-detectors for telecommunications [57–60].

Unfortunately, as mentioned above, these approaches have some pitfalls. Physical fabrication strategies require high vacuum and energy, whereas chemical approaches are connected with noxious and pernicious waste production. Alternatively, green and eco-benign approaches have been developed to mitigate the burden of hazardous waste and energy usage [3–5]. For producing multifunctional metal, metal oxide, and metal sulfide NPs, the interaction between therapeutic plants and metal-based NPs has been regarded as a promising field of research. Although the chemical synthesis of Pb-based NPs has been effectively described, there are only a few reports on the biosynthesis of Pb-based NPs in the literature.

Thus, the focus of this chapter is to offer a report on the eco-friendly synthesis of Pb-based NPs and their recent application.

2 Green Fabrication of Pb-Based NPs

Nowadays, green nanotechnology synthesis involves the production of NPs and/or nanomaterials without the use of hazardous chemicals that produce harmful waste materials. In other words, eco-benevolent synthesis is an environmentally sustainable, simple, and less expensive method of producing nanoparticles that is not harmful to human health or the environment. Indeed, existing conventional methods can produce NPs in large amounts with precise size and topology. Regardless, these methods necessitate costly protocols, as well as sophisticated, time-consuming, hazardous, and out-of-date protocols [1]. On another side, the green approaches have some advantages, including a simple manufacturing technique, a quick and simple economic model, and minimal waste creation. Furthermore, bio-materials, fungi, microbes, and plant extracts are employed in the biogenic fabrication of Pb-based NPs [1–3]. Green fabrication of Pb-based NPs employing diverse microbes and medicinal plant extracts is presented in Table 1.

2.1 Synthesis of Pb NPs from Microbial Biomass and Plant Extracts

In the green synthesis process of NPs, biomolecules found in plant extracts and microbial biomass can serve as both bio-reductant and bio-stabilizers. Various aqua-soluble plant metabolites and coenzymes are among the bio-reductants and

Table 1 Environmentally gracious fabrication of Pb-based NPs employing diverse microbes and medicinal plant extracts with structural properties

NPs	Name of entities (plants/microbes)	Parts	Characterization techniques	Shape	Size (nm)	Ref.
Pb	*Avivennia marina*	Leaves	UV-vis, XRD, TEM, FTIR	–	15–25	[61]
	Cocos nucifera	–	UV-vis, XRD, TEM,	Spherical	47	[38]
	Aspergillus sp.	Biomass	SEM, TEM	–	5–20	[62]
	Jatropha curcas	Latex	UV-vis, XRD, TEM,	Spherical	5–17.5	[63]
	Serratia plymuthica	Biomass	UV-vis, XRD, TEM, DLS	–	92.93	[64]
PbO	*Sageretia thea*	Leaf	UV-vis, XRD, TEM, FTIR, HR-TEM	Quasi-spherical	27	[65]
	Averrhoa bilimbi	–	XRD, FTIR, SEM	Nonuniform	–	[66]
	Datura sternum	Leaf	UV-vis, XRD,	–	60	[67]
	Eucalyptus globulus	Leaves	UV-vis, FTIR, SEM, HR-TEM, XRD, PL, EDS	–	34.61	[68]
PbS	*Aspergillus flavus*	Biomass	UV-vis, FTIR, SEM, TEM, EDX, XRD	–	35–100	[69]
	Aspergillus sp.	Biomass	UV-vis, XRD, PSA, TEM	Spherical	10–15	[70]
	Desulfotomaculum sp.	Biomass	XRD, TEM	Spheroidal	13	[71]
	Rhodosporidium diobovatum	Yeast	UV-vis, TEM, XRD, EDS	Spherical	2–5	[72]
	Torulopsis sp.	Biomass	UV-vis, XRD, XPS, TEM	–	–	[73]

bio-stabilizers involved. Bio-materials, fungi, microbes, and plant extracts are utilized in the biological production of Pb NPs. The biogenic synthesis of Pb NPs has been successfully achieved using extracts from various plant species.

Elango et al. [38] revealed the green fabrication of spherical-shaped Pb NPs employing *Cocos nucifera* extract as a bio-reductant as well as a bio-stabilizer with a mean diameter of Pb NPs was estimated to be around 47 nm [38]. Green synthesis of Pb NPs employing a leaf extract of *Avivennia marina* was described by Shankar et al. [61]. This experiment stirred the reaction mixture on a magnetic stirrer at 60 °C [61]. Pavani et al. [62] reported the fabrication of Pb NPs from lead acetate utilizing *Aspergillus* sp. biomass as a natural fuel [62]. Facile biosynthesis of spherical-shaped Pb NPs employing an aqueous latex extract of *Jatropha curcas* was described by Joglekar et al. [63] with a median size of 5–17.5 nm [63]. Ramadan et al. [64] applied biomass of *Serratia plymuthica* to produce Pb NPs that had a mean NPs diameter of 92.93 nm [64].

2.2 *Synthesis of PbO NPs from Plant Extracts*

Implementing plant extracts in the fabrication of NPs is an effective way to adopt a green chemical strategy. Herein, Khalil et al. [65] employed an aqueous leaves extract of *Sageretia thea* to synthesize PbO NPs with a mean diameter of 27 nm. This eco-benevolent production of PbO NPs has occurred at 60 °C [65]. The schematic layout for the eco-benevolent synthesis of PbO NPs is presented in Fig. 1. Also, Hamid et al. [67] described the green production of PbO NPs

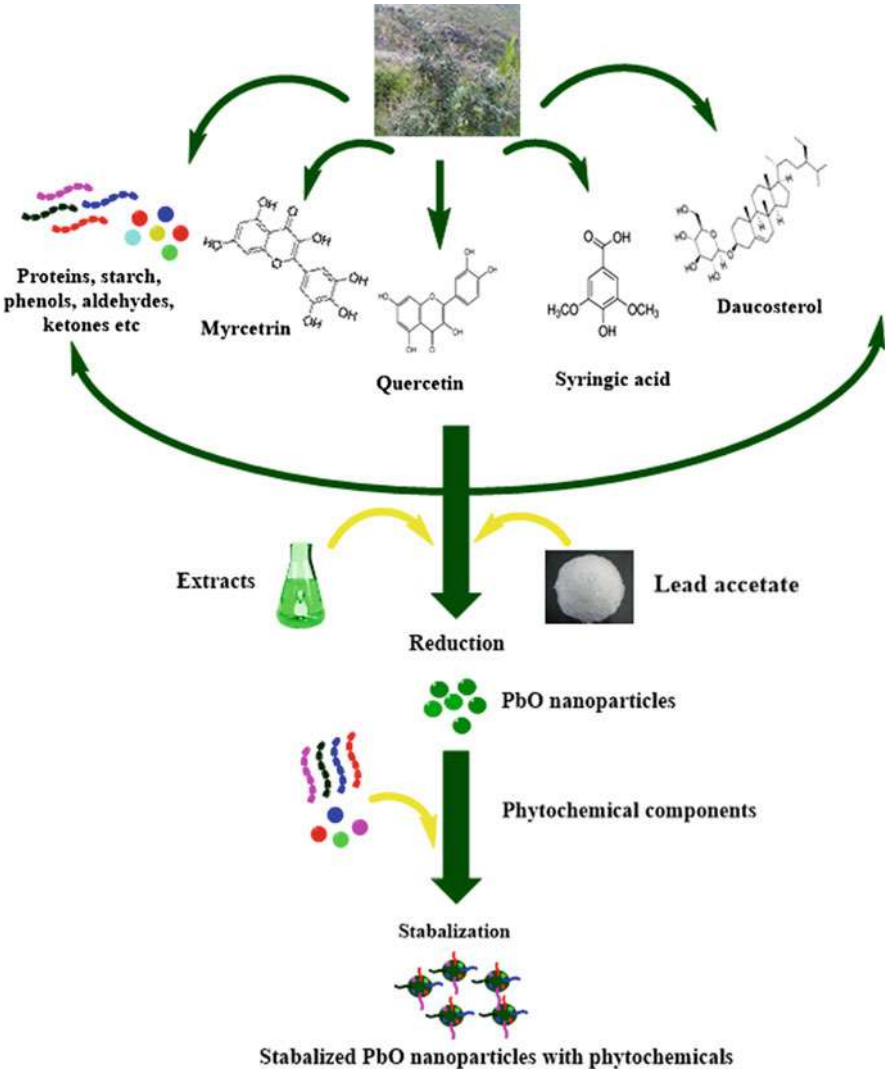

Fig. 1 Schematic presentation of eco-friendly fabrication of PbO NPs. (Reproduced from ref. [65])

employing leaf extract of *Datura sternum*. The average diameter of PbO NPs in optimum conditions was around 60 nm [67]. Moreover, Tailor et al. [68] used *Eucalyptus globulus* aqueous leaf broth as a natural fuel to create PbO NPs. As-synthesized PbO NPs estimated 34.61 nm in size, according to XRD analysis [68].

2.3 Green Synthesis of PbS NPs from Microbial Biomass

With the utilization of microbial biomass, effective biosynthesis of PbS NPs has been accomplished. Metal NPs have long been synthesized using several microbes, including bacteria, fungi, and yeast. The following summarizes the literature on the biosynthesis of PbS NPs employing microbes. Recently, PbS NPs were synthesized using biomass *Aspergillus flavus* [69]. This biomass efficiently synthesized PbS NPs of the median size of 35–100 nm. In another study, PbS NPs were synthesized using *Aspergillus* sp. in 25 °C with the size ranging from 10 to 15 nm [70]. Also, PbS NPs were prepared via *Desulfotomaculum* sp. with a diameter of 13 nm. The incubation was kept at 30 °C for 48 h, and pH was kept between the range of 5 and 9 [71]. Diverse characterization techniques confirmed the formation and stability of PbS NPs. Biosynthesis of PbS NPs using microbial biomass and their structural properties are presented in Table 1.

3 Recent Applications of Biosynthesized Pb, PbO, and PbS NPs

Pb-NPs nanoparticles can be used in a variety of ways. Therein, antibacterial and pesticidal activities of *Avivennia marina*-mediated Pb NPs against *E. coil*, *Streptococcus*, *Staphylococus*, *Shigella*, *Vibrio*, *Salmonella*, *Enterobacteria*, and *Sitophilus oryzae* were evaluated. This study showed remarkable pesticidal activity. However, more accurate studies are required before recommending Pb NPs for pest management [61].

Elango et al. [38] employed *Cocos nucifera* extract for green production of Pb NPs and investigated their antimicrobial effect against *Bacillus subtilis*, *Staphylococcus epidermis*, *E. coli*, and *Staphylococcus aureus*. Also, they revealed the photocatalytic performance of as-synthesized Pb NPs for malachite green dye.

Khalil et al. [65] easily prepared the PbO NPs by employing aqueous leaves extracts of *Sageretia thea* and studied the biocompatibility and biological applications of PbO NPs. As a result, they showed that the synthesized PbO NPs have considerable bactericidal effectiveness against *Staphylococcus epidermis*, *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis*, *Klebsiella pneumonia*, and *Pseudomonas aeruginosa*. They also reported the antioxidant, enzyme

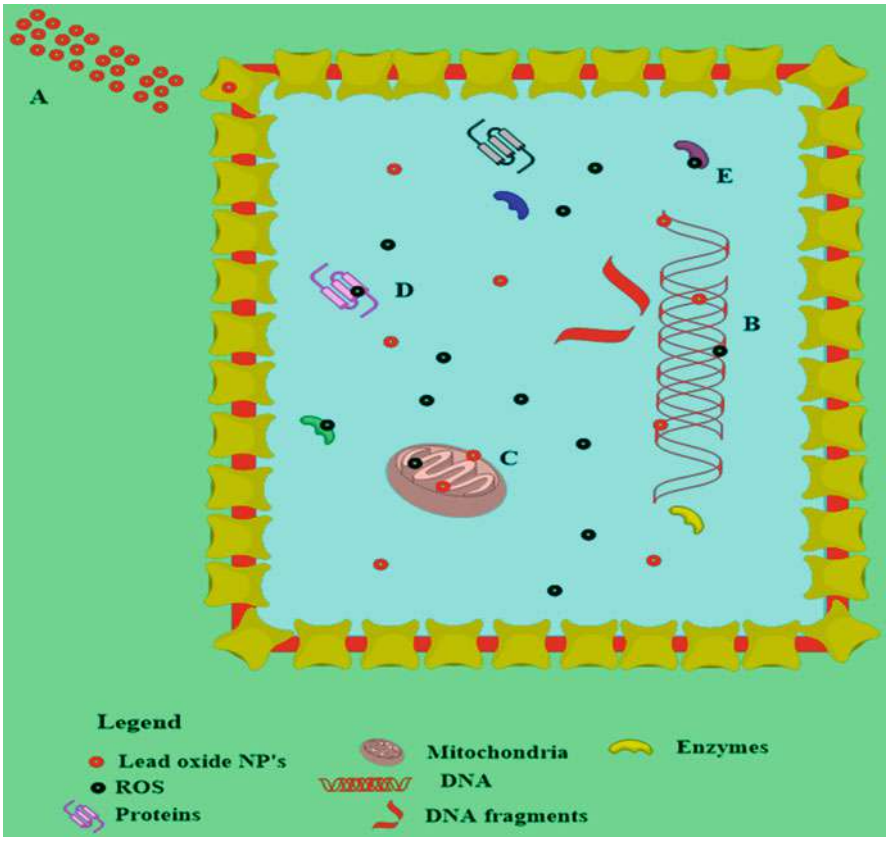

Fig. 2 Schematic presentation of the cytotoxic nature for biosynthesized PbO NPs. (Reproduced from ref. [65])

inhibition, and antileishmanial activities of PbO NPs. Furthermore, the authors investigated the MTT cytotoxicity study of PbO NPs and depicted their schematic mechanism in Fig. 2.

Moreover, Tailor et al. [68] investigated the eco-benign synthesis of PbO NPs utilizing leaf extract of *Eucalyptus globulus* and reported their bactericidal effect. The synthesized PbO NPs exhibit a significant bactericidal effect against *E. coli* and *Staphylococcus aureus*.

Priyanka et al. [69] revealed the biosynthesis of PbS NPs employing biomass of *Aspergillus flavus* was in the diameter of 35–100 nm. Therefore, these as-synthesized PbS NPs were effectively used to detect arsenic in the aqueous medium.

4 Future Directions and Conclusion

According to a report on the most recent breakthroughs in this field, these NPs were synthesized with low-cost equipment employing microbes and plant extracts in green, easy, nontoxic, and quick processes. One of the safest, most sustainable, and most efficient green chemistry approaches are producing metal-based NPs employing plant extracts. Surprisingly, no harmful compounds are used or manufactured. Pb-based NPs are valuable in sensors, ceramics, glasses, pigments, batteries, and solar cells, among other applications. Only a few parts of different plants have been employed to synthesize Pb-based NPs. Plant extracts' active phytochemical/biomolecules are used to create Pb-based NPs. These plant phytochemicals not only speed up the reaction with a predictable output, but they also entirely prevent polluting the environment. In addition, microbes were employed in the production of Pb-based NPs. The most prominent implications of these green NPs structures formed by microbial biomass and plant extracts are the removal of hazardous chemicals.

Despite current breakthroughs in the biosynthesis of MNPs from plant sources, a couple of obstacles remain to be handled in the coming time:

- Only a few plants and microbes have been explored for the biosynthesis of Pb-based NPs. There is an opportunity to utilize diverse medicinal plants and microbes for the biosynthesis of Pb-based NPs.
- Implementation of bio-waste materials like eggshell, starch, gum, and cellulose are needed to be examined for the bio-inspired synthesis of Pb-based NPs.
- For the mechanism of Pb-based NPs formation, it is necessary to clarify the biomolecules available in the plant extract and microbial biomass.
- A study of the effects of time, temperature, concentration, and pH on the synthesis of Pb-based NPs is required.
- Biosynthesized Pb-based NPs can be explored by advanced characterization techniques.

Therefore, we believe that sustainable approaches have a significant role in the economic and industrial synthesis of Pb-based NPs. Furthermore, among the green chemistry technologies available, plants- and microbes-mediated synthesis of Pb-based NPs appear to be the most effective and ideal for cheap and scalable production.

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