Far Western University

Faculty of Education

Professional Bachelor of Education Program

Course Title: Curriculum, Assessment and Planning of Science Education

Course No.: Sc.Ed.524 Nature: Theoretical

Level: P.B.Ed Credits: 3

Semester: Second Teaching Hours: 48 Hrs

1. Course Description

This course is designed for students pursuing a major in science education under the Professional B.Ed. Studies. It lays a foundation for understanding the science curriculum and assessment from both theoretical and practical perspectives. Students will be engaged in individual and group tasks. It equips students with the knowledge and skills to design, implement, and evaluate science curricula and assessment strategies, aligning with the standards and promoting effective learning. Students will critically reflect on content areas and engage in individual and collaborative problem-solving and project-based learning tasks. The course includes five chapters that deal with the introduction to curriculum, analysis and development of science curriculum, curricular materials, curriculum planning, and assessment in science education.

2. General Objectives

The general objectives of this course are as follows:

- To equip the learners with a broader understanding of the science curriculum from different perspectives.
- To foster students' ability to perform critical content analysis of school science curricula.
- To review curricular materials and use them in teaching and learning science.
- To understand the various curriculum designs and review science in educational policies and the school curriculum.
- To elaborate on the various forms of assessment and develop and analyse assessment tools.

3. Contents in Detail with Specific Objectives

Specific Objectives	Contents
• To introduce the science curriculum from modern perspectives • Enlist the aims and objectives of the school science curriculum. • Assess the indigenous and socio-cultural perspectives on the science curriculum. • Elaborate on the paradigm shift, constructivist and pragmatist	**Unit 1: Introduction to Science Curriculum (8 Hrs)** 1.1. Concept of curriculum from modern perspectives 1.2. Aims and objectives of the school science curriculum 1.3. Indigenous and socio-cultural perspectives on science curriculum 1.4. Paradigm shift, constructivist and pragmatist perspectives in science curriculum development

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<tr><td>perspectives in science curriculum development.
• Elaborate on the emerging trends and innovations school science curriculum</td><td>1.5. Emerging trends and innovations in science curriculum: STEM, STEAM, research-based, competency-based science curriculum</td></tr>
<tr><td colspan="2">Assignment/Project Task:
• Explore the indigenous science in your community and find the linkages with modern science concepts in the school curriculum and present them in the class.</td></tr>
<tr><td>• Elaborate on the approaches of science curriculum development.
• Use of Ralph Tyler's four-step Model, Hilda Taba's curriculum model, and Wheeler's model for curriculum design in science education
• Overview on Explain the science curriculum development process in Nepal.
• Develop a paper on using the TPACK framework in science curriculum design
• Discuss the place of science in the national curriculum.
• Perform critical content analysis of the science curriculum and develop a review report.
• Evaluate the vertical and horizontal alignments in the school science curriculum</td><td>Unit 2: Development and Analysis of School Science Curriculum (10 Hours)

2.1. Approaches of science curriculum development: Subject-centered approach, Interdisciplinary approach, Process approach.
2.2. Overview on the use of Ralph Tyler's four-step Model and Hilda Taba's curriculum model, and Wheeler's model in science curriculum development
2.3. Use of the TPACK framework in science curriculum design
2.4. Science in the national curriculum
2.5. Critical content analysis of the school science curriculum: Integrated 1-3, basic level, and secondary level science curriculum.
2.6. Vertical and horizontal alignment in the school science curriculum of Nepal</td></tr>
<tr><td colspan="2">Assignment/Project Task:
• Perform critical content analysis of the science curriculum in terms of objectives, Design, content, vertical and horizontal alignment, instructional methods and evaluation, and develop a review report</td></tr>
<tr><td>• Illustrate the features and effective use of textbooks, teacher guides and digital materials in science teaching and learning.
• Review the school science textbook and teacher guide.
• Develop a report on various curriculum materials developed during international innovative curriculum development projects</td><td>Unit 3: Curricular Materials (8 Hrs)
3.1 Introduction to science textbook, reference books, and teacher guide
3.2 Features and use of science textbook, and teacher guide
3.4 Curricular materials developed in CHEM-study, BSCS, and Nuffield science projects.</td></tr>
<tr><td colspan="2">Assignment/Project Task:
• Review the school science textbook/ teacher guide and write a review report
• Develop a report on various curricular materials developed during CHEM-study, BSCS and Nuffield science projects</td></tr>
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- Explore the provisions, priorities, and programs for school science development in national education policies.
- Review National curriculum framework.
- Elaborate the key elements of curriculum planning.
- Explain the science curriculum development process in Nepal.
- Discuss the idea of decentralisation and localisation in the school curriculum.
- Report the challenges in school science curriculum development.

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Unit 4: Science Curriculum Planning (10 Hrs)

4.1 School Science in Education Policies: School Education Sector Plan and other relevant policies

4.2 Review of National Curriculum Framework

4.3 Key elements of curriculum planning

4.4 The science curriculum development process in Nepal

- Needs assessment.
- Setting goals and objectives
- Content selection and organisation
- Determining learning facilitation and evaluation
- Piloting and feedback
- Curriculum revision
- Implementation

4.5 Challenges in science curriculum development

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Assignment/Project Task:

- Develop a review report on science in educational policies i.e., NCF, SESP and other relevant policies.
- Explore the challenges of school science curriculum development in Nepal and present the paper.

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- Elaborate on the concept of assessment in science.
- Apply assessment as, for, and of science learning.
- Review the school science specification grid and develop a test item matrix.
- Distinguish between teacher-made tests and high-stakes testing by standardised achievement tests.
- Elucidate the requisites of a quality science test and review the science test paper.
- Analyze the school science specification grid and develop a test item matrix.
- Develop items for a science test using revised Bloom's taxonomy and develop a complete test paper for the school level using a specification chart and test matrix and marking schemes for test scoring.
- Develop and implement a practical skill test with rubrics and student portfolios.

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Unit 5: Assessment in Science (12 Hrs)

5.1. Concept of assessment

5.2. Assessment as, for and of learning science

5.3. Analysis o specification grid and development of test item matrix.

5.4. Teacher-made tests and high-stake testing by standardized science achievement tests

5.5. Quality of science tests and test paper

5.6. Designing of items for science test using revised Bloom's taxonomy and their marking scheme

5.7. Development and implementation of a practical skill test with rubrics and students' portfolios

5.8. Review of the NASA Study Framework developed by the Education Review Office.

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• Review the NASA study framework developed by ERO	
Assignment/Project Task: • Develop 10 multiple-choice, 5 short and 3 long questions using different level of the Revised Bloom's cognitive domain and their marking scheme • Review the NASA Framework developed by Education Review Office, MoEST, Nepal	

4. Instructional Techniques

4.1 General Instructional Techniques*:* Lecture, text reading, exercise course, tutorial, self-study, project work, assignments on different topics, group discussion, reflective writing

4.2 Specific Instructional Techniques

Unit	Teaching Methods and Strategies
1	- **Lecture & Discussion**: Use interactive lectures to introduce key concepts, followed by group discussions on different definitions, aims, and objectives of school science curriculum. Provide an overview on how to use Ralph Tyler's four-step Model for curriculum design, Hilda Taba's curriculum model and Wheeler's model in science curriculum development. - **Community Survey:** Conduct a community survey on the exploration of indigenous science and socio-cultural perspectives on science and find their scope in school science curriculum - **Document Review and Presentation:** Explore the paradigm shift, constructivist and pragmatist approaches in science curriculum development and present the findings in a group. **Collaborative Learning**: Encourage students to collaborate in small groups to explore the emerging trends and innovations in science curriculum, and discuss STEM, STEAM, research-based science curriculum
2	- **Interactive Lectures and Practice**: Introduce the various approaches of curriculum development and overview on the use of Ralph Tyler's four-step Model and Hilda Taba's curriculum model, and Wheeler's model in science curriculum development - **Guest lecture:** Invite guest lecture and sharing session to present process of school science curriculum development in Nepal - **Concept Mapping**: Create concept maps to illustrate the relationship between technological, pedagogical, and content knowledge in school science and discuss the use of TPACK framework in science curriculum design - **Review:** Review the position of science in the national school science curriculum **Critical content analysis and report writing**: Perform critical content analysis of integrated 1-3, basic, and secondary school science curricula and develop a report on the topics' general objectives, competencies, contents, instructional strategies, activities, and evaluation. Find the vertical and horizontal alignments, strengths, weaknesses, and areas for improvement
3	- **Flipped learning**: Provide students with pre-classroom tasks to study the features and uses of the textbook, reference books, and teacher guide, and help students organize classroom presentations, discussions, and consolidation sessions during face-to-face class sessions. - **Workshop and Review Report:** Assign each group a curricular material, such as a textbook, teacher guide, digital materials, or model lessons, to review and provide comments on them.

	Enlist the Materials: Enlist the materials developed by CHEM-study, BSCS, and Nuffield science projects, and develop innovative ideas to develop curricular materials for school science.
4	- **Interactive lecture and Policy Review:** Inform students about educational policies and their provisions and engage students in developing a policy review framework and review education policies of Nepal, such as NCF, SESP, and other relevant educational policies to find out their provisions, priorities, and programmes for school science education development in Nepal - **Review Report:** Analyze the National Curriculum Framework and develop a review report. - **KWL:** Students will participate in KWL activities to find the curriculum development process in Nepal. **Group Discussion and Presentation:** Explore the challenges of science curriculum development in Nepal and present it in the classroom.
5	- **Lectures cum discussion**: Provide an elaborated concept and uses of assessment as, for, and of learning science. - **Discussions & Reflections**: provide basic knowledge and facilitate comparative discussions on the tools of assessment, teacher-made tests, high-stakes testing, and standardized tests - **Presentation followed by discussion**: - Present the test paper and engage students to review it and conduct the debate on the requirements of a quality science test - **Item Writing with Marking Scheme:** Provide a task to write the test items with marking using the revised Bloom's taxonomy. Engage them to panel the items and present the finalized items in class. - **Group Projects**: Assign group projects where students design a practical skill test with rubrics and student's portfolio **Review:** Assign a group task to review the NASA Framework, the assessment framework of PISA and TIMSS and present in the class

5. Evaluation Scheme

5.1 Internal Evaluation 40%

Internal Evaluation will be conducted by the course teacher based on the following activities.

a) **Attendance and Participation in class activities**: **5+5=10 marks**
b) **Assignment I: Reflective Notes and Class presentation:** **5+5=10 marks**
(Reflective notes on 2 to 4 questions given by a teacher at the end of every unit and presentation on any two questions among them)
c) **Assignment II**: **one Term paper/ Essay/Project and Interview:** **5+5=10 marks**
(Logical essay/term paper/project on the topics chosen by students and approved by the teacher and the interview)
d) **Mid-term exam**: **10 marks**

5.2 External Evaluation (Final Examination) 60%

The Office of the Controller of Examinations will conduct the final examination at the end of the semester.

Types of questions	Total questions to be asked	Number of questions to be answered and marks allocated	Total marks
Group A: Multiple choice items	10 questions	10 × 1	10
Group B: Short answer questions	6 with 2 'or' questions	6 ×5	30
Group C: Long answer questions	2 with 1 'or' question	2 ×10	20

Recommended Textbooks

Akpan, B. & Kennedy, T. J. (2021). *Science education in theory and practice: An introductory guide to learning theory*. Springer.

Alsop, S. & Hicks, K. (2013). *Teaching science: A handbook for primary and secondary school teachers*. Routledge.

Davar, M. (2012). *Teaching of science*. PHI Learning Pvt. Ltd.

Davies, D. & McGregor, D. (2017). *Teaching science creatively*. Routledge.

Forster, S. (2009). *Methods of teaching chemistry*. Global Media.

Frase, B. J., Tobin, K. G., & McRobbie, C. J. (2012). *Second international handbook of science education*. Springer.

Hassard, J. & Dias, M. (2009). *The art of teaching science: Inquiry and innovation in middle school and high school*. Taylor and Francis.

Howe, A., Collier, C., McMahon, K., Earle, S. & Davies, D. (2017). *Science 5-11: A guide for teachers.* Routledge.

Joshi, S. R. (2007). *Teaching of science.* APH Publishing Corporation.

Martin, D. J. (2009). *Elementary science methods: A constructivist approach*. Wadsworth Cengage Learning.

Ornstein, A. C., & Hunkins, F. P. (2017). *Curriculum: Foundations, principles, and issues* (7th ed.). Boston, MA: Pearson.

Sears, J. & Sorensen, P. (2000). *Issues in science teaching*. Routledge.

Thomas, K., & Huffman, D. (2020). *Challenges and opportunities for transforming STEM to STEAM education*. IGI Global.

Far Western University
Faculty of Education
Professional B.Ed. Programme
(Pedagogy and Material Development in Schools: Teaching of Science)

Course Title: **Teaching of Science Education**
Course No: Sc.Ed. 425 Nature: Theoretical
Level: B.Ed. Credit Hours: 3
Semester: Second Teaching Hours: 48

1. Course Description

This course is designed to provide B.Ed. Science Education students with essential pedagogical knowledge, practical skills and material development. It emphasises the development, implementation, and evaluation of instructional materials tailored for science education. It integrates theoretical foundations with hands-on activities, enabling students to create effective teaching and learning resources that address the diverse needs of learners in the classroom. Throughout the course, students will engage in designing and preparing instructional materials, applying them in classroom settings, and developing analytical reports based on their experiences. The course promotes active engagement, reflective practice, and collaborative learning under the guidance of facilitators.

2. General Objectives

The general objectives of this course are as follows:

- To provide students with a foundational understanding of science pedagogy
- To equip students with the competencies to design and develop appropriate and effective instructional materials for science teaching and learning.
- To develop 21st-century skills and use them in the material development, teaching, and learning of science.
- To enhance students' capacity to use student-centred teaching methods and use them in pedagogical practice.
- To develop different plans for teaching science
- To perform action research by exploring the potential problems to be solved and writing a report action research report.

3. Contents in Details with Specific Objectives

Specific Objectives	Contents
● Define the concept and scope of science education. ● Identify the goals and objectives of teaching science at the school level. ● Explore 5E model (engage, explore, explain, elaborate, evaluate) and its effectiveness in science lessons. ● Apply inquiry-based teaching and learning strategies to enhance student engagement and critical thinking in science. ● Describe contemporary approaches to science	**Unit 1: Foundations of Science Pedagogy (10 Hrs)** 1.1 Concept and scope of science education 1.2 Goals and objectives of teaching science at school level 1.3 Contemporary approaches to science teaching and learning • Constructivism • Inquiry-based learning • 5E model • ABC model

teaching, including constructivism and inquiry-based learning. ● Analyze the role of science education in achieving sustainable development goals.	1.4 Science education and its role in sustainable development goals
Assignment/Project Task ✧ Visit a local school and observe science classes. Interview teachers to learn how they understand the goals and objectives of science teaching. Prepare a report explaining how these goals shape their teaching methods and student learning outcomes.	
• Explain the importance of material design for science learning. • Prepare worksheets, posters, charts and diagrams for science teaching and learning. • Develop audio-visual resources including recordings and videos related to science learning. • Make power-points and digital lesson modules tools and platforms. • Construct improvised (low-cost and no-cost) instructional materials.	**Unit 2: Material Design and Development Process (10 Hrs)** 2.1 Printed materials (worksheet, posters, charts, and diagrams) and their design 2.2 Audio-visual materials (audio recording, video recording and editing**)** and their development 2.3 Introduction, development and use of digital materials (PowerPoints, interactive quizzes, and digital lesson modules) 2.4 Development of low-cost and no-cost materials using local resources
Assignment/Project Task ✧ Develop low-cost or no-cost teaching aids using locally available resources and use them in the class. Also, write a mini report of its development.	
• Define scientific literacy with examples. • Describe the techniques for promoting scientific literacy among the students. • Apply critical thinking approaches in science lesson activities and teaching • Enlist the values of science teaching and learning at school level • Discuss the ways of stimulating life skills through science lessons. • Identify different types of science process skills and explain the ways of developing science process skills. • Explain chemistry pedagogy for the 21st century.	**Unit 3: 21st Century Skills in Science Education (10 Hrs)** 3.1 Developing of scientific literacy 3.2 Critical thinking approaches 3.3 Values of science education 3.4 Life skills development 3.5 Science process skills 3.6 21st-century relevant science pedagogy
Assignment/Project Task ✧ Interview science teachers and observe a science class to understand how their teaching reflects the broader vision of science education in today's world. Analyze the strategies used to foster curiosity, reasoning, and responsible citizenship.	
• Identify the key features of project-based and problem-based learning methods. • Demonstrate the use of collaborative and cooperative strategies in science activities. • Apply simulation tools and virtual field trips to	**Unit 4: Science Learning Methods (8 Hrs)** 4.1 Project-based and problem-based method 4.2 Collaborative and cooperative method 4.3 Simulation and virtual field trips in science teaching 4.4 Experiential and hands-on learning method

enhance science teaching. • Design hands-on science tasks that promote experiential learning. • Explain the steps of conducting the experimental method. • Compare the effectiveness of different science learning methods through group reflection.	4.5 Experimental and laboratory methods
Assignment/Project Task ✧ Observe five science classes conducted by school science teachers. Note down the methods they use. Based on this information, prepare the most suitable science teaching and learning method for your context. Share it with teachers and students. Then, apply it in your own class	
• Explain the need of planning for teaching • Develop daily lesson plans and weekly lesson plans, and implement them among the peers. • Detail out the unit planning of secondary science. • Design an annual plan for science facilitation. • Develop Co-curricular activities plan Design a teaching improvement plan and implement them • Define the concept of classroom action research. • Explain the need for classroom action research in science education. • Describe key characteristics of classroom action research. • List the steps involved in conducting classroom action research. • Identify classroom problems suitable for action research in science teaching and learning, write a proposal and conduct classroom action research	**Unit 5: Planning of Science Teaching and Classroom Action Research (10 Hrs)** 5.1 Introduction and importance of planning for teaching 5.2 Lesson plan: Daily and weekly and their implementation 5.3 Unit plan 5.4 Annual plan 5.5 Planning Co-curricular activities: Science exhibition, Field Excursion, Seminar, and Workshop 5.6 Teaching Improvement Plan 5.7 Concept and characteristics, and steps of classroom action research 5.8 Identification of the problems, proposal development, and implementation of classroom action research
Assignment/Project Task ✧ Observe a real classroom or reflect on your own teaching experience to identify a specific problem. Describe the steps of conducting classroom action research to address this issue, and illustrate each step with your own practical example.	

4. Instructional Techniques

4.1 General Instructional Techniques*:* Lecture, text reading, exercise course, tutorial, self-study, project work, assignments on different topics, group discussion, reflective writing

4.2 Specific Instructional Techniques

Unit	Teaching Methods and Strategies	
1	- **Interactive Lecture & Concept Clarification:** Present definitions and scope of science education using case examples. Use questioning strategies to connect school science with real-life contexts. - **Jigsaw Group Activity:** Assign each group a topic from constructivism, inquiry-based learning, 5E model or ABC model. Groups become "experts" and then reassemble to teach peers. - **5E Model Microteaching Session:** In small groups, students design and deliver a short lesson using the 5E model on a given science topic. Peer and instructor feedback follows.	

	- **Comparative Matrix Development:** Ask students to create a matrix comparing constructivism and inquiry-based learning in terms of principles, roles of teacher/student, and application in classrooms. - **Panel Discussion:** Organize a student-led panel on "Science Education for Achieving SDGs" with pre-assigned research and role preparation.	
2	- **Hands-on Material Creation Workshop:** Students design and create worksheets, posters, and diagrams based on specific science topics from the school curriculum. - **AV Production Task:** Divide students into teams to script, record, and edit a short instructional video on a science topic using mobile devices and free editing software. - **Digital Tool Practice Session:** Conduct guided lab sessions where students make PowerPoints and interactive quizzes using platforms like Google Slides. - **Improvisation Challenge:** Assign students to develop low-cost teaching aids from locally available or recycled materials and demonstrate their use in a mock class. - **Peer Review Gallery Walk:** Organize an exhibition where students display their materials. Peers give feedback using structured review rubrics.	
3	- **Case-Based Discussion:** Present classroom scenarios and ask students to identify how scientific literacy and critical thinking can be fostered. - **Critical Thinking Strategy Simulation:** Use science puzzles or real-life problems (e.g., pollution, food safety) and have students solve them collaboratively, applying higher-order thinking. - **Value Identification Workshop:** Students brainstorm values embedded in science (e.g., integrity in experiments) and design mini-lessons to integrate values into teaching. - **Science Process Skill Toolkit:** Groups create assessment tools (e.g., checklists, observation forms) to measure process skills like hypothesizing or data analysis. - **Vision Statement Poster Design:** Ask students to develop a vision for 21st-century chemistry education and present it through posters.	
4	- **Lab Layout Blueprint Creation:** Students draft a science lab layout plan for a secondary school, including safety zones, storage, and experiment areas. - **Safety Drill Simulation:** Conduct a mock drill where students role-play lab emergencies and demonstrate appropriate safety and risk management measures. - **Experiment Design Task:** Assign groups to design simple curriculum-aligned experiments using easily accessible materials and write instructional guides. - **Inventory Management Role-Play:** Simulate a lab store room with equipment lists. Assign roles (e.g., lab assistant, teacher) to practice inventory and maintenance routines. - **Lab Manual Compilation Project:** Students collaborate to produce a mini-lab manual including 3–5 experiments, safety guidelines, and maintenance checklists.	
5	- **Workshop:** Students engage in a group of four to design instructional planning of lessons, such as lesson plan, unit plan, annual plan and teaching improvement plan - **Concept Mapping:** Students create a concept map outlining the key characteristics and processes of classroom action research. - **Problem Identification Brainstorming:** In groups, students identify real or hypothetical problems in science classrooms suitable for action research. - **Workshop:** Workshop for planning co-curricular activities. - **Action Research Proposal Development:** Each student drafts a mini-proposal including title, rationale, objectives, methodology, and tools for a selected classroom problem. - **Peer Review and Refinement:** Students exchange their proposals for peer feedback using	

	structured critique guidelines. - **Reflective Journal:** Ask students to maintain a journal that documents their thoughts and learning throughout the research design process.	

5. Evaluation Scheme

5.1 Internal Evaluation (40%)

Internal Evaluation will be conducted by the course teacher based on the following activities.

a) **Attendance and Participation in class activities**: (**5+5=10 marks)**

b) **Assignment I: Reflective Notes and Class presentation: (5+5=10 marks)**

(Reflective notes on 2 to 4 questions given by a teacher at the end of every unit and presentation on any two questions among them)

c) **Assignment II**: **one Term paper/ Essay/Project and Interview: (5+5=10 marks)**

(Logical essay/term paper/project on the topics chosen by students and approved by the teacher and the interview)

d) **Mid-term exam**: (**10 marks)**

5.2 External Evaluation (Final Examination): (60%)

Office of the Controller of Examination will conduct final examination at the end of semester.

Types of questions	**Total questions to be asked**	**Number of questions to be answered and marks allocated**	**Total marks**
Group A: Multiple choice items	10 questions	10 × 1	10
Group B: Short answer questions	6 with 2 'or' questions	6 ×5	30
Group C: Long answer questions	2 with 1 'or' question	2 ×10	20

Recommended Textbooks

Acharya, K. P. (2020). *Methods of science teaching*. Intellectuals' Book Palace.

Baumfield, V., Hall, E., & Wall, K. (2008). *Action research in the classroom*. Sage Publications Ltd.

Davar, M. (2012). *Teaching of science*. PHI Learning Pvt. Ltd.

Fosnot, C. T. (2005, Ed.). *Constructivism: Theory, perspectives and practice.* Teachers College, Columbia University.

Hassard, J. & Dias, M. (2009). *The art of teaching science: Inquiry and innovation in middle school and high school*. Taylor and Francis.

McKenney, S., & Reeves, T. (2018). *Conducting educational design research*. Routledge.

Ornstein, A. C., & Hunkins, F. P. (2017). *Curriculum: Foundations, principles, and issues* (7th ed.). Boston, MA: Pearson.

Tyler, R. W. (2013). Basic principles of curriculum and instruction. In *Curriculum studies reader* (pp. 60-68). Routledge.

Your Smart Class (2024). *Preparation of low-cost teaching aids: A comprehensive guide*. https://yoursmartclass.com/preparation-of-low-cost-teaching-aids-a-comprehensive-guide/