THE LEARNING, FACILITATION AND ASSESSMENT OF MATHEMATICS AND SCIENCE SUBJECTS FOR STUDENTS WITH VISUAL IMPAIRMENTS

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Research Team

Krishna Bahadur Thapa, PhD	Principal Investigator (PI)
Shovhakhar Aryal, PhD	Co-Investigator (CI)
Mohan Paudel, PhD	Co-Investigator (CI)
Dirgha Raj Joshi, PhD	Co-Investigator (CI)
Naba Raj Gautam	Management and Supervision

Field Researcher

Santosh Gautam

Ramesh Bhattarai

Tara Poudel

Bina K. C.

Dharma Raj Kandel

Dr. Basudev Bista

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Study Team

दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीका लागि विज्ञान तथा गणित विषयको सिकाइ सहजीकरण र मूल्याङ्कन

पृष्ठभूमि

राष्ट्रिय जनगणना २०७८ अनुसार नेपालमा जम्मा जनसङ्ख्याको करिब २.२% मा विभिन्न किसिमको अपाङ्गता छ। अपाङ्गता अधिकार ऐन, २०७४ मा दृष्टि अपाङ्गता भएका व्यक्तिहरूलाई दृष्टिविहीनता, न्यून दृष्टियुक्त र पूर्ण दृष्टिविहीनका रूपमा वर्गीकृत गरिएको छ। नेपालको संविधान, शिक्षा ऐन, शिक्षा नीति तथा विभिन्न दस्तावेजहरूले दृष्टिसम्बन्धी अपाङ्गता भएका बालबालिकालाई ब्रेललिपिका माध्यमबाट समावेशी शिक्षा प्राप्तिको अधिकार सुनिश्चित गरेका छन्। राष्ट्रिय शिक्षा नीति, २०७६ ले समावेशी तथा विशेष शिक्षाका अवसर, अपाङ्गतामैत्री भौतिक पूर्वाधार, सुधारात्मक कक्षा, लचिलो पाठ्यक्रम र विद्यार्थी मूल्याङ्कन प्रणालीमा अनुकूलन गर्ने व्यवस्था गरेको छ। यद्यपि यस्ता कानुनी र नीतिगत व्यवस्था भए तापनि दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीका लागि विशेष गरी गणित र विज्ञान विषयमा अझै सिकाइका समस्या र चुनौती देखिएका छन्। विभिन्न अध्ययनले गणित र विज्ञान विषयका पाठ्यवस्तुहरू स्वाभाविक रूपले बढी दृश्यात्मक वा दृष्टिनिर्भर हुने भएको कारणले यी विषयहरूप्रति दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सहज पहुँच सिर्जना गर्न चुनौतीपूर्ण रहेको देखाउँछ। दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सिकाइ आवश्यकताअनुसार विद्यमान गणित र विज्ञान विषयका पाठ्यक्रम, पाठ्यपुस्तक, शिक्षण सामाग्री र उपलब्धि मूल्याङ्कन गर्ने प्रणाली तथा अभ्यासमा परिमार्जन वा अनुकूलन कमै भएको देखिन्छ। परिणामतः उनीहरूको सिकाइ, सिकाइ सहजीकरण तथा मूल्याङ्कन अभ्यास चुनौतीपूर्ण देखिन्छ। यस्ता विद्यार्थीहरूको आवश्यकताअनुसार लचिलो र समावेशी शिक्षण विधि तथा सहजीकरण, समावेशी मूल्याङ्कन प्रणालीको सीमित प्रयोग तथा विविधतापूर्ण सिकाइ वातावरणको निर्माणमा भएका समस्याहरू पहिचान गरी नीतिगत र व्यावहारिक तहमा सुधारका उपायहरू अवलम्बन गर्ने उद्देश्यले यो अनुसन्धान गरिएको हो।

उद्देश्य

१. दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीका लागि गणित तथा विज्ञान विषयको सिकाइ, सिकाइ सहजीकरण र सिकाइको मूल्याङ्कनसम्बन्धी समस्याहरूको पहिचान गर्नु।

२. दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीका सिकाइ समस्या र सिकाइ सहजीकरण तथा मूल्याङ्कनसम्बन्धी समस्या समाधानका लागि सुझावहरू प्रदान गर्नु।

अध्ययन विधि

यस अध्ययनमा गुणात्मक र परिमाणात्मक दुबै विधि समेटिएको मिश्रित अनुसन्धान ढाँचालाई अपनाइएको थियो। मिश्रित ढाँचाको प्रयोगले कुनै पनि विषय वा समस्याको विश्लेषण गर्दा तथ्याङ्क र अनुभव दुबैलाई समावेश गर्न सकिने भएकाले यसले अध्ययनलाई समग्र र गहिरो बनाउँछ। अनुसन्धानमा प्रायः गुणात्मक विशेषता भएका पक्षहरूका साथै परिमाणात्मक दुबै खालका तथ्याङ्कहरूको संयोजन गराउँदा नतिजाहरूको विश्वसनीयतामा वृद्धि गर्न सहयोग पुग्छ। दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित तथा विज्ञान विषयमा हुने सिकाइ, सहजीकरण र मूल्याङ्कनसम्बन्धी जटिलता बहुआयामिक हुने भएकाले यस अध्ययनमा मिश्रित अनुसन्धान विधिको अनुसरण गरिएको हो। यसै ढाँचाबमोजिम अनुसन्धानलाई विषयगत (गुणात्मक) र वस्तुगत (परिमाणात्मक) पक्षहरूको सन्तुलित विश्लेषण गरी नतिजा प्रस्तुत गरिएको छ।

अनुसन्धानको उद्देश्यहरू प्राप्त गर्नका लागि उदेश्यमूलक नमुना छनोट (**Purposive Sampling**) विधिका आधारमा सातओटै प्रदेशबाट १४ स्रोत विद्यालय, ८ एकीकृत विद्यालय र १ विशेष विद्यालय गरी जम्मा २३ ओटा सामुदायिक विद्यालयका प्र.अ., शिक्षक, विद्यार्थी, अभिभावक र सरोकारवालाहरूलाई नमुनाको रूपमा समावेश गरियो। यसले दृष्टि अपाङ्गता भएका विद्यार्थीसम्बन्धी विषयमा उपयोगी, तथ्यपरक र व्यावहारिक जानकारी दिन सकोस् भन्ने अपेक्षा गरिएको थियो। छनोट गरिएका नमुनाको आकार **(Sample Size)** ले सरोकारवालाहरूको सहभागिता प्रतिनिधिमूलक रहेको छ। यसमा २१ जना प्रधानाध्यापक, १४ जना विषयगत शिक्षकमा ७ गणित र ७ विज्ञान विषय, ५ जना नीतिगत सरोकारवाला **(CDC, NEB, CEHRD** का अधिकारीहरू**)**, ७ जना विद्यालय व्यवस्थापन समिति सदस्य, ७ जना स्थानीय शिक्षा अधिकारी **(LEO)**, ७ जना अभिभावक, २४ जना लक्षित समूह छलफल र ७६ जना सर्वेक्षणका लागि दृष्टि अपाङ्गता भएका विद्यार्थी सहभागी भएका थिए। तथ्याङ्क सङ्कलनका लागि फरक फरक समूहका सहभागीहरूका लागि विभिन्न साधनहरूको निर्माण गरिएको थियो। यसमा अन्तर्वार्ताहरू **(Key Informant Interview Guideline-KII, In-depth Interview Guideline-IDI, Parent Interview Guideline, Interview Guideline for School Management Committee, Local Education Officer Interview Guideline)**, विद्यार्थी लक्षित समूह छलफल (FGD) निर्देशिका र सर्वेक्षण प्रश्नावली प्रयोग गरिएका थिए। तथ्याङ्क सङ्कलनका लागि प्रत्यक्ष भेटघाटबाट गरिएको थियो भने त्यसको विश्लेषण गर्दा विषयगत दृष्टिकोण **(Thematic Analysis)** लाई अनुसरण गरिएको थियो।

अध्ययनका मुख्य नतिजाहरू

यस अनुसन्धानले दृष्टिसम्बन्धी अपाङ्गता भएका बालबालिकाहरूका विज्ञान तथा गणित विषयमा सिकाइ पहुँचको अवस्था तथा समस्याहरूको विश्लेषण गरी सुधारका लागि नीतिगत तथा कार्यान्वयन तहमा अवलम्बन गर्न सकिने उपायहरूलाई नतिजाका रूपमा प्रस्तुत गरेको छ। पूर्वकार्यहरूको समीक्षाका साथै गुणात्मक तथा परिमाणात्मक तथ्याङ्क विश्लेषणका आधारमा प्राप्त नतिजाहरूलाई निम्नानुसार प्रस्तुत गरिएको छः

नीतिगत समायोजन

दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूका लागि विज्ञान तथा गणित विषयमा सिकाइ पहुँचको अवस्था तथा सिकाइ समस्या, सिकाइ सहजीकरण र सिकाइ मूल्याङ्कनको सन्दर्भमा नीतिगत व्यवस्थाहरू भए पनि त्यो पर्याप्त देखिँदैन। पाठ्यक्रम कार्यान्वयनका क्रममा थोरै मात्र समायोजन तथा अनुकूलन गर्न सकिने नीतिगत व्यवस्था देखिन्छ। पाठ्यवस्तुलाई विद्यार्थीका विविध आवश्यकताअनुरूप सहजीकरण गर्नका लागि विद्यालय तहमा शिक्षक

निर्देशिकाको अभाव रहेको पाइयो । दृश्यमा आधारित पाठ्यवस्तु र सामग्रीहरूलाई स्पर्श तथा श्रव्य माध्यममा रूपान्तरण गर्ने कार्य सीमित भएकाले दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूका लागि कम पहुँचयोग्य देखिएका छन् । त्यस्तै विज्ञान प्रयोगशाला पनि कम पहुँचयोग्य भएकोले श्रव्य तथा प्रविधिमा आधारित प्रविधियुक्त विज्ञान प्रयोगशाला (भर्चुअल साइन्स ल्याब) को नीतिगत व्यवस्था र प्रयोगको आवश्यकता रहेको पाइयो । त्यसैले नीतिगत व्यवस्था तथा त्यसको कार्यान्वयन पक्षमा थप सुधार गर्नुपर्ने देखिन्छ ।

पाठ्यक्रम तथा पाठ्यसामग्रीको कार्यान्वयन

दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूका लागि विज्ञान तथा गणितका पाठ्यक्रमहरूमा सिकाइ सहजीकरण गर्न विषयअनुसारको समायोजन तथा अनुकूलनको लागि प्रयाप्त निर्देशिकाको अभाव रहेको देखियो । विशेषतः न्यून दृष्टि भएका विद्यार्थीहरूले पाठ्यपुस्तक तथा सामग्रीमा साना अक्षर तथा चित्रहरू भएकोले उनीहरूका लागि अनुकूलन तथा समायोजन गरिएका सामग्रीहरूको उत्पादनमा जोड दिनु आवश्यक छ । त्यस्तै पाठ्यक्रम निर्माणमा मुख्य सरोकारवालाहरूजस्तै दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थी, अभिभावक तथा शिक्षकहरूको सहभागिता न्यून रहेको पाइयो । यसमा पनि सुधार आवश्यक देखिन्छ ।

सिकाइ समस्या

विज्ञान तथा गणित दुबै विषयको सिकाइ तथा समस्याका विषयवस्तुहरू अधिक दृष्यमा आधारित भएकाले दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूले त्यस्ता विषयवस्तु (जस्तैः चित्र, रेखाचित्र, ज्यामितीय आकृतिहरू, विज्ञानका रासायनिक सूत्रहरू) सिकाइमा समस्याको सामना गरिरहेका छन् । स्पर्श तथा श्रव्य सामग्रीको न्यून उपलब्धताले गर्दा सिकाइमा थप चुनौती सिर्जना भएको छ ।

सिकाइ सहजीकरण

शिक्षकहरूले दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई विज्ञान तथा गणित विषय सिकाइमा विभिन्न शिक्षण रणनीतिहरू प्रयोग गरी सहजीकरण गरेको पाइयो । मुख्य रणनीतिहरूमा मौखिक व्याख्या, सहपाठी सहयोग सिकाइ, स्वःसिकाइ आदि रहेका छन् । त्यस्तै सिकाइ सहजीकरणका लागि सामग्रीको निर्माण तथा प्रयोगमा पनि अनुकूलनता ल्याउने प्रयास गरेको पनि पाइयो । यद्यपि त्यस्ता प्रयासहरू सबै विद्यालयमा नभएको र अपर्याप्त भएकाले सुधारको जरुरत देखिन्छ ।

पहुँचयोग्य स्रोत सामग्रीको अवस्था

अध्ययनको क्रममा सहभागी विद्यालयहरूमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई लक्षित गरी ब्रेल पुस्तक तथा सामग्रीहरू, स्पर्श आधारित सामग्रीहरू, थ्रि (3) डी मोडेल, स्क्रिन रिडरमैत्री सामग्रीजस्ता पहुँचयोग्य आधारभूत सामग्रीहरूको समेत अभाव रहेको पाइयो । परिणामतः विज्ञान र गणित विषयको सिकाइ सहजीकरणमा असर परिरहेको छ । यस्तो असर मुख्यतः अमूर्त वा दृष्यमा आधारित अवधारणाहरू बुझ्नमा समस्या भएको छ ।

व्यावसायिक क्षमता

दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई सिकाइ सहजीकरणका लागि दक्ष शिक्षकको जरुरत हुने भए पनि धेरैजसो शिक्षकहरू समावेशी शिक्षणमा अनभिज्ञ रहेको पाइयो । तालिम तथा अनुभव आदानप्रदानको कमी, सहायक प्रविधिको ज्ञान तथा प्रयोग र वैकल्पिक शिक्षण विधिमा कम दक्षता रहेकाले दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूका विज्ञान तथा गणित सिकाइ सिकाइ आवश्यकता सम्बोधनमा शिक्षकहरूको दक्षता पर्याप्त देखिँदैन । यसको प्रत्यक्ष तथा परोक्ष असर विज्ञान तथा गणितजस्ता प्रयोगात्मक तथा अमूर्त विषयवस्तुको अवधारणा विकासमा परको छ । परिणामस्वरूप विद्यार्थीहरूलाई ज्यामिति, रेखाचित्र तथा समीकरणहरूको अवधारणा विकासमा समस्या परेको छ ।

सिकाइ मूल्याङ्कन

दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सिकाइ मूल्याङ्कनका के कसरी भइरहेको छ भन्ने सवालमा मूल्याङ्कनको अभ्यास मूलतः लिखित परीक्षा (पेपर पेन्सिल) मा आधारित नै रहेको पाइयो । सिकाइ मूल्याङ्कनमा मौखिक, स्पर्शमा आधारित, पूर्ण ब्रेलको प्रयोग, प्रयोगात्मक क्रियाककलापहरू, पोर्टफोलियो विश्लेषणजस्ता वैकल्पिक तथा समावेशी तरिकाहरूको बिरलै मात्र प्रयोग भएको पाइयो । सिकाइ मूल्याङ्कनमा गरिएको परम्परागत समायोजन (कन्टिन्जेन्ट तरिका) का सन्दर्भमा समय थप तथा लेखन सहयोगीको व्यवस्था भए पनि पर्याप्त समय नभएको तथा लेखन सहयोगी पाउन नसकिएको पाइये । पाइएका सहयोगीहरू विषयवस्तुमा अनभिज्ञ हुने हुनाले एउटा लेख्नुपर्नेमा अर्को लेखिदिने वा विज्ञान र गणितका कतिपय सङ्केतहरू समेत नबुझ्ने हुनाले वास्तविक सिकाइ क्षमताको मूल्याङ्कन हुन नसकेको पाइएको छ ।

सम्बन्धित निकायहरूबिच समन्वय

पाठ्यक्रम निर्माण, त्यसपश्चात्को प्रबोधीकरण तथा सामग्री विकास र कार्यान्वयन, अनुगमन गर्ने निकायहरूबिच उचित समन्वय आवश्यक पर्छ । अध्ययनको क्रममा विज्ञान तथा गणित विषयको पाठ्यक्रम निर्माण, शिक्षण सामग्रीको विकास तथा गुणस्तरीयता कायम गर्ने निकाय र सिकाइ मूल्याङ्कन गर्ने निकायहरूबिचमा समन्वयको अभाव देखिएको छ । यी निकायहरूमध्येमा पनि विशेषतः पाठ्यक्रम विकास केन्द्र, राष्ट्रिय परीक्षा बोर्ड, शिक्षा तथा मानव स्रोत विकास केन्द्र आदिबिचको प्रभावकारी समन्वयको कमी रहेको देखियो । फलतः दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सिकाइ सहजीकरण तथा सिकाइ मूल्याङ्कनमा प्रभावकारी नीति तर्जुमा तथा कार्यान्वयनमा रिक्तता देखिएको छ ।

सिफारिस

अध्ययनको नतिजाको आधारमा सम्बन्धित निकाय तथा सरोकारवालाहरूलाई दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सिकाइ सहजीकरण तथा सिकाइ मूल्याङ्कनमा प्रभावकारी नीति तर्जुमा तथा कार्यान्वयनमा देखिएको रिक्तता वा कमीलाई सम्बोधन गर्न निकायगत रूपमा सिफारिसहरू प्रस्तुत गरिएको छ ।

पाठ्यक्रम विकास केन्द्र

- दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई लक्षित गरी विज्ञान तथा गणित विषयका शिक्षक निर्देशिका तयार पार्नुपर्ने टड्कारो आवश्यकता देखिन्छ । पाठ्यक्रम निर्माणसँगै दृष्टिसम्बन्धी अपाङ्गताका साथै अन्य अपाङ्गता भएका विद्यार्थीहरूको सिकाइ आवश्यकतालाई ध्यान दिई पाठ्यसामग्री तथा शिक्षक निर्देशिकालाई पनि सँगै निर्माण र वितरण गर्नुपर्छ ।
- पाठ्यक्रम तथा त्यसको आधारमा तयार पारिएका सामग्री, शिक्षण रणनीति तथा सिकाइ मूल्याङ्कनमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूले केही हदसम्म पहुँच राख्ने देखिएको छ । यद्यपि सामग्री विकास गर्दा ठूलो अक्षर, स्पर्शमा आधारित, श्रव्य तथा डिजिटल सामग्री समावेश गरिनुपर्छ । पाठ्यक्रम निर्माण तथा सुधारको क्रममा सिकाइ मूल्याङ्कनमा विविध विकल्पहरू दिनु जरुरी छ । यी कार्यहरूमा सिकाइको विश्वव्यापी ढाँचाको अवधारण तथा सिद्धान्तलाई अनुसरण गर्नुपर्छ ।
- विज्ञान तथा गणित विषयका पहुँचसम्बन्धी चुनौतीहरू हटाउन वा घटाउन श्रव्य आधारित, स्क्रिन रिडरमैत्री तथा भर्चुअल विज्ञान ल्याबको अवधारणालाई कार्यान्वयन गर्नु उपयुक्त देखिन्छ । यसले दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सिकाइमा पहुँच वृद्धि गर्नमा सहयोग पुग्ने देखिन्छ ।
- पाठ्यक्रम निर्माण प्रक्रियामा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थी, अभिभावक, शिक्षक र विज्ञहरूको सहभागिता तथा परामर्श सुनिश्चित गर्नु पर्छ । साथै सिकाइ आवश्यकताको पहिचान गर्न कार्यशाला सेमिनारजस्ता औजार तथा उपायहरूको अनुप्रयोग गर्नु उपयुक्त हुन्छ ।
- विज्ञान र गणितमा वैयक्तिक शिक्षा योजना **(IEP)** को प्रयोगलाई नीतिगत रूपमै समावेश गर्नुका साथै सहायक प्रविधिहरूको प्रयोग सुनिश्चित गर्नुपर्छ ।

राष्ट्रिय परीक्षा बोर्ड

- दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको वास्तविक सिकाइ क्षमताको मूल्याङ्कन तथा अभ्यासलाई सहज बनाउन समावेशी परीक्षा तथा मूल्याङ्कन प्रणालीको विकास गर्नु आवश्यक छ । यसमा लिखित परीक्षा (पेपर पेन्सिल) मा आधारित मूल्याङ्कनको साथै अन्य वैकल्पिक तरिकाहरूलाई समेत समायोजन गर्नुपर्छ । त्यसमा मौखिक परीक्षा, स्पर्श आधारित, पूर्ण ब्रेलको प्रयोग, प्रयोगात्मक क्रियाकलापहरू, पोर्टफोलियो विश्लेषण आदिको पनि प्रयोग गर्नु आवश्यक छ ।
- सिकाइ मूल्याङ्कनमा अतिरिक्त समय तथा लेखन सहयोगीको प्रावधानले मूल्याङ्कन प्रक्रियामा गरिएको सकारात्मक प्रयासलाई झल्काउँछ । यद्यपि, समावेशी शिक्षाको अवधारणाअनुसार विज्ञान र गणित विषय विषयमा सिकाइ मूल्याङ्कन परिपाटीलाई लचिलो तथा अनुकूलन गर्न मिल्ने गरी प्रणाली विकास गर्नु आवश्यक हुन्छ ।
- समावेशी परीक्षा तथा मूल्याङ्कनलाई वास्तविकतामा ल्याउन निर्देशिकाको विकास गरिनु आवश्यक छ ।
- परीक्षा तथा मूल्याङ्कन अभ्यासलाई लचिलो तथा समावेशी बनाउन प्रश्नपत्र तथा अन्य उपकरणहरूलाई विविध ढाँचा तथा रूपमा विकास गर्नु पर्छ । जस्तो- प्रिन्ट गरिने प्रश्नलाई ब्रेल तथा श्रव्य प्रश्नपत्रको रूपमा पनि निर्माण गर्नु पर्छ । साथै प्रविधिको प्रयोगलाई उच्च प्राथमिकतामा राखिनु पर्छ ।

शिक्षा तथा मानव स्रोत विकास केन्द्र

- अध्ययनबाट प्राप्त तथ्याङ्कको विश्लेषण गर्दा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूले ज्यामितीय आकृतिहरू, रासायनिक प्रतिक्रियाहरूका समीकरणहरू साथै चित्र र ग्राफहरूजस्ता व्यावहारिक र दृश्यमा आधारित विषयवस्तुको अध्ययनका सन्दर्भमा बढी जटिलतालाई महसुस गर्छन् । यसर्थ उनीहरूले स्पर्श रेखाचित्र, अडियो पुस्तकहरू तथा विज्ञान र गणितमा अन्तरक्रियात्मक सिकाइ सामग्रीहरूको अभावका कारण प्रमुख चुनौतीहरूलाई सामना गर्छन् । त्यसैले शिक्षा तथा मानव स्रोत विकास केन्द्रले उनीहरूको सिकाइलाई सहज बनाउन स्पर्श ग्राफिक सामग्री र श्रव्य आधारित सामग्री विकास गर्न पहल लिनुपर्ने देखिन्छ ।
- विज्ञान र गणित विषयको शिक्षक प्रशिक्षणको आवश्यकता उच्च देखिन्छ । त्यसैले बहुज्ञानेन्द्रिय शिक्षण रणनीतिहरू, स्पर्शमा आधारित सामग्रीको विकास र प्रयोगका लागि शिक्षक तालिमको योजना तथा कार्यान्वयन गर्नुपर्ने टड्कारो आवश्यकता भएकाले केन्द्रले यस कुरालाई मनन गरी शिक्षक क्षमता विकासमा कार्य गर्नुपर्ने देखिन्छ ।

प्रणालीगत समन्वय

दृष्टिसम्बन्धी र अन्य सबै खालका अपाङ्गता भएका बालबालिकाहरूका लागि समावेशी शिक्षाको वृहत्तर अवधारणालाई व्यावहारिक कार्यान्वयन गर्नका लागि पाठ्यक्रम विकास केन्द्र, राष्ट्रिय परीक्षा बोर्ड र शिक्षा तथा मानव स्रोत विकास केन्द्रबिचको सहकार्यलाई प्रणालीगत संरचनामा परिणत गर्नु पर्छ । फलतः साझा रूपमा सिकाइ, सिकाइ सहजीकरण तथा सिकाइ मूल्याङ्कनका क्षेत्रमा देखिएको कमी तथा जटिलतालाई साझा प्रयत्नबाट समाधान गर्न सकिन्छ । प्रणालीगत समन्वयको माध्यमबाट तहगत रूपमा निम्नानुसारका कार्यहरू गर्नु आवश्यक देखिन्छ ।

स्थानीय तह

- बजेट व्यवस्थापन गरेर साधनस्रोतयुक्त कक्षा, ब्रेल तथा स्पर्श सामग्रीको विकास र प्रयोग, प्रविधिको पहिचान तथा पहुँचको सुनिश्चित गर्नु पर्छ ।

- शिक्षकहरूलाई समावेशी शिक्षाको बारेमा वृहत् तालिम सञ्चालन गर्नु पर्छ ।
- स्थानीय स्तरमा उपलब्ध सामग्रीहरूको प्रयोग गरी स्पर्श सामग्रीको विकास तथा प्रयोगमा प्रोत्साहन गर्नु पर्छ ।
- अनुगमन तथा मूल्याङ्कन संयन्त्रको विकास गरी रचनात्मक सुधारहरूको खाका विकास गर्नु आवश्यक छ ।

विद्यालय तह

- विद्यालयमा विशेष आवश्यकता भएका बालबालिकाहरूको सिकाइ आवश्यकताको पहिचान गर्ने, शिक्षक तथा कर्मचारीबिच छलफल गर्ने र प्राप्त निष्कर्षलाई कार्यान्वयन गराउनुपर्ने आवश्यकता देखिन्छ ।
- विद्यालयस्तरमा लक्षित विषयमा आधारित वैयक्तिक शिक्षा योजना (IEP)सम्बन्धी तालिम प्रदान गर्नुपर्ने देखिन्छ । स्थानीय सरकारसँगको सहकार्य तथा सहयोगमा यो कार्य गर्नु जरुरी छ ।
- विद्यालय सुधार योजनामा पहुँचयुक्त पूर्वाधार, सिकाइ सहजीकरण र स्रामग्रीको खोजको प्रक्रियालाई विकास गर्नु आवश्यक छ ।

निष्कर्ष

गुणात्मक र परिमाणात्मक दुबै तथ्याङ्कबाट प्राप्त निष्कर्षहरूले पाठ्यक्रम, सिकाइ सामग्री, शिक्षण सहजीकरण तथा मूल्याङ्कन तरिकाको विश्लेषण गर्दा दृष्टि अपाङ्गता भएका विद्यार्थीहरूका सिकाइ सहजीकरणमा केही सकारात्मक अभ्यासहरू त भएका छन् । यद्यपि, प्रणालीगत अवरोधहरू पनि उत्तिकै देखिएका छन् । विज्ञान र गणित विषयका पाठ्यक्रमहरू मुख्यतः दृश्यमा आधारित नै देखिए तर स्पर्श तथा श्रव्यमा आधारित सामग्री प्रयोग तथा सिकाइ वातावरणमा केही अभ्यास भए पनि मूलतः पर्याप्त देखिएन । दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई आवश्यक पर्ने आधारभूत ब्रेल पाठ्यपुस्तक, स्पर्शयोग्य मोडेल तथा अडियोमा आधारित अनुकूलनको कमीले चित्र, रेखाचित्र, रासायनिक प्रतिक्रियाका समीकरणहरू र ज्यामितीय आकृतिहरूसँग सम्बन्धित विषयवस्तु सिकाइमा विद्यार्थीहरूले कठिनाइको सामना गरिरहेका छन् । समावेशी शिक्षासम्बन्धी नीतिगत रूपमा प्रगतिहरू भए तापनि कार्यान्वयन तहमा प्रशस्त चुनौतीहरू विद्यमान छन् । समग्रमा पाठ्यक्रम, सिकाइ सामग्री, शिक्षण विधि र सिकाइ मूल्याङ्कन प्रणाली दृष्टि अपाङ्गता भएका विद्यार्थीको आवश्यकताअनुसार अनुकूलनमुखी प्रावधानमा समेटिनु आवश्यक छ । दृश्य सामग्रीप्रति अधिक निर्भर हुनुपर्ने, स्पर्श र श्रव्य आधारित सामग्री तथा सिकाइमा कमी, शिक्षकहरूको दक्षता तथा सहायक प्रविधिमा कम अभ्यासजस्ता कारणले गर्दा विद्यार्थीहरूको अवधारणात्मक सिकाइमा बाधा उत्पन्न भएको छ । मूल्याङ्कन प्रणाली परम्परागत हुनुका साथै समावेशी अभ्यास न्यून छन् । साथै, CDC, NEP र CEHRD जस्ता निकायहरूबिचको समन्वयको कमीले नीतिगत कार्यान्वयनमा अवरोध सिर्जना गरेको छ । अतः पाठ्यक्रम समायोजन, शिक्षक क्षमता अभिवृद्धि, पहुँचयुक्त सामग्रीको विकास, मूल्याङ्कन प्रणालीमा सुधार र प्रणालीगत समन्वयमार्फत दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गुणस्तरीय सिकाइ सुनिश्चित गर्न नीति तथा अभ्यासमा व्यापक सुधार आवश्यक छ ।

EXECUTIVE SUMMARY

Broadly speaking, disability refers to a condition whether physical or mental that affects the functional capability of an individual in daily living and academic areas. Among various types of disabilities, visual impairment is recognized as the severity of the vision loss that could be in the form of blindness and low vision. In Nepal, there is a legal and policy provision to ensure equal rights to education for all children, including those with visual impairments.

This study explored the learning problems, facilitation practices, and assessment challenges faced by the students with visual impairments (VI) in science and mathematics education at the school level. Although the legal and policy frameworks advocate inclusive education, their translation into classroom practices, especially in science and mathematics subjects, remains limited and inconsistent.

The study adopted a mixed-methods design combining qualitative (FGDs, KIIs, in-depth interviews) and quantitative (student surveys) approaches. VI students, teachers, parents, headteachers, SMC members, Local Education Officers, and other concerned stakeholders from CDC, CEHRD, NEB were key respondents in this research. Interview, FGD, and KII guidelines as well as survey tools were major research instruments used in this research. All research instruments were developed based on the objectives of the research with the help of policy and other literature. School based data were collected from 23 schools, including integrated, resource and special schools by field visit (face-to-face mode) covering seven provinces and mountain, hill and terai geographical regions. The qualitative data were analyzed by thematic ways whereas the quantitative data were analyzed by using descriptive statistics as mean and standard deviation. Furthermore, both qualitative and quantitative results were triangulated with the alignments of objectives and research questions.

Findings of the study showed that science and mathematics curricula heavily rely on visual content such as diagrams, charts, chemical symbols, and geometric figures which are inaccessible for students with visual impairment. This finding indicates that science and mathematics learning may become effective by incorporating tactile and auditory alternatives to visual contents. Students with visual impairment also reported difficulty in understanding abstract concepts, conducting experiments, or solving visual-based mathematical problems due to lack of adapted materials like Braille resources, tactile models, or screen readers. Thus, the key results from qualitative and quantitative tool- survey data indicated that students with visual

impairment facing moderate to significant problems and challenges in accessing and engaging with science and mathematics content.

The results overall show that learning facilitation has been constrained by teachers' limited training in inclusive pedagogy and the absence of subject-specific teaching materials. Instruction largely remains lecture-based; however, some schools were observed integrating tactile and digital tools in teaching science and mathematics. Some promising practices like peer-assisted learning and use of tactile aids were observed but remain inconsistent. Assessment practices were found to be rigid and conventional, relying on written exams with minimal accommodations. Most schools lacked provisions for oral exams, tactile-based assessments, or the use of assistant writers. The study exposed that the present assessment systems lack the ability to capture students’ actual learning potential.

The study recommends the adaptation as well as the review of science and mathematics curricula to address the real needs of the students with visual impairment is necessary. Similarly, additional visual impairment friendly accessible tactile learning materials in multi-sensory formats need to be developed. Additionally, additional focus is needed for teachers’ professional development focusing on innovative pedagogy for visual impairment students. Moreover, concerned stakeholders need to improve existing assessment practice with reference to visual impairment students. Without these reforms, students with visual impairment will remain excluded from meaningful participation in science and mathematics education.

The finding of this research facilitates policy makers for reforming visual impairment student related policies, content, pedagogy, and resources development and sharing. Similarly, this study provides evidence-based problems and challenges of facilitating to the students with visual impairment and hence helps stakeholders like teachers, head teachers, local and provincial level officials to understand the existing pedagogical practices and problems associated with visual impairment students in mathematics and science learning. However, these findings are limited to qualitative and some quantitative information hence some intervention and detailed observations are needed to find real problems of such students.

DECLARATION

The report of this study was developed through rigorous human intelligence (HI) by the research team, conducting extensive fieldwork, literature reviews, qualitative insights, and consultations with stakeholders. The findings, interpretations, and recommendations are based on human-led analysis and critical reasoning. However, to ensure linguistic clarity, consistency, and compatibility with academic standards, the language of the text was refined and cross-checked using Artificial Intelligence (AI) tools. This support was limited to language enhancement and did not influence the integrity, originality, or analytical content of the study.

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ABBREVIATIONS

CDC	Curriculum Development Centre
CEHRD	Center for Education and Human Resource Development
FGD	Focus Group Discussion
IDI	In-depth Interview
KII	Key Informant Interview
LECU	Local Education Coordination Unit
LEO	Local Education Officer
NCF	National Curriculum Framework
SDG	Sustainable Development Goal
SM	Science and Mathematics
SMC	School Management Committee
STEM	Science Technology Engineering and Mathematics
VI	Visual Impairment

CHAPTER: ONE

INTRODUCTION

Background

Visual impairment refers to the perceptual difficulties that are closely related to problems in visual information processing. Visual impairments can be classified in various ways; however, they are broadly categorized into two types: low vision and blindness, which correspond to moderate and severe levels of visual dysfunction, respectively (Naipal & Rampersad, 2018). In addition, it is indicated that these categories also vary by a range of functional and academic (Jones et al., 2019). The impairments can lead to several difficulties and challenges in both the learning process (Ookeditse & Garegae, 2024) and daily to day activities (Lipkin et al., 2015; Naipal & Rampersad, 2018).

Whatever the classifications, the condition of visual impairments presents substantial obstacles within educational environments, particularly in relation to the acquisition and comprehension of academic contents and completion of coursework (Agesa, 2014). Academic problems faced by students with visual impairments may include various domains of learning including science and mathematics subjects.

Since science and mathematics learning may require deep visual sensations, thus, the learning process should be shaped and facilitated accordingly. It is reported that students with visual impairments (VI) often struggle learning science and mathematics contents through the visual sensations (Ookeditse, 2018). They require more adapted strategies and flexibility in the learning environment and educational support system. The important aspect of this process is the design of curriculum in such a way which identifies and addresses the unique difficulties and challenges of students with VI in learning facilitation of science and mathematics contents (Naipal, & Rampersad, 2018). The effective curriculum may yield extensive support mechanisms during the process of development and implementation. More clearly, the selection and arrangement of contents, methodological delivery and learning assessment are the key components of the curriculum development and implementation. These overall processes seek such type of mechanism that ensures equitable access to learning opportunities. In this regard, students with visual impairments require special support not only for daily living activities, but their learning through making contents, engagements and expressions more flexible and universal (Rule et al., 2011). However, such support is often lacking in many mainstream schools, especially in developing countries.

Existing research reveals a severe lack of effective curricular and instructional resources, teaching strategies and techniques, and a set of interventions for teaching scientific concepts to these learners (Jones et al., 2006). Students with VI often struggle to comprehend abstract ideas, which are frequently conveyed through visual supports such as cell diagrams, tactile graphics, 3D models, audio descriptions, and Braille or large-print resources, etc. (Sahin & Yorek, 2009). It is illustrated that students with VI further require visual interpretation directly correlated to their academic success (Sahasrabudhe & Palvia, 2013). In addition, instructional delivery which is generally delivered by extensive visual representations also present comparable problems and challenges for students with VI (Smith & Smothers, 2012) and limit them in accessing science and mathematics learning (Bell & Silverman, 2019). These practices may dominate the real potentialities of students with VI and create obstacles in learning contents of both science and mathematics subjects (Yusof et al., 2020).

Science and mathematics learning of students with VI could be supported by three embedded curricular models: (a) the core curriculum which is expected to deliver fundamental knowledge and skills; (b) compensatory competencies offered by school and other agencies offer diverse and alternative opportunities by enhancing accessibility and engagement with the core curricular contents; and (c) expended core curriculum designed to address the unique learning needs of students with VI (Hatlen, 1996). Since these students possess cognitive capacities equivalent to their sighted peers, appropriate adaptations can enable them to grasp and master their higher-order science and mathematical concepts.

Objectives of the Study

The main objective of this study is to identify the challenges that students with visual impairments face in learning and being assessed their learning in science and mathematics at the school level. The study also aims to provide evidence-based recommendations to improve inclusive teaching, learning and assessment processes in these subjects. The specific objectives of the study are as follows:

a. To identify problems related to learning, learning facilitation, and assessment of mathematics and science subjects for students with visual impairments.

b. To provide suggestions for solving the problems related to learning, learning facilitation, and assessment for students with visual impairments.

Guiding Research Questions

1. How are the education policy provisions designed and implemented to support students with visual impairments in learning mathematics and science subjects?
2. How do students with VI experience learning problems in science and mathematics at the school level?
3. How is the facilitation of learning in science and mathematics carried out for the students with visual impairments in schools?
4. How do students with visual impairments, their teachers and head teachers perceive the challenges and limitations of current assessment practices in science and mathematics?
5. What are the prerequisites and strategies useful to address the challenges related to learning, learning facilitation, and assessment in science and mathematics for students with visual impairments?

Scope of the Study

Constitution of Nepal (2015), Disability Right Act (2017), and educational policies such as, National Education Policy (2019), Free and Compulsory Education Act (2018), School Education Sector Plan (2022-2032), and National Curriculum Framework (2019) consider inclusion as a key principle for ensuring equitable access to education, guaranteeing the right of every child, including children with disabilities. However, there are limited studies regarding learning, learning facilitation, and assessment of mathematics and science subjects for students with VI. This study encompasses the exploration of those problems and challenges in terms of learning, instructional facilitations, and assessment of science and mathematics for students with visual impairments (VI) and provides solutions to ensure equitable educational opportunities. Hence, the study identified subject-specific problems and challenges faced by teachers and students in teaching and learning science and mathematics at schools.

The perspectives of students, teachers, head teachers, and parents are instrumental in identifying these problems and challenges for finding appropriate solutions. Moreover, it focuses on identifying gaps in policy provision and its implementation regarding inclusivity in school education, with a particular focus on visual impairment. Similarly, the samples of this study cover seven provinces including different geographical regions as Mountain, Hill, and Tarai and the types of schools where the students with disability are placed in integrated, special and resource schools. The scope of this research is also to provide insights at policy level and reform curriculum design and instructional practices as per the learning needs of the visually impaired learners. The scope of this study has been conceptualized at three levels: thematic, temporal and geographical and they are detailed out in the Figure 1.

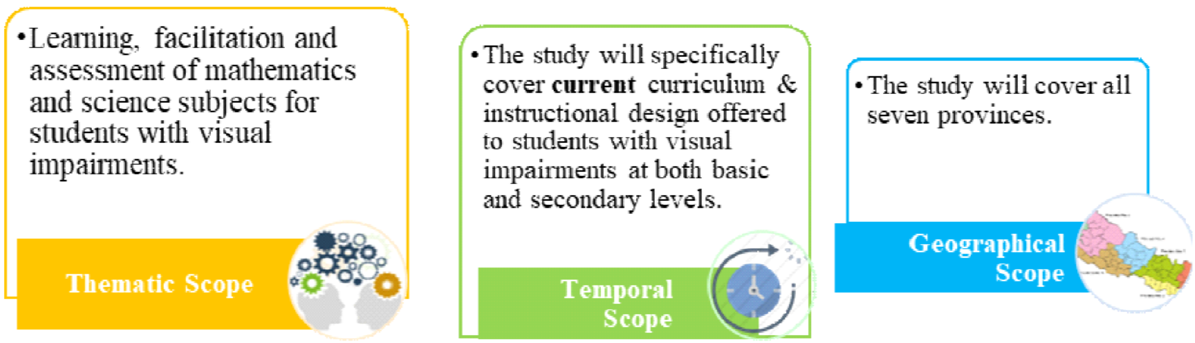


Figure 1: Scope of work

CHAPTER: TWO

REVIEW OF RELATED LITERATURE

The first part of the review deals with sensory processing modalities, sensory integration theory, the Universal Design for Learning (UDL) approach, strategies of curriculum differentiation and accommodation, support services with assistive technologies, and principles for enhancing participation. Similarly, the second part of the review includes an empirical overview of the literature landscape from two South Asian countries like Nepal and India and other countries such as the USA, Australia, and South Korea. To set the context for the study and guide the development of research methods and research tools, the empirical review of these five countries focuses on to identify the policy provisions and practices of teaching and learning facilitation and assessment of students with disabilities particularly with visual impairments.

Theoretical Keystones: Sensory Processing Modality of Children with VI

Vision plays a prominent role in how people interact with the environment, develop strategies to respond meaningfully, and access relevant information (Ricciardi et al., 2014). However, this sort of learning experience is affected among the students with visual impairments (VI). It is reported that children with visual impairment are often observed at risk of being over or under responsive to the particular environmental stimulus such as auditory, tactile or visual stimulus (Jutley-Neilson et al., 2018). This indicates that they might face numerous problems due to visual impairments both in formal and informal learning processes. Formal learning often relies on single sensory modality mainly visual, providing limited opportunity to experience learning through only one sense gateway. On the other hand, social learning might have affected the children with visual impairment since research finding revealed that they have fewer opportunities for positive peer interaction in terms of visual exchanges (Benarous et al., 2020). Formal education has been widely advocated to ensure universal access regardless of any impairments and known problems. In this regard, sensory processing modality is expected to be learned by the teachers and other educational professionals; thus, they might be able to help students with VI altering the information processing instead of depending only on visual processing modality.

Sensory Integration Theory

Sensory integration theory assumes that our brain allows us to take diverse sensory signals or stimuli from our different sense gateways (i.e., sense organs- ear, eye, skin, tongue, and nose) (Ayres,1972). It is stated that the concomitant use of multiple senses is necessary to perceive, understand and comprehend the meaning of environmental stimulus clearly. Even though the instructional contents highly demand visual sensation, sensory integration approach might be an alternative modality of sensing information even if it ensures relatively limited access to contents that highly demand visual sensation. This approach supports compensatory strategies for students with VI, enabling access to learning opportunities (Dionne-Dostie et al., 2015). Sensory Integration theory provides a framework to emphasize and explain the role of all our sensory systems in being used to the optimum extent, creating a supportive and engaging environment that promotes learning, mobility, and independence (Kashefimehr, 2018).

Universal Design for Learning

Universal Design for Learning (UDL) is a flexible educational framework that integrates multiple approaches, such as multi-sensory teaching, differentiated instruction, and technology use, to support diverse learning styles and paces (Palley, 2002). Based on the principles of UDL, a learner is provided with a wider range of learning stimulus which opens an opportunity to maximize the nature of neural networks addressing every person's learning strength and needs (Brand, & Dalton, 2012). The UDL framework aims to remove learning barriers by enabling all students, including those with disabilities, to access, participate in, and benefit from general education environments. This design consists of three principles: engagement, representation, action and expression in a flexible framework that has multiple means or modalities (Leinenbach, & Corey, 2004).

The first principle engagement emphasizes motivating students by offering choices and addressing individual interests. For example, the contents are presented in written, visual pictorial forms including these in audio or audio-visual and tactile forms like brail etc. The second principle, representation, focuses on presenting information in different formats, such as visual, audio, tactile, and braille, to support diverse perceptual needs. This encourages teachers to stimulate students' senses by tailoring differently designed contents and materials. This principle stresses that students should be motivated by recognizing their interests. The third principle, Action and Expression, promotes flexible assessment, allowing students to demonstrate their learning through different methods such as oral, written, tactile, or kinesthetic responses. This principle expects teachers to apply varieties of forms, approaches and designs to examine or evaluate their students' achievement and performance. It is illustrated that the performance of mathematics and science education should be assessed employing either written or oral, tactile (i.e., braille), kinesthetic activities as applicable. It demands differentiation in the ways that students can express (answering way) what they have learnt.

There are numerous contents of mathematics and science education which demand visual imaging and memory, perceptual sensation as well as some activities to respond to the tailored instruction. For example, some content may demand braille notation for children with VI in both mathematics and science related contents to enhance access, engagement and expression. However, conventional teaching practice does not consider such sort of multiple means and application to address the genuine learning needs of children with VI since they have limitation or no visual sense to absorption.

Strategies of Adaptation and Differentiation

Students with visual impairments always need adaptation and differentiation not only in everyday living, but also in the teaching-learning process. Adaptation and differentiation might help to reduce barriers which create disabling conditions more severe. Thus, students with visual impairments need more adapted and differentiated contents, implementations, assessment and environments (Sapp, & Hatlen, 2010). Science and mathematics learning relatively requires visual perception and practical responses, which may be lacking among students with visual impairments, thereby creating unique challenges in understanding abstract concepts, spatial relationships, and hands-on experimentation (Brand & Dalton, 2012). In the classroom, some curricular as well as environmental adaptations and modifications are suggested to manage as the teaching strategies (Brand & Dalton, 2012). These considerations are as below:

Curricular Adaptations and Differentiations

One of the core components of the curriculum development is the content selection and arrangement. When we consider addressing learning needs of children with VI, there should be wide space for the varieties of contents and its diverse forms (Brand & Dalton, 2012). For the Students with VI, this content should be presented in diverse and accessible formats (Loh et al., 2024). This sort of curriculum adaptation and differentiation suggests curriculum developers and policy makers to adopt materials into textbooks in Braille or large print, using audio books, or utilizing digital resources that can be accessed with screen readers. In addition, materials that are concrete forms or real objects may help students with VI to conceptualize the real form or sense of the materials. Guided by the UDL principle of multiple means of representation, curriculum developers and policymakers should ensure content is accessible through Braille, large print, audio books, or screen-reader-compatible digital formats. A piece of text from a mathematics resource book is coined here as, "… an effective teacher was able to create a lot of situations to explain this concept to the child. The cells of the Braille slate can be used to explain this idea; the Geo-board can be used, the seating positions of the children in the class itself can be used to explain this, tactile graph sheets can be used, and so on" (Smith, 2007).

Instructional Approach and Method

Students with visual impairments (VI) often struggle with conventional teaching methods, as these methods do not adequately address their specific needs. Therefore, teachers must adopt or modify instructional approaches to ensure meaningful access to learning (Lamichhane, 2017). It is that teachers need to consider some specific instructional approaches which may enhance learning. The approaches can be presented as individualization, concreteness, unified instructions, additional stimulation and self-activity (Lowenfeld, 1981).

Individualization refers to the adaptation of instructional approaches in such a way that learning should be individualized and based on their individual differences. It highlights that instructional planning and delivery must consider an individual's condition of visual impairment, such as causes, onset, severity and eye care. Next, concreteness emphasizes instructional approaches to be more realistic to the objects and concepts of the surroundings. This strategy may seek combined sensation to the stimulus that also help them to gauze the spatial characteristics of the objects. Similarly, another aspect to be addressed before and during instructional delivery is unified instructions. It refers to the combined sensations used in classroom instruction to capture the environmental stimulus tailored by a teacher. It emphasizes the need of varied impressions that can be gained by multiple gateways of perceptual procession such as hearing (auditory), touch (tactile), smelling (olfactory), feeling, air currents, temperature changes etc.

When a teacher uses this strategy to use unifying instruction by manipulating other gateways of information processing become meaningful experiences to the students with VI. The strategy of additional stimulation is also one that can help students with VI enhancing access to learning. This strategy aims to promote proactive activities in instructional delivery which may be used by presenting additional materials or increase the intensity of stimulations such as high-contrast images, large sizes, additional materials or changing their forms, auditory or tactile cues, technological modifications, altering the materials for same instructional purpose etc. Lastly, the strategy of self-activity encourages students with visual impairment for active participation in learning. It promotes independent learning allowing them to explore and make experiments as well as taking their own decisions to the contents and materials.

Learning Assessment

Educators have a vital responsibility to assess all students, including those with special needs, through fair, flexible, and inclusive methods that enable every learner to demonstrate their knowledge, skills, and understanding (Carless, 2015; Hockings, 2010). Students with visual impairment fall into the same disability (visual impairment), but appear with different characteristics and severity. It is because of this; visual impairment basically includes the students with both low vision and total vision loss or blindness. Thus, there are needs to address different learning needs prevailing importance of differently designed instruction and assessment forms or models (Wardhani, 2023). As the children with visual impairment have diverse learning needs. Thus, they should be provided with a range of opportunities to express their learning experiences and skills through multiple means (Waterfield & West, 2005). Conventional, one-size-fits-all assessments may not effectively capture the learning outcomes of students with VI. Instead, more flexible, individualized, and multi-modal assessment strategies are recommended (Adzanku et al., 2021).

These approaches focus not only on assessing what students know at the end of a term, but also on how they learn, apply, and progress over time. Flexible and inclusive approaches of learning assessment always demand diverse models and methods that can be considered as combined strategies as per the nature of the subject, assessment, and its purpose. Various assessment approaches that can be utilized to evaluate the learning performance of visually impaired (VI) students like performance-based assessment, ecological assessment, rating scales, portfolio assessment, work sample analysis, observation, task analysis, and teacher-made tests (oral or written).

These strategies can be used as per the individual student's performance, efficiency and availability. However, combined or multiple strategies are widely advocated while planning and implementation of learning assessment of students with VI. These strategies insist to employ assessment as learning rather than just semester end traditional evaluation (assessment of learning).

Support Services with Assistive Technology

Students with VI could be highly benefited through Assistive Technologies (ATs) and devices that enhance access to the learning of mathematics and science contents (Mulloy et al., 2014). The ATs and devices which might be relevant, accessible, applicable, affordable and available for both students with VI as well as teachers as well (Muradyan, 2023). There are some specific ATs and devices which are helpful to enhance access to learning mathematics and science contents (Smith & Smothers, 2012; Grasse et al., 2016; Kelly, 2018; Monteiro et al., 2019).

Table 1 Assistive Technologies and Devices

Main ATs and devices	**Functions**
Auditory & audio-based Tools	● Talking lab equipment: talking thermometers, scales, calculators ● Audio descriptions of experiments: real-time narration by teachers or AI ● Screen readers: NVDA[1], JAWS for digital contents ● Science podcasts & audiobooks: Accessible science textbooks
Tactile & 3D Models	● 3D printed models: molecules, plants, plant/animal anatomy ● Raised-line drawings & tactile diagrams: swell paper diagrams of cells, human anatomy ● Tactile globes & maps for geography/astronomy ● Braille-labeled science kits: Chemistry elements in Braille
Accessible Science Software & Apps	● Daisy Consortium's STEM books: Accessible science textbooks ● MathTrax: Graphs & equations converted to audio/tactile formats ● SciAccess Initiative tools for astronomy & physics
Digital & Smart Assistive Technologies	● Screen magnification software: ZoomText, Magnifier for low vision ● Graph & data sonification tools: Converts graphs into sound patterns ● Braille displays & notetakers: Refreshable Braille for digital content ● AI-powered apps: Seeing AI for reading lab instructions

[1]NVDA (NonVisual Desktop Access) and JAWS (Job Access With Speech)

Multisensory Learning Approaches	● Scent-based learning: Using smells to identify chemicals in biology ● Vibrating devices, for physics experiments on sound waves). ● Kinesthetic models: Magnetic atom kits for chemistry
Adaptive Lab Equipment	● Tactile marking kits: High-contrast labels, bump dots for lab tools). ● Talking microscopes with audio output for magnification ● Adaptive measuring tools: Talking rulers, beakers with tactile markings ● Safe, tactile-friendly lab setups: Non-glass alternatives, heat-resistant tools

Table1presents some important assistive technologies (ATs) and devices along with their functions. Teachers should be aware of the availability of these ATs and devices, as they can effectively increase science and mathematics learning.

It is important that teachers should make informed and thoughtful decisions when selecting and using ATs and devices. They should also consider their own capacity to handle these tools as well as the relevance and appropriateness of the technologies within the specific educational context of Nepal. Similarly, the cost and affordability of the ATs and devices must also be carefully considered, as the financial constraints of schools can limit their ability to procure such resources Principles of enhancing participation (5As principles).

Based on the findings of different studies, key considerations such as availability, accessibility, affordability, acceptability, and accountability as the 5As principles are recommended to the stakeholders for improving the accessibility and delivery of services for people with disabilities including students with visual impairments. These could be related and implemented in this study to identify the level of accessibility, effectiveness and way forward regarding mathematics and science learning of children with VI as presented below:

- **Availability:** Education and other supportive services provided by state or local agencies either in services, goods or products must be available in sufficient quantity, and these must also be of good quality.
- **Accessibility:** A non-discriminatory approach; accessibility of the physical environment (To include buildings, classroom and learning tools and materials); services being within learning needs of students with VI.
- **Affordability (economic accessibilit**y): Affordable services for all should be assured including learning opportunities, support services, assistive devices/technologies on the principle of equity.

- σ **Acceptability:** All the education, learning and other supportive services must be culturally appropriate, respectful of different values, needs and interests within communities. Sensitive to issues of confidentiality, gender and life-cycle requirements are needed to address.
- σ **Accountability:** Instructional plans, programs, and services targeted at students with VI should be designed and implemented to address their genuine needs and interests. Policymakers need to consult and involve service users at all stages actively, and those who have responsibility must ensure a full range of delivery to the students with VI.

Literature Landscape of South Asia and Beyond

The research team has carried out desk review of overall literatures of supporting science and mathematics learning for children with disability through reviewing the literature context of South Asia and beyond, including policy provisions, access to learning resources, curriculum adaptation, teaching-learning strategies, access to assistive technology, and inclusive assessment systems and practices as presented in Table 2.

Table 2: Thematic Review Matrix of Learning Science and Mathematics for students with VI

	Theme					Study and Analysis
Country	Policy and Practices	Accessibility	Curriculum & Instructional Design	Support Services with AT	Achievement Assessment	Gaps/ Inconsistencies
Nepal	Strong policy base (Constitution 2015, Disability Rights Act 2017, NCF 2019, SESP 2022–2032); poor implementation; inclusive vision undermined by resource gaps and teacher capacity	Severe shortage of accessible STEM materials (Braille, tactile, auditory); poor infrastructure; rural-urban divide in access	NCF advocates UDL and differentiated instruction; limited classroom implementation; lack of tactile/audio tools for abstract SM concepts; rigid classroom practices persist	AT supported in policy but limited in practice; lack of tools (e.g., Braille math devices, screen readers); weak training & coordination	Inclusive, competency-based evaluation promoted; rarely implemented in science/math; no alternative assessments (Braille/oral); lacks data tracking system	- Identify learning problems and challenges experienced by students with VI - Analyze the instructional facilitations applied in teaching science and math - accessibility to resource materials, and assessment practices
India	Strong policies (RPwD Act, NEP 2020); poor implementation; science/math often excluded in special schools	Severe shortage of accessible resources (Braille, tactile); rural areas most affected; Swayam Prabha lacks accessibility	Rigid curriculum; limited tactile/auditory adaptation; lack of teacher training	Some use of Braille, talking calculators, Arduino tools; uneven availability; NGO support critical	Inconsistent accommodations; no standard framework; assessments prioritize memorization; lack of IEP-aligned assessments	
Australia	Strong policies (Disability Act, Standards); variable	Available Braille, tactile tools; uneven distribution;	UDL promoted but not uniformly practiced; reliance	Use of notetakers, screen readers, tactile	Accommodations like Braille/oral used; UDL partially adopted; high-	

	implementation; teachers unprepared	rural areas underserved	on visuals; need for more training	software; access varies; lack of trained staff	stakes exams still visually biased	
USA	Strong legal framework (IDEA, Section 504); gaps in training, accessibility in STEM curriculum	APH and NIMAS support access; delays in accessible materials; underfunded districts struggle	UDL and tools like AnimalWatch VI, Talking LabQuest used; general teachers lack training	Braille displays, 3D models, screen readers available; teacher training inadequate	Mandated accommodations exist; adaptive tools (e.g., AnimalWatch); IEP-alignment weak; standard tests lack conceptual flexibility	
South Korea	Policies support inclusion (Special Ed Act, Five-Year Plan); implementation struggles due to pressure, untrained teachers	Limited tactile/Braille STEM materials; digital content lacks accessibility; resource libraries not well distributed	Standardized curriculum; poor UDL use; weak collaboration between general and special educators	Screen readers, Braille displays used; cost, infrastructure gaps, and limited training hinder impact	Rigid exams; little alignment with IEPs; tactile/oral formats used in special schools only; mainstream lacks inclusive tools	

Nepal

In Nepal, there is a strong legal and policy framework to facilitate inclusive education for children with disabilities. As grounded on the legal and policy related documents such as the Constitution (2015), Disability Rights Acts (2017), National Education Policy (2019), Free and Compulsory Education Act (2018), School Education Sector Plan (2022-2032) mandate free, equitable, non-discriminatory and accessible education for children with disabilities (Adhikari, 2019; Human Rights Watch, 2018; Lamichhane, 2013). However, most of the literature reveals disparities between these initiatives and classroom practices. Most of the schools, particularly in rural settings, do not have the disability friendly infrastructure and learning materials for effective learning. Literature also discloses teachers' feeling incompetency to facilitate visually impaired students effectively, especially in the areas of science and mathematics.

In terms of accessibility of learning resource materials, literature shows the problems faced by students with disability. Despite the National Curriculum Framework (2019) advocating flexibility of curriculum and differentiated instruction, particularly students with VI do not usually have access to appropriate materials such as tactile learning materials and audio resources. This severely hampers their engagement, especially in STEM areas where conceptual ideas require adapted learning materials.

The NCF (2019) encourages universal design for learning, multi-modal teaching, and differentiated instruction, but evidence-based strategies for implementing these strategies within the classroom are still in development. Mostly visually impaired learners frequently miss out on opportunities for tactile and sensory-based learning necessary to develop scientific and mathematical ideas. The School Education Sector Plan (2022–2032) proposes making schools inclusive, but provides limited guidelines on altering curriculum content or training teachers to utilize inclusive pedagogy.

Although some policy guidelines encourage the use of assistive devices, there is no more guidance on how to integrate tools like Braille math software, tactile models, or screen readers into classroom practice. Although Nepal has endorsed international protocol like the UN-CRPD (2006) and SDG-4 (2018) yet translating this commitment into action, particularly with regard to teaching science and mathematics to children who are visually impaired, is not extensive. To move from policy to practice, improvement of resource allocation, teachers' capacity, and incorporating assistive technology seems to be key to have inclusive education to Nepal.

India

India has introduced several Acts and policies such as the Rights of Persons with Disabilities Act (2016) and the National Education Policy (2020), to ensure inclusive education for children with disability. However, the gap in policy and practice persist particularly in teaching learning science and mathematics for students with VI. These learners have rare access to mainstream education due to lack of teacher training and learning resource materials (Kumar &Sharma, 2023). In terms of access to content of science and math curriculum and learning materials literature highlight that student with VI seem to be facing problems. The researchers show that rural areas are particularly affected by the intermittent availability of tactile science and mathematics learning materials (Jha, 2023; Sharma & Deshpande, 2022).

The literature exposes that student with VI are seen to be struggling with access to most of visual based contents of science and math curriculum design and instructional approaches in terms of provision and delivery of learning science and math supportive services with assistive technologies such as talking calculators, screen readers, and low-cost audio-supported experimental devices, have made some progress. But access to these technologies is not equitable for learners with disability (Ghai, 2022; Senjam et al., 2022). Similarly with reference to inclusivity of learning achievement assessment of students with VI, the availability of tactile papers and provision of oral tests but often seems to be aligning conceptual knowledge in the subjects of science and math (Mishra & Sharma, 2023; NCERT, 2022).

Australia

Inclusive education systems and practices in Australia are seen to be grounded on strong legislations and policies including the Disability Discrimination Act (1992) and the Disability Standards for Education (2005). Despite these policy provisions, the practice in implementing inclusive practices of the support services in science and mathematics learning for students with VI, seems to be inconsistent across Australian territories. The majority of teachers report inconsistency in professional development training mainly in the STEM areas. This emphasizes the need for strong professional development as well as providing specialized resources to facilitate inclusive teaching (Amato et al., 2022; Miyauchi & Paul, 2020).

Australian curriculum planning prioritizes designs such as Universal Design for Learning (UDL) intended to provide inclusivity. However, the applied use of differentiated instruction approaches varies as per needs of learners.as there is effective use of tactile models, audio descriptions, and collaboration pedagogy by teachers, (Miyauchi & Paul, 2020; Southcott & Opie, 2016). Students with VI have access to assistive technology like Braille notetakers, screen readers, tactile graphics software, and refreshable Braille displays to support science and mathematics learning. In Australia the practice of learning assessment for visually impaired students is meant to follow inclusive principles by utilizing methods like Braille papers, oral exams, and tactile graphics (Amato et al., 2022).

USA

In the United States, the Individuals with Disabilities Education Act (IDEA, 2004) and Section 504 of the Rehabilitation Act (1990), that guarantees Free Appropriate Public Education (FAPE) and require Individualized Education Plans (IEPs) for students with disability. The majority of the contents of science and mathematics curricula are equipped with guidelines of pedagogical differentiation and support services.

Efforts like the National Instructional Materials Accessibility Standard (NIMAS, 2004) and products by the American Printing House for the Blind (APH) have opened up access to learning materials. The literature of science and math curriculum in USA reveals the spirit of Universal Design for Learning (UDL) and accessibility to assistive technologies such as 3D tactile models, screen readers, and Braille displays. IDEA provisions accommodation and flexibility in learning assessment system and practices with Braille, audio, oral and time extensions.

South Korea

South Korea has developed an effective special and inclusive education system and practice for teaching learning students with disabilities. The major policy is the Special Education Promotion Act (amended 2007) and 1997–2001). The first five-year plan for inclusive education was initiated and focused to facilitate learning of students with disabilities in regular schools. Likewise, the literature reveals that although such frameworks are useful for students with VI, inclusion of students with intellectual disability remains in its early stages, with few systematic measures toward facilitating their full participation in science and mathematics learning (Cho & Kim, 2021; Kim &Lee, 2020). Despite strong policies, there are problems because of academic pressure and sociocultural attitudes.

There are good practices of VI-friendly learning materials resources like tactile, auditory, and digital access to libraries in science and mathematics learning mainstream environments. Further, the use of assistive technologies such as screen readers, Braille displays, and tactile models, seems to be very effective in the practices of science and mathematics learning. Additionally, learning assessment policies for VI students are still contingent (Choi & Kim, 2021; Song & Lee, 2022).

CHAPTER: THREE

METHODOLOGY

Study Design

This study adopts a mixed-methods research design, integrating both qualitative and quantitative approaches to provide a comprehensive understanding of the research problem. The qualitative data were collected through focus group discussions (FGDs) and in-depth interviews, capturing nuanced insights from participants' lived experiences and perspectives. Simultaneously, quantitative data were obtained through surveys, allowing for validation and triangulation of the qualitative findings. This methodological combination reflects the core rationale of mixed-methods research—drawing on the strengths of both paradigms to enrich the overall analysis. As Kim et al. (2017) suggest, such a design is particularly effective for addressing contextual and descriptive questions (what, when, where, and how), rather than solely focusing on causal relationships. It enables a more flexible and naturalistic inquiry, aligning well with complex social phenomena. While the study leans toward a qualitative orientation, the inclusion of quantitative data serves to substantiate and support key interpretations and arguments. Primary data forms the foundation for the analysis, yet the review of relevant national and international documents adds depth and broader perspective, enhancing the contextual relevancy and credibility of the findings.

Selection of the Study Site

The study was conducted across all seven provinces of Nepal as Sudurpaschim, Karnali, Gandaki, Lumbini, Madhesh, Bagmati, and Koshi representing the three ecological belts: Mountain, Hill, and Tarai. In total, 20 districts and 23 schools were included in the study with the consultation of CDC (see Annex XIII). List of schools were collected from the CEHRD. Additionally, the sampling also ensured the representation of three types of schools as models from special schools, integrated and schools adopting resource class strategy (See details in Annex XIII).

Selection of Participants

To achieve the objective of this study, the participants were represented from multiple sources reflecting professionals, experts, practitioners as well as service recipients and providers were expected to provide relevant, rich and practical information. Purposive sampling method was applied to select the participants for the purpose of collecting VI students related information. Headteachers, subject teachers (mathematics and science), SMC member, parents, students with visual impairments, and policy stakeholders as officials of Curriculum Development Center (CDC) and National Examination Board (NEB), Location education officer (LEO), and representatives from School Management Committee (SMC) were key primary data source stakeholders for the research. Details of participants involved in this study are presented in Annex XIV.

Sample size

The study tries to ensure representation of all selected schools, hence 21 headteachers, 14 subject teachers (7 mathematics and 7 science), 7 SMC member, 7 Local Education Officers (LEO), 7 parents, 76 students for survey as well as 24 for FGD (Each FGD consists 4-6 students) with visual impairments, and 5 policy stakeholders (Officials of CDC, NEB, and CEHRD) were actual sample of the research for primary data. The further details of the participants are presented in Annex XIII.

Tools for Data Collection

The research team developed different research tools such as KII, interview, and FGD guidelines for collecting qualitative data whereas the survey tool was developed for quantitative information. The developed tools were disseminated in CDC twice and their feedbacks were incorporated before its finalization for the validation process. After the finalization of tools, it was translated into Nepali language. In total, four KII guidelines (for CDC, CEHRD, NEB, and head teachers), two interview guidelines for subject teachers (Math and Science), three interview guidelines stakeholders (For parents, SMC, and LEO), one FGD guideline for students, and one survey tool were developed. All research tools except survey were qualitative in nature whereas the survey tool consists of five-point rating scale types of items measured from strongly disagree to strongly agree. The details of the tools are explored as follows:

Key Informant Interview (KII): The guideline was developed and implemented for the purpose of exploring relevant data. It materialized key themes into a tool employed among diverse participants such as headteachers (HT), Local Education Officers (LEO) at Municipality and Rural Municipality level, Curriculum Development Center (CDC) and National Examination Board (NEB) officials and subject experts. The KII was developed in such a way that focused on information regarding key issues and concerns of cognitive and conceptual challenges, tactile and assistive learning tools, pedagogical approaches, assessment methods, technological availability and application, etc.

Additional interview guidelines were developed for specific stakeholders to deepen the understanding of systemic and practical issues:

- σ Parent Interview Guideline aimed to capture parents' perspectives on their children's problems and resilience in learning mathematics and science, including the use of assistive tools, school support, and expectations from educational institutions and local governments [Annex VII].
- σ School Management Committee (SMC) Interview Guideline focused on gathering the SMC's viewpoints regarding the challenges students with VI face in accessing mathematics and science content at the school level [Annex IX].
- σ Local Education Officer (LEO) Interview Guideline was developed to understand policy-level actions, ground-level challenges, and existing initiatives related to curriculum implementation and learning assessment in mathematics and science for students with VI [Annex X].

In-depth Interview: An In-depth Interview (IDI) Guideline was developed that was later employed among the mathematics and science subject teachers. It covers major themes identified as the key areas of the study such as students' interest and participation in mathematical and science learning, concern of accessibility, instructional design and curriculum and learning assessment. Also, support services including ATs were included in the IDI while these key themes were expanded in the lines of accessibility, challenges, and measures to improve participation and better achievement [Annex V-VI].

Focus Group Discussion: A FGD Guideline was constructed which was later employed among students with VI. Relevant information and data were collected using FGD from students that mainly included questions related to the status of accessibility in mathematics and science learning, challenges and expected measures to improve classroom instructions. It covers in-depth specific contents relevant to the practice, problems and challenges of achievement assessment on mathematics and Science subjects for students with VI [Annex VII].

Survey questionnaire: A survey questionnaire was developed to examine the perception of the students with visual impairments regarding mathematical and science learning problems and challenges. It was used to gather information about the specific condition/situation from the students with VI engaging in the selected school for this study. The questionnaire includes items relevant to the learning status, challenges, as well as assistive tools and support mechanism including expected reforms regarding mathematics and science learning and was presented in 5-points Likert-items. Items for both mathematical and science subject matters were selected based on key themes identified by desk review, however these are presented as the Likert items in analysis. The questionnaire was presented in two sections based on the particular objectives and expected outcomes of the study. The first section of the questionnaire includes items related to mathematical situations, problems and challenges. It consists of 17 items including 2 negative statements (i.e., items 7 and 10). The next section of the questionnaire was related to science learning accommodated by appropriate measures to resolve the situation, problems and potential challenges that consists of two negative statements (i.e., item 7 and 27) out of 15 items under this section [Annex XI].

Document review: Secondary data, both published and unpublished, help to gather some important information which yields on developing study design, structure findings and draw conclusions. This study developed a document review guideline that helped researchers to make a rigorous review of available documents; review of CDC's documents and relevant documents available from MoEST and CEHRD including theoretical and empirical articles. Similarly, published research articles were reviewed to theorize the study, its findings and recommended implications. The guidelines largely focused on synthetizing information regarding the key issues and concerns of cognitive and conceptual challenges, and assistive learning tools (ATs) also includes technological availability and application, pedagogical approaches, assessment methods, challenges and policy reformations relevant to the learning mathematics and science for students with visual impairments. Major national and international policy provision related documents were reviewed in terms of thematic areas including policy and practice, accessibility, curriculum and instructional design, accessibility, support services and learning achievement assessment as per the table presented below [Annex XII].

Data Collection Procedure

Both qualitative and quantitative data were collected by face-to-face mode. A one-day orientation workshop was conducted for field researchers, focusing on data collection techniques and proper use of research tools. All data were collected in person by the field researchers at designated locations, including sample schools and various wings of the Ministry of Education, Science and Technology. Informed consent was obtained from all participants by researchers, both orally and written form, prior to data collection.

Data Analysis

Policy documents like The Constitution of Nepal (2015), Disability Rights Act (2017), Free and Compulsory Education Act (2018), National Education Policy (2019), National Curriculum Framework (NCF) 2019, School Education Sector Plan (2022–2032) as well as other related documents were reviewed to address the research questions. The quantitative data was analyzed by using mean and standard deviation. The qualitative data were transcribed and translated in English language before result analysis. The translated data was thematized based on the themes of objectives and research questions. The results of the qualitative and quantitative data were analyzed by a triangulation method for cross validation of the results. The codes used in the qualitative data analysis process to indicate participants are presented in Annex XV. Further details of the data analysis are presented in Annex... (Data analysis matrix).

Methodological Procedure

A concise methodological procedure was followed during planning, implementation and reporting phases to accomplish entire activities of the research project. The study team carried out the study in a commonly recommended structure as it started from collection and review of relevant documents to final deliberation. In particular, the activities of the project started from desk review for documents analysis (document review), consultation with stakeholders, field visit and collection of relevant data, data analysis workshop and analysis, preparing report, dissemination supported by continuous supervision, monitoring and controlling. The flowchart illustrates the major steps/tasks to be undertaken to accomplish this research. The details of the research process is presented in Figure 2.

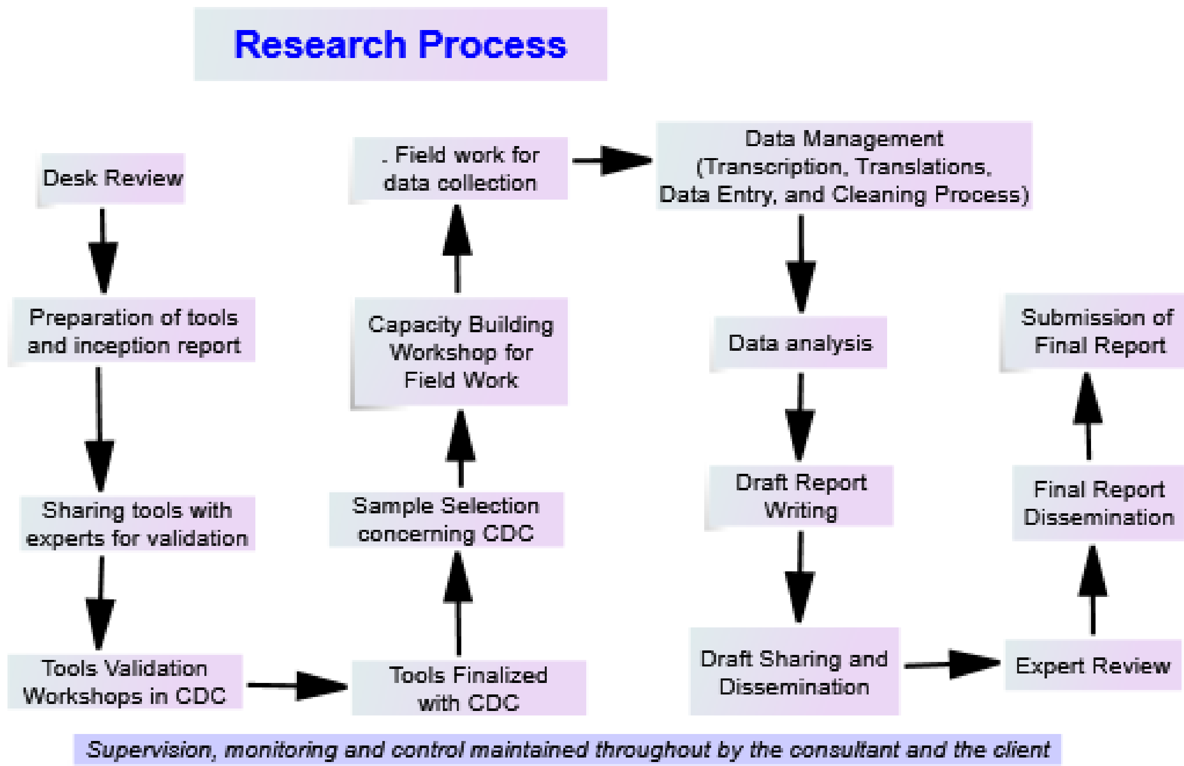


Figure 2: Methodological Steps of the Study

Trustworthiness of the Study

The research focused on the qualitative information tools' trustworthiness maintaining truth value, applicability, consistency, and neutrality (Creswell, 2014; Levitt et al., 2018; Maykut & Morehouse, 1994). The researcher used a triangulation approach to analyze data and interpret obtained from different data sources. Under this strategy, information and findings were compared with key highlights of the interviews, FGDs', and findings obtained from surveys. Thus, source triangulation was highly valued and perceived as the reliable tool implemented in this study. This strategy enabled researchers to conclude that the reliability of their findings was well-supported by the participants' voices and the phenomena observed. The table below presents the different sources and transcription files which can be assessed for further interest, extraction and extension.

Ethical Protocols

The researchers were conscious of ethical guidelines and considerations while conducting research. Following the ethical norms and maintaining confidentiality throughout the study was one major concern. Researchers were abiding by the basic ethical principles of research such as informed consent, autonomy of the participant, no-harm, and fair presentation of empirical data.

Limitations

The sample schools were selected with the consent of the CDC office from the list of schools obtained from the CEHRD, however some selected schools do not have the program associated with VI students hence those schools were replaced by other schools. The study has several methodological limitations like almost all information was collected by interview and KII whereas the survey was conducted among a limited number of students of class nine and ten hence the results of this study will not generalize in the entire country context. Similarly, the study is limited to the VI students focusing on mathematics and science subjects hence further research is needed in the context of other subjects and other types of disabled learners. Furthermore, self-reported perceptions and stakeholders’ reflections were reported in this research hence further research should focus on real practice by some experiment and in-depth observation of the activities associated with the reported contentment in this research.

CHAPTER: FOUR

RESULTS

This chapter presents the findings of the study on the key areas that impact on the education of students with VI in learning, learning facilitation and assessment practices in science and mathematics subjects. The result of the study first highlights a brief recap of cases of field reflection, and then examines field data related to interest, expectations and achievement of visually impaired learners, education policy provisions designed and implemented to support their rights of learning in an inclusive setting. The specific learning problems faced by these learners, followed by learning facilitation practices applied in teaching and the challenges related with current practice of learning assessment are also analyzed to highlight existing gaps in policy and practices. Finally, the study has explored some prerequisites and strategies required to address the problems and challenges related to learning, learning facilitation, and assessment to promote equitable and effective education in science and mathematics subjects.

Cases of Field Reflection

The field experience of this study remained very insightful as the data collection was firstly scheduled from 5 Jestha 2082 to 11 Jestha 2082, however due to heavy rainfall and challenging field conditions, the work extended by an additional week, particularly in the remote areas. A recurring voice across the majority of visited schools was heard as the lack of teacher preparedness and shortage of VI-friendly teaching-learning materials as per needs of students. The field study has also revealed several promising yet inconsistent practices aimed at facilitating students with VI in learning science and mathematics

Box 1: Case of positive impact of adapting constructive facilitation

Aryan from Jhapa district is a student with visual impairment studying in a secondary school. The school runs a resource class that also includes students with visual impairment. He always used to feel it was very difficult to learn various subject matters included in mathematics and science. Lessons and experimental tasks on making pictures, graphs, light and gas in mathematics and science more difficult were more difficult including remembering and equations, using formulas, writing them in braille format. Due to this, he used to stay passively in the class and used to understand these subjects are beyond his condition. But his family decided to transfer him to another special school in Morang district where he felt a different and motivating environment. He found that there was an integrated teaching method in learning mathematics and science. Since science, technology, engineering and mathematics were taught together (i.e., STEM approach), it led to a positive change in both his perception and learning. The school's provision and use of various tactile, sound-producing materials like talking thermometer, 3D models, and locally developed geometry tactile materials made it easier to understand and solve abstract mathematics and science problems. He felt that unless the school created a facilitating and appropriate learning environment, it would be very difficult for students with visual impairments to learn mathematics and science subjects.

Box 2: Case of rigid assessment system and its effect

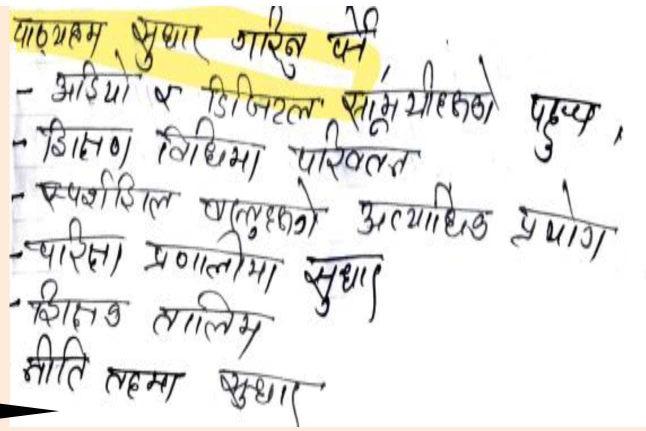
Kamal Krishna is a bright student studying in grade 9 at a school with a resource class for visually impaired students. He gets excellent results in all his subjects, obtains A+ in each subject. However, his scores are low in mathematics. Although he knows almost all the subjects in mathematics, sometimes he does not get the results he should have when taking the exam in Braille or sometimes through an assistant writer. This is affecting his overall performance. Even though he gets A+ in other subjects, his GPA is still below 3.90 because of mathematics. He feels that if he gets the opportunity to take oral exams, evaluate through class performance or project work, he would get A+ in mathematics too.

The two cases mentioned above indicate that visual impairment doesn't inherently limit learning science and mathematics learning. As the Sensory Integration and Processing theory by Ayres (1972) highlights, transforming an inactive learner into an active or engaged one requires appropriate support particularly for understanding abstract concepts in science and mathematics. These cases exposed that there is a need for effective learning facilitation in Science and Mathematics education for visually impaired students who require three interconnected components to be aligned: adaptive learning environments, specialized facilitation materials and flexible assessment practice.

Education Policy Provisions in Learning Science and Mathematics

Most of our existing core policies and legal documents such as Constitution of Nepal (2015), Disability Rights Act (2017), National Curriculum Framework (2019), National Education Policy (2019) and the School Education Sector Plan (SESP 2022–2032) outline a general framework for inclusive and accessible and equal educational opportunities for all including children with disabilities. However, there is a lack of disability-specific support provisions in policy particularly for students with VI in learning science and mathematics education. These policies also do not clearly ensure unique learning needs of visually impaired learners. Most noticeably, the National Curriculum Framework (2019) broadly promotes inclusive education, but it lacks disability specific guidelines for teaching science and mathematics learning. Thus, participants' concerns about inconsistencies in the curriculum have led to problems and challenges, primarily due to the lack of subject-specific accommodations and poor coordination in support mechanisms, as reflected in the following points:

A mathematics teacher during IDI in Koshi province shared that whatever the policy document says, there is an urgent need for reviewing our math curriculum as per needs of learners with VI. He further pointed the major reconsiderations to be taken in our existing curricula of math in the following way:



Furthermore, in terms of policy provisions of science and mathematics curriculum head teacher in KII, Kathmandu shared that some of the contents such as root, square root, or double/triple root of mathematics in the curriculum are complex for students. This needs to be adjusted or modified as per the need. If students are not interested in a certain field or cannot pursue it, there should be room to focus on subjects useful in life. Schools or local governments should be empowered to make such decisions. So, there is a need for curriculum reform

Similarly, science subject teacher of Sindhupalchok district in IDI noted that stakeholders particularly students, resource class teacher and parents are not involved in curriculum development process. The experience and knowledge of these stakeholders regarding teaching learning difficulties in science and mathematics are of great importance. Therefore, present curriculum must be linked to the needs and capacities of visually impaired learners.

Head teacher in KII in Kailali district shared that curriculum design lacks flexibility and adaptation strategies focusing on visually impaired learners, not even a single word. If this is the reality, it indicates a great failure in the curriculum development. The only thing that comes from the top is Braille books. The curriculum must identify and include the learning needs of these students. It should clearly mention what and how to adapt. Teacher guidelines for mathematics and science must include specific instructions.

Moreover, the CDC expert in the KII expressed that, to the best of their knowledge, the key issue in curriculum policy is how well teachers integrate content, pedagogy, and technology. This alignment is often weak. In a country like ours, where systemic limitations exist, inclusive instructional strategies must be prioritized to address the learning needs of students with visual impairments.

Hence the above-mentioned results of the study regarding curriculum design and practice in teaching and learning science and mathematics revealed that the current curriculum content requires revision to address the learning needs of the students with VI. The complexity and inaccessibility of certain contents such as roots and abstract scientific concepts, underscore the need for more relevant and adaptable curriculum structures. Moreover, the exclusion of key stakeholders particularly students with VI, teachers and parents from the curriculum development process has contributed to limitations to curriculum. Similarly integrating subject-specific accommodations into teachers' guidelines for science and math, along with ensuring active participation of resource class teachers and learners themselves in curriculum design appears to be a critical step toward making science and math education more inclusive and equitable for learners with VI.

Results of Qualitative Study

Learning Interest, Expectations and Problems in Science and Mathematics

Students with visual impairments largely depend on multi-modality and pathways to learning of visual contents. As visual information is required to be transformed into accessible forms by supporting verbal explanations, audio materials, tactile as well as other extensive use of assistive technologies for learning visual contents of science and math subjects. In this regard, the study has first explored learning interest, expectations and achievement of students with VI and then the problems and challenges experienced by them in learning.

Learning Interest, Expectation and Achievement

Generally, people may perceive students with visual impairments do not keep interest in learning science and mathematics subjects. This perception is more common since students with VI have limitations in visual processing and sensations. Some lessons are more interesting, but not all are equally similar in science even for general students too. Exploring the interests, expectations and achievement status of students with VI in learning science and mathematics was realized as the most important aspects for this study. Understanding learners' motivation, subject preferences and their perceived problems and challenges matter a lot for addressing the issues. Thus, the results of study sought to identify learning interests, expectations and achievement that are likely to promote inclusive teaching strategies, accessible content, and supportive educational environments for their academic needs. In this regard, most subject teachers expressed that student with VI show moderate interest in learning both science and mathematical contents. A teacher respondent shared those theoretical parts of Science and Mathematics are easier to the students with blind and low vision, however practical or lab related activities are difficult for them. As a science teacher in IDI- Kaski district shared:

"For all people, some contents or topics of science are interesting while some are not. In particular, students with blind are reluctant to show their keen interest in learning numerical parts. However, this sort of concern is relatively easy for students with low vision".

Most of the respondents in this study agreed that students with VI are not distinct in keeping interest in learning science and math; they have interest as general students. However, their interests depend on the nature of contents.

As the students with VI generally keep interest in Science and Mathematics, they express a desire to be the instruction inclusive, examination system, qualified teachers and equal learning opportunities. Their expectation remains to some extent related to accessible resources which includes talking assistive learning devices such as talking thermometer, talking calculator, tactile learning materials, verbal explanations, flexible learning assessment and so on.

"In learning science and math, we expect science lessons to include tactile models, audible experiments and verbal explanations. In mathematics, we anticipate access to Braille resources, talking calculators, and guided problem-solving teaching methods. Students FGD, Kathmandu

Providing that resourceful learning environment, individualized support, availability of adequate materials, and facilitations it was observed that students with VI making average progress compared to their sighted peers in their overall achievement of Science and Mathematics. However, one of the head teachers in KII Jhapa district shared that learning achievement of visually impaired learners seems to be affected by the visual nature of subject specific content that is asked in science and mathematics exams. He further shared:

Their overall learning achievement seems to be average. They obtain good to above-average grades in the SEE exam and evaluations. The most notable thing is that one of the students has obtained B+ or A grades in some subjects, but A+ is rarely achieved due to lower scores in science and mathematics, largely affected by learning barriers.

Learning difficulties faced by the students with low vision, the Head teacher in KII in Tanahun district, expressed that Mathematics and Science have become even more difficult for students with low vision as they can neither rely fully on Braille nor can learn like sighted students. In fact, it is relatively less difficult for blind students who use Braille, but those with low vision face greater challenges in making progress in learning.

Similarly, students with low vision in focus group discussion in Tanahun district remarked that when the teacher teaches us by writing on the whiteboard, but I can't see it.

Furthermore, one of the students with low vision in a focus group discussion in Tanahun district remarked that I cannot see what the teacher writes on the whiteboard during the lessons. I can only see what's written in my notebook. While studying subjects like Mathematics and Science, the letters appear to be spinning. My eyeballs also move. I understand when I listen, but it’s not very clear and precise. These remarks expressed by respondents indicate that students with low vision face more difficulties in learning Mathematics and Science compared to the students with blind who use Braille.

Generally, the above findings show that students with VI have unique needs, interest and expectation in learning visual contents of science and math. Though their engagement in learning varies by the nature of contents, theoretical concepts are easier while numerical contents of math and practical activity in science pose greater challenges for them. Thus, to make Science and Mathematics learning more effective, visually impaired students expected adjustment in contents and instruction, accessible materials, tactile models and audible text as well as supportive assessment practice. Most teachers and students noted the limitations of appropriate support and learning resources. Despite these limitations their academic achievement in Science and Mathematics is seen as average.

Learning Problems in Science and Mathematics

The study team has analyzed and presented field data to respond to the first research objective and first research question. One of the main objectives of this study was to identify learning problems faced by the students with VI in terms of perceptual, contents and objects handling and mapping content problems as well as challenges in terms of availability and accessibility, support services, IEP, equitable participation, teachers' competency and attitudes.

Problems in Perceptual Development of Science and Mathematics Concepts

Learning science and mathematics are highly dependent on receiving and sensing visual or spatial information. Thus, students with VI face significant perceptual problems due to the visual nature of contents and dominant visual instructional instruction. Alternative or accessible forms of learning materials and formats can overcome such problems. This study sought insights from the participants that indicated that students with VI face problems regarding access to learning materials. A teacher teaching science subject at secondary level expressed that student with VI mostly find theoretical contents of science to some extent easier; however, they struggle profoundly in lab related activities and abstract concepts in mathematics due to lack of the availability of tactile models and audio content. Similarly, another notable remark was expressed by a mathematics subject teacher that mathematics is fundamentally visual. Concepts like shapes of rectangle, square, triangle, etc. rely on visual representation. For students with VI, understanding these without tactile or audio-descriptive explanations is extremely difficult. Regarding the need of science subject related learning VI friendly materials at his school was remarkable.

"Without visual or tactile tools, teaching space and motion concepts in science I feel like telling a story without any pictures because they get lost in imagination."

Science Subject Teacher-IDI, Kaski

This teacher's voice underpins the crucial need of materials that are highly helpful to develop right perception on science and mathematics subjects. In the key observations, it was found that in some of schools there were braille text books and basic tactile learning materials like braille diagrams, math learning materials and tactile charts, models whereas in most of schools it was observed that there was lack of science and mathematics related supplementary learning materials in braille and tactile formats. This indicates that limited availability of materials could have left students with VI providing inadequate learning experience to gain better understanding of science and mathematics contents. One student in a focus group discussion (FGD) in Kavre district also supported this observation.

It is difficult to read, understand and experience science related contents, especially lab topics. Teachers explain orally, but it is not enough for us to form a picture in our minds. Just listening is not enough. When teachers teach the same topic again later, I feel a completely different subject is being taught.

Students FGD - Kavre

Students' voices may further rationalize their compressive understanding of science and mathematics contents which captures existing barriers in perceptual development. Instead of a dominant mode of oral instruction, they need more support by substantial tactile and braille materials.

Learning Problems in Contents and Objects Handling

Science and mathematics subjects include subject-specific representation of visual notations, diagrams, pictures, figures, tables, equations, maps, charts, illumination related contents including geometrical representations. Conventional educational practice hardly accommodates this content into accessible forms and formats. In this regard, policy experts of CDC expressed that *current education system primarily emphasizes content knowledge (CK) rather than pedagogical based content knowledge (PCK) which is crucial for teaching students with VI*, and further he insisted that the existing curriculum does not adequately provide diverse strategies for content delivery of visual elements like diagrams, formulas, and chemical mixing in science and mathematical shapes and symbols that require special pedagogical facilitation. While Universal Design for Learning (UDL) principles are acknowledged in the curriculum, their implementations seem to be inconsistent due to lack of training and science and math related braille and tactile learning material production.

"I believe the curriculum has tried to adapt universal design for learning (UDL) principles, but implementation faces several challenges. A major problem is the lack of teacher training and braille and tactile science and mathematics learning material production, though most of school-level curriculums have been converted into braille."

KII CDC Expert

Similarly, the contents included in the curriculum and textbooks seek reasonable and locally adaptation to ensure learning accessibility for students with VI. Participants were concerned with the hands-on learning experience of students with VI. However, the lacking was coined the forms of contents. The present curriculum has space to adapt contents, but it is nominal to promote learning of the students with VI in science and mathematics.

"They (students with VI) pay more attention to the material. Especially with the use of ICT, internet etc.; it has become somewhat easier. But there is a problem in using the objects and chemicals available in the school, classroom and lab. Clear direction and adaptation are required. Listening to the audio or precise directions has also helped in handling the objectives."

Science Teacher IDI, Kavre

Problems in Mapping Out Contents

Students with VI face problems in mapping contents and its specifications. These may include relations of different contents, following sequence and process and spatial information. These problems could be addressed by adapting contents into accessible forms and formats.

In the field observations, it was found that in some of schools there were braille text books and basic tactile learning materials like braille diagrams, math learning materials and tactile charts, models, whereas in most of schools it was observed that there was lack of these supplementary learning materials in braille and tactile formats. A head teacher in Sarlahi stated:

"We previously had some tactile charts and models that supported teaching science and math to students with visual impairments, and they made a noticeable difference. Although we currently lack Braille diagrams, tactile science models, and audio-supported math tools. Making availability and accessibility to tactile materials for scientific concepts like body systems and lab setups talking calculators, and Braille equations in math, would significantly improve our ability to teach these subjects effectively and inclusively"

In terms of problem faced by students with VI regarding learning materials as a teacher teaching science subject at secondary level expressed that student with VI mostly find theoretical parts of science to some to extend easier however, they struggle profoundly in lab related activities due to lack of the availability of tactile models and audio-visual content. Similarly, another remarkable remark expressed by a science subject teacher was that Science is fundamentally visual. Concepts like cell structures, chemical reactions, planetary orbits, electrical circuits, and anatomical diagrams rely on visual representation. For students with VI, understanding these without tactile or audio-descriptive alternatives is extremely difficult. Regarding availability of science subject related learning materials at his school reversely remarked:

"I feel like telling a story without any pictures, visual or tactile tools, teaching space and motion concepts in science because they could get lost in imagination."

Science subject teacher-IDI, Rupandehi district

The above field data of study uncover critical systemic problems in science and mathematics learning for students with VI where the key findings expose problems facing in access to curriculum design and pedagogical approaches. Despite students' average competence in theoretical concepts, educational systems still lack to provide essential tactile learning materials and audio alternatives needed for laboratory activities and spatial learning of science and math These findings also indicate there is gap in curriculum design and learning needs of students with VI. Most teachers expressed their unawareness to deliver abstract contents of science and mathematics effectively. These findings call for an urgent need for reviewing current curriculum contents of science and mathematics for meeting learning needs and developing accessible materials to ensure equitable learning opportunities for learners with VI.

IEP and Support Service

An Individualized Education Plan (IEP) and appropriate supports service is assumed to be most crucial for meeting learning needs of learners with VI; however, the respondents including science and mathematics subject teachers, head teachers, School Management Committee (SMC) members, local education officers, parents, and even students sampled for this study shared their unawareness regarding IEP and common supports services for making science and math learning more effectively. Therefore, in most of the schools it was found that problem faced by students with VI due to the unavailability of Individualized Education Plans (IEP) and science and mathematics related support services.

As one science subject teacher Kailali district shared: *We've never heard of IEPs here. If it exists, no one's asked us what we need. We just adjust ourselves to whatever the system gives or doesn't give.* Similarly, an SMC member in Mahottari expressed: *Even though we started supporting visually impaired students long ago... Identification and facilitation require expertise and resources we currently don't have, but the commitment is there—we just need direction and support to do better.* Likewise, a respondent of student FGD expressed:

We've never heard of IEPs and in our school, there is no more the availability of tactile diagrams, models, geometry kits and note takers. If it exists, no one's asked us what we need. We might not be familiar with the term 'IEP', but teachers have been applying. We just adjust ourselves to whatever the system gives or don't give.

Students FGD–Sindhupalchok district

However, despite limited resources some of community-based schools like Amar Singh secondary school in Kaski district, Gyanchakshu secondary school in Dharan, and Shanti Model secondary school in Rupandehi have initiated their sincere efforts for meeting learning needs of science and mathematics for students with VI. In this regard, a respondent of mathematics subject teacher shared his views in the following way:

Our school, despite limited resources, is deeply committed to science and math learning for visually impaired students. We constantly explore ways to adapt lessons, use tactile tools, and ensure accessibility. Our teachers actively seek to understand and meet their unique needs, fostering an environment where these students can truly engage and achieve in complex subjects. It's challenging, but their progress motivates us greatly."

Math teacher IDI- Dharan

Thus, the study has revealed that the majority of respondents in the study have expressed concerns of IEP and lack of appropriate support services for making science and math learning effective for students with VI. It was found that students often feel excluded due to the unavailability of adapted materials and teaching learning materials in science and math learning. Overall implications of IEP and providing support services such as accessible learning materials, specialized teaching, inclusive classroom environments, and organizational support, are vital for effective science and math learning for students with VI.

Assistive Technologies and Digital Resources

In this section, the study has primarily utilized qualitative data gathered from various stakeholders to respond to the first research objective and the second research question with regard to the accessibility barriers experienced by students with VI in accessing infrastructural facilities and digital resources for learning science and mathematics. In this context, both physical and digital access issues have been explored through fieldwork and consultation with stakeholders.

Major concerns expressed by stakeholders: policy experts, head teacher, science and math subject, teacher, and students are presented here.

The study revealed that most of the community-based schools sampled across seven provinces show that students with visual impairments face significant challenges due to inaccessible infrastructure. As buildings, classrooms, labs, canteens, toilets and even playgrounds often lack mobility-friendly features like tactile flooring, orientation signage and ramps, support. Libraries are often found void of braille or audio resources, and science laboratories were observed inaccessible for experiential learning to the learners with visual impairments.

However, despite limitations, some schools were found to have been initiated with local-level efforts to respond to above challenges. For instance, the community-based schools like in Rupandehi, Kashki and Sunsari have tried their best to accommodate VI learners and facilitate them with peer-assisted learning approaches. These schools have locally engaged in the creation of using local clay to make tactile models for science concepts, verbal demonstrations, and encouraging student buddy systems that was found as a positive impact in supporting basic comprehension for students with VI.

In terms of access to digital resource one of the respondents of CDC has acknowledged that science and mathematics curriculum development process has not sufficiently considered non-visual content delivery methods and further shared:

To make science and mathematics content more accessible, we need diverse pedagogical strategies for content delivery. Visual elements such as diagrams, formulas, and chemical mixing in science labs, or geometric shapes in math, need special facilitation for students with visual impairments.

KII -CDC Expert

The science subject teacher expressed that although there are no appropriate tactile based lab kits, he and his colleagues encourage group work, step-by-step with verbal instruction and hands-on experience through sighted peer assistance. He further shared:

They like science and try hard, but during experiments, they depend on touch and listening. Without proper materials, they mostly observe through others instead of doing things themselves. Learning pace could be catered by maximizing multi-modality of instructions even the reality of several limitations exists.

IDI Science Subject Teacher, Sunsari

In mathematics, a teacher reported the lack of institutional tactile tools, but she used local objects like cups, body measurements, and sticks to convey basic geometry and measurement concepts, acknowledging these as temporary but necessary even though it is locally created.

“*I often read aloud and explain step-by-step, but for topics like algebra or geometry, they really struggle. Peer support helps, but they need more specialized tools and strategies.” IDI Math Subject Teacher, Kashki*

In most schools, digital learning support was observed as a challenge in field study. Most schools sampled from rural geography were remarked with the lack of even basic computer labs, internet facilities. However, it was observed most interestingly but seriously that none of the sampled and visited schools had integrated screen readers, braille displays, or digital accessible information system (DAISY) supported materials. Most teachers were found to be largely unfamiliar with accessible platforms such as Non-Visual Desktop Access (NVDA). Despite the many challenges faced by both teachers and learners in teaching and learning science, one notable self-initiated effort shared by a teacher appears relevant here:

“In my school, there are quite limited institutional and digital learning resources. However, I personally use my own mobile phone to support the learning of students with VI. I search for and download audio explanations of science-related podcasts from the internet that align with the curriculum. During class, I play these audio resources aloud so that students with VI can grasp abstract scientific concepts through listening. This method has helped make lessons more interactive and engaging for them ".

IDI Resource Class teacher, Kapilvastu

While the above efforts may not be systematic however such examples reflect the willingness of educators to bridge learning gaps using whatever tools are available. Similarly, KII with CEHRD expert remarked: *so far I know without teacher input, awareness, or support, we cannot make inclusive learning of science and math education for students with visual impairments.* Students with VI reported feelings of exclusion in both infrastructure and instructional support. They emphasized the absence of tactile diagrams, adapted lab tools, or inclusive evaluation mechanisms.

In the study, a head teacher of Rupandehi acknowledged the problems arising from budget limitations and lack of adapted resources. However, he expressed pride in his staff's creative approaches and underscored that dedicated teachers, even with minimal support, can create meaningful learning experiences for students with VI. He also expressed that the school, despite its budget limitations, has begun exploring partnerships with NGOs to receive basic tactical based learning materials and teacher orientation programs.

Overall, the results of this study showed that VI friendly infrastructure and digital accessibility remained key barriers for equitable learning in science and math for students with visual impairments at school level education. Government's interagency (federal, provincial and local level) policy reforms can only address infrastructure and digital inequity but also actively recognize and support the local creations happening within schools. Institutionalizing these efforts through training, resource provision, and inclusive monitoring mechanisms can transform isolated practices into sustainable inclusive education for VI learners across Nepal.

Equitable Participation

Students with VI need meaningful participation, and ensure fair opportunities to succeed in their learning achievement as their normal peers. This sort of participation refers to the class management which largely relies on teachers' efforts, classroom environment, accommodations in materials and instructional methods that really help address their learning needs. Participants expressed their voices in the line of both enabling and hindering that determine their equitable participation. Some of the participants voiced that student with VI face challenges in participation in lab work and experiments as well as upper grades mathematical classes.

> *"Teaching practices are led by subject teachers. They give preference for students with VI placing in first bench and with normal peers who can help him/her. Additionally, teachers help them by explaining oral mode as per their needs. Thus, they can note in their Braille."*
>
> Headteacher KII, Baglung district

Similarly, teachers pronounced that the participation of the students with VI could be ensured if we manage digital devices and assistive tools. They expressed notable examples of their school as the variety of devices they have been providing for students resulted in progress and convenience in their learning. One teacher engaged in teaching mathematics in a school which running resource class as well expressed:

We have managed computers (laptops) to increase their (students with VI) meaningful participation in learning and classroom. Further, they can use voice recorders as available in schools. These measures have significantly made instructional and learning meaningful and equitable. Importantly, our Metropolitan have managed braille question papers in exam and learning assessment along with computer as per their interest and convenience.

Mathematics subject teacher-IDI, Kavre district

However, reverse experience and opinion was recorded during the field study of this study. One head teacher voiced that general schools rarely address the real learning challenges of the students with VI. As expressed,

In my experience, "it is hard to manage students with VI in our general school with a tail of integration or resource class. No training, limited adapted instructional materials, no trained teachers. So, I argue, there should be a residential school where their learning may be adequately addressed. Admission in any school could increase the possibility of exclusion in learning. Headteachers KII –Sindhupalchok district

Large class size and lack of adequate adapted materials for both science and mathematics are also other challenges of learning which prevent students with VI in meaningful participation in science experiments and mathematical instruction. Accommodated instructional strategies, materials and individualized supports are highly demanded for the students with VI. However, some factors like large class size, teachers without subject-specific training, and limited instructional materials may hinder their participation in learning.

Teacher Competency

Teachers' competency is crucial to enhance learning of students with VI through creating equitable learning opportunities to ensure desirable learning outcomes. Participants of this study also commonly agreed that a teacher's competency is prerequisite not only for support to students with VI, but it implies for all general students as well. Data indicated that there are key challenges of teacher competency and professional development regarding teaching science and mathematics for students with VI in Nepal's context. This sort of challenge may create learning barriers on science and mathematics for students with VI. During a FGD with the students of school located in Jajarkot has remarked:

Our teachers have not that much idea of teaching mathematics for students like us. It is because, I think, he has not received inclusive education training as he shared with us so we just are passive listeners in math class.

Students FGD, Jajarkot

Not only students, head teachers and subjective teachers of both science and mathematics, especially those engaging in upper grade teaching, have been left without any training, orientation and professional development in most of the cases. Their sorrow was expressed as that they are really aware about the real learning needs, potentialities and challenges of children with VI. Despite lots of problem faced by teachers and learners in teaching and learning science as one the notable and self-initiative shared by a teacher seems to be relevant present here:

Both teachers of Science and Mathematics have not participated in any training and orientation related to the learning potentialities and challenges faced by children with special needs. Now, they are engaged in visual impairment specific training. The students with VI are not in teachers' priority because they are unaware about the issue; neither have they known how to teach effectively. This is a key challenge of learning for students with VI.

Headteacher KII, Kailali

The attitude of stakeholders is a key determinant of academic achievement and one of the major learning challenges faced by students with visual impairments, as it is influenced by multiple interconnected factors. Negative attitudes held by the teachers, Head teacher and school administration may limit creating learning opportunities and participation. These may also create more disabling environmental conditions in the classroom and school. The study observed some participants' experience and attitudes that identified some teachers who hold lower academic degrees and are not participating in any professional development training and exposure expressed relatively negatively connotation. Students participating in FGD from a school of Kavre discussed how their teachers hold attitudinal barriers in their learning science and mathematics. Participants voiced out and expressed as:

You should learn from other students. Asking too many questions affects other (general) students. Much time not only for you. Instead of asking small questions, focus on other subjects. You are not going to make any significant achievement even after studying mathematics.

Students FGD, Kavre district

In the key observations, it was found that some head teachers and teachers, not all, also expressed their conviction students with VI should be provided options whether they want to carry Science and Mathematics with other subjects or want to avoid these subjects or part of the contents. One head teacher shared:

…especially, difficult subjects like math and science can be exempted from them. It is better to teach those life-skills or subjects for practical life than difficult subjects like math. Some subjects that are only for writing in exams do not seem useful to them.

Headteacher KII, Palpa district

Learning Facilitations Practiced in Science and Mathematics

This part of study deals with addressing research objective one and research question three regarding learning facilitations applied by teachers for teaching science and math. The spirit of inclusive learning facilitation generally assumes that *one size does not fit for all*. Therefore, all students in a classroom cannot learn equally from the same instructional strategies due to their unique learning needs and preferences (Mastropieri & Scruggs, 2018). Instructional facilitations that work well for sighted learners may not be as effective as for students with VI Given that the diversity of learners within integrated and resource classrooms, teachers need to use differentiated instructional approaches for facilitating learning science and math for students with VI. The observed results of the study present the types of learning facilitations practiced by teachers in teaching science and mathematics.

Learning through Braille, Large Print and Audio Materials

Students with VI need braille, large printed and audio materials for their equitable excess to science and math learning and to enhance their meaningful participation in core curriculum. As students with blindness and low-vision have different needs of supportive materials. Students with Low vision are not able to use generally printed textbooks and learning materials effectively. As Baglung-based head teacher noted that, as per the capacity of our school *blind students are needfully facilitated by learning materials made available in braille and auditory forms, while low-vision students are much assisted by large-print materials.* Likewise, a math teacher from Kashki voiced that *both blind and low-vision students have been greatly facilitated by braille and large-print textbooks*. Further in KII the official of CEHRD shared:

For students with VI, especially those who are blind, a tool called the trailer frame, a type of board used for practicing mathematics, was once widely used to facilitate math learning. This material was in use until the year 2052 B.S but is no longer used today. Being visually impaired myself, I found this tool extremely helpful for learning math. Currently, neither our students nor teachers are aware of this resource, making it difficult for students with VI to learn mathematics effectively.

However, the results of classroom observations in most schools revealed that though braille textbooks are provided, visually impaired students could not get the same access in learning material of Science and Mathematics learning as their sighted peers due to limitations of accessible learning materials.

Learning via Verbal Mode and Extended Time

The results of this study reflects that almost all teachers expressed that they use oral mode of communication and extended time as instructional facilitations strategies and techniques for delivering contents of science and math to students with VI.

Most of the science and math subject teachers participating in the study corresponded that they usually spoke loudly while writing particular contents of SM on the white board mainly to make the information accessible to all learners including those students with VI. A science subject teacher in Rupandehi said that *I read everything loudly that I write on the chalkboard by considering the learning needs of blind students*. Classroom observations also displayed that some teachers were providing oral instruction speaking loudly while writing on the board. A Science subject teacher in Kaski district said *that I simply write some Science subject, specifically physics related equation formulas like* $E=mc^2$ *on the board and interact with all written contents orally. Students with visual impairments also record some important points communicated by me*. So, most of the contents delivered in the classroom were found by communicating through oral mode to make them accessible

Similarly, the results of this study also revealed that students with visual impairments are unable to access commonly designed and prepared resource materials and learn abstract concepts of Science and Mathematics at the same pace as of their sighted peers. Therefore, these students were observed as facilitated by teachers providing extra time to get mastery over the science and math related contents. In this regard head teacher in Kathmandu noted that *all of the students with visual impairments are supported to read text contents at their own pace by giving extra time.*

These findings, thus, indicate that teachers are motivated to do their possible best efforts for addressing learning needs of students with visual impairments.

Lecturing and Peer Assisted Learning Facilitation

Results of the study reflect that the majority of teacher respondents participating in this study were found applying lecture mode and peer-assisted learning as instructional techniques in teaching learning Science and Mathematics subjects for students with VI. Regarding lecture mode of instructional facilitation, as Science and Mathematics subject teachers teaching in an integrated class in Kathmandu district expressed that we *use lecture mode as core instructional facilitation for teaching most of the conceptual contents of science and math subjects* and visually impaired students *can easily grasp, though it is conventional mode approach of teaching we use it as major instructional strategy*.

Likewise in this study peer -assisted learning was found as another most useful and productive instructional technique applied by most of teachers respondents in teaching visually impaired students. *In peer-assisted learning, each of students with and without hearing impairments are paired with each other and then both of them are motivated to sit together on the same bench and a sighted peer is asked to support his buddy in learning Science and Mathematics subjects. This technique has been very fruitful,* science subject resource class teacher of Kailali and math subject teacher of integrated school in Lalitpur expressed respectively. Therefore, a group composed of sighted learner and visually impaired learner for peer-assisted learning was also found to be the most beneficial instructional technique to deliver core contents of particular text, also psychologically productive to harmonize relations among friend circle.

Flexibility in Teaching

Instructional flexibility is indispensable in teaching Science and Mathematics subjects for students with VI because this type of instructional strategy ensures access to the content through multiple means. Through instructional technique differentiation such as the utilization of tactile devices, manipulative, and descriptive verbal descriptions, teachers can meet the diverse learning needs of visually impaired students. In this study, some of teachers were found differentiating presentation of text content of science and math subject through auditory materials to explain abstract concepts. In this regard a science subject teacher of integrated school in Baglung expressed that *I just record and take picture of some of the abstract concept of science like the structure of* *plant cell and atom and present the recorded contents and read the all text pictured aloud in classroom to facilitate learning to understanding of visual notation of science subject.*

Equally, tactile learning materials like abacus play important roles in mathematics. While teaching basic math literacy in resource class in Jhapa a teacher noted that *I frequently use abacus as an effective tactile material- the sensory-based learning materials to enhance numeracy knowledge to introduce basic, mathematical contents like subtraction, addition, multiply and dive mentioned in the curriculum and students enjoy learning this way.* However, the results show that these practices were not found consistent across all resource classes that demand for teacher training and resource allocation to ensure equal access to opportunities for visually impaired students.

Facilitation through Differentiated Instruction

As it is said that in inclusive education setting a smallest adjustment can create the biggest difference for students with VI in learning. Broadly speaking, a teacher's preparedness and competency for making instructional differentiation as per the need of the learner is a way of providing multiple means of learning opportunities to explore the full potential of learners with or without VI. A science subject teaching teacher in integrated class of Rupandehi remarked that Though *I don't have much knowledge and skills about differentiated instruction; however, I think that a teacher needs to understand and even when we do a lesson planning, we must think 'how can I make content delivery as accessible as possible to someone who can't see very well or can't see at all.* Correspondingly in KIIs, the CDC experts noted that *I believe the curriculum has tried to adopt universal design for learning (UDL) principles, but implementation faces several challenges. A major challenge is teachers' competency in instructional delivery through multiple means of learning though most of school-level curriculums have been converted into braille."*

These results indicated that most teachers teaching science and mathematics subjects at secondary level are aware of the learning needs of students with VI. However, there is inconsistency of these findings with the teachers teaching at basic level. Thus, the role of a teacher in supporting students with VI in their science and mathematics learning is to provide an accessible learning environment. It is essential that teachers should plan accommodations in their teaching methods and content prior to each lesson.

Facilitation through Self-Sustained Learning (SSL)

Self-sustained learning is simply defined as the persistent and self-initiated pursuit of knowledge development in a particular subject area. SSL has been viewed as an important learning outcome in the literature and one important component of effective teaching, which can transform passive student learning into active pursuit of knowledge in and outside of their usual classroom. It also has similarities with other concepts of learning, such as self-regulated learning and lifelong learning. The results of study revealed that in some secondary level Science and Mathematics teachers used SSL strategy to make classroom learning more effective. As a science subject teacher in a special education school setting in Sunsari was found encouraging SSL by guiding students to consult libraries and the internet for getting more information about the content shared at class. So, the teacher expressed, *"I very often encourage my students with visual impairments to visit the Braille library regularly and explore the internet for science books to expand their understanding beyond what we cover in class. As we have managed a small braille library as well and this facilitation has supported the learning of our students.* Although this result is not consistent in most of other integrated and resource class due to the lack of braille and tactile learning materials in library and teacher's knowledge about SSL. However Self-sustained learning is considered as an important factor in promoting students' long-term learning engagement and effective achievement in science and math education.

Facilitation through ICT Integration

To ensure equal opportunities for all students, the accessibility of ICT-based educational tools is recognized globally as a critical concern. Literature shows that in developed countries, students with visual impairments have access to a wide range of effective assistive technologies. However, in developing countries when engaging with ICT learning materials, they frequently face various challenges related to accessibility and usability.

In this study the results showed that most teachers either in urban or rural areas were found unaware about using visual impairment specific ICT materials during their instructional delivery. In this regard, a head teacher of integrated school in Kathmandu expressed f*or students with visual impairments, we support students to use the free software Non-Visual Desktop Access (NVDA), which is available online. This allows many students to access assistive technology without incurring additional costs. By using NVDA, we promote learning by enabling students with VI to work on the same equipment as their peers. This not only supports equitable participation during* *teaching and learning sessions but also ensures that when they need assistance, it is easier to provide help, as everyone is familiar with the common technology being used.*

Despite global recognition of the role ICT in ensuring equal learning opportunities, most teachers lack awareness of assistive technologies for students with visual impairments. While tools like NVDA promote inclusion, limited use and knowledge of such resources hinder equitable access and meaningful participation in science and math learning.

Further the CDC policy expert in KII remarked, *I think that our key priority is making science and math accessible by integrating ICT. Differentiating pedagogy and simplifying or adapting content are vital as our education system mainly focuses on content-based knowledge (CK), but integrating pedagogy-based knowledge (PKS) and technology-supported pedagogy (TPACK) is essential to meet the real needs of students with VI.*

Despite limited teaching learning resource and knowledge in inclusive education, the above findings shows that teachers use different types of learning facilitations in science and mathematics classrooms. The data exposed most of teachers rely heavily on verbal instruction, extended time, and peer support facilitations however due to limited training and inadequate access to subject specific materials such as assistive technologies and tactile resources. Teachers' awareness of differentiated instruction and ICT integration seems to be below average. However, the insightful practices of facilitation practice along with self-sustained learning and audio-supported strategies have been very beneficial for learning science and mathematics.

Challenges and Limitation in Current Assessment Practice

This part of the results explores the research question four in terms of identifying challenges and limitations in evaluating and assessing learning achievement in science and math. In this regard, almost all key stakeholders of this study expressed their concern over the contingent approach-based assessment as being practiced**.** As the contingent approach of assessment is considered as a paper-pencil *test*. In the study almost all schools and teachers were observed guided by a contingent approach of assessment. As for assessing the learning of students with VI in science and mathematics teachers provided extra time, assistant writers, different setting, and schedule which is considered as a form of assimilation into an existing system. The demerits of this approach create many exclusionary barriers to the students with VI.

In this study it was observed that in summative or contingent assessment (assessment of learning), students reported the lack of adapted learning materials such as tactile diagrams and auditory resources. They expressed that classroom activities of science and math are not that much differentiated. Most students also noted that individualized support in assessment is rare. One student from Sarlahi shared: *Present practice of assessments seems to be a bit more rigid because we face the problem in finding assistant writers and it also seems to be overlooking exploring our true potential as what we actually know.*

Another respondent of the integrated school of Kathmandu remarked exam *papers often include diagrams, graphs, and geometry-based questions which we cannot attempt independently*. Most students of secondary level stated that *assistant writers are either unavailable or inadequately trained, and additional time is not sufficient to address our needs*. In this regard, the NEB expert shared that *Students with visual impairments manage theoretical questions, but struggle significantly with interpreting diagrams, graphs, and practical-based assessments. The unavailability of adapted tactile materials, screen-reading compatible content and assistive devices in local level and lack of trained teachers and evaluators further compounds the inequality. Without systemic reform and investment in accessible formats, assessments fail to reflect students' actual comprehension.*

Similarly, most of the teachers said that they lacked training in inclusive assessment strategies for science and mathematics. They expressed problems in adapting evaluation methods to accommodate the needs of VI learners, especially in practical areas. A mathematics teacher integrated school in Kavre reported, *we've never used any assistive materials in math. Nothing has been integrated, so we don't know the impact. They just learn what they can, with very limited support.* He also reported a lack of institutional support, including the absence of standardized guidelines, assistive technologies, and subject-specific tactile resources. As a result, both formative and summative assessments often seem to be challenging to reflect the actual learning and understanding of students with VI. A student with VI at a special school setting in Sunsari remarked: *The responsibility of allocating writers must be mandatory for schools and colleges in order to make our exams easier.*

Thus, this result indicates significant challenges in assessing and evaluating the learning achievements of students with visual impairments (VI) in science and mathematics in Nepal. The study shows that most schools rely on a rigid, contingent paper-pencil assessment system, which primarily offers accommodations like extra time, assistant writers, or separate settings rather than meaningful adaptations. While these adjustments represent a form of assimilation which seems to be rigid to address the issues of accessibility.

Lack of Alignment between Teaching, Learning and Assessment

CDC Policy experts identified one of the key issues in inclusive classroom practices as the lack of alignment between content delivery, technology use, and assessment. He pointed out that this alignment is often weak and constrained by systematic limitations. SMC member in the sample school in Kathmandu pointed out that

> *Assessment for visually impaired students is neither fair nor accessible. Without proper tools, adapted content, or trained evaluators, we cannot truly measure what these students know. What we need is a rethinking of both tools and methods—otherwise, we are just assessing gaps, not potential.*

In this regard, NEB Officials (KII) *opined that Despite policies intending inclusive mechanism and practice of assessment however it lacks to match inclusive needs of assessment of students. Comprehensive research is urgently required to uncover the extent of exclusion students with VI facing in science and math assessment. Such evidence should guide reform in curriculum, pedagogy, and evaluation methods. The National Examination Board appears open to policy change, but concrete reforms must ensure standardized adaptations, integration of assistive tech and equitable evaluation methods.*

In FGD, Students in Kavre discussed exclusion in assessment practices for VI students. Participants spoke out and expressed that *Assessment for visually impaired students is neither fair nor accessible. Without proper tools, adapted content, or trained evaluators, we cannot truly measure what these students know. What we need is a rethinking of both tools and methods—otherwise, we are just assessing gaps, not potential. Further a local education officer in Jajarkot viewed that Assessment in science and math has been too rigid. We need more flexible approaches, but we don't even have the experts locally to help us understand how to design those.*

Subject-Specific Problems of Assessment across Subject Areas

Subject-specific challenges of assessment for students with visual impairments (VI) are particularly evident in science and mathematics where content deeply relies on visual representations such as diagrams, symbols, graphs, and practical experiments.

Respondents opined that schools should ensure that every learner, regardless of disability, has equal and equitable access to participate in the learning process, and that multiple opportunities and strategies should be developed to assess their achievement.

A mathematics expert from Koshi province discussed the mathematics-specific challenges of assessing the mathematical skills of VI students. He opined that Mathematics heavily depends on spatial and symbolic representations. Visual impairments pose a unique challenge in interpreting graphs, charts, and geometric figures. While some efforts have been made, I believe there hasn't been a thorough assessment of how students with visual impairments comprehend these concepts.

In the same line, a mathematics subject expert of CDC discussed that VI students are disproportionally disadvantaged in the general classroom. Current assessment overlooks measuring VI students' abilities of verbal reasoning, logical thinking and handling tactile tools for solving mathematics problems. *He suggested the need for content adaptation in mathematics by transforming visuals into tactile materials or auditory descriptions*. Highlighting the need for using alternative assessment, he suggests *that evaluation should not rely solely on written or visual formats. Alternative assessment methods- such as the use of abacuses or verbal reasoning through interactive dialogue- should be incorporated to assess learning outcomes of visually impaired students accurately*.

The head teacher of an integrated school in Kathmandu reported that opportunities for assessing learning of laboratory activities are limited, resulting in a lack of hands-on experience and practical skills.

A teacher teaching science in integrated school in Kailali described *the problems faced by VI students in the science written test as students faced problems in understanding the question when someone was assigned to help them, particularly when it included diagrams and figures. On top of that, the School Education Examination (SEE) science test paper has provisioned alternative questions for students with visual impairments. These alternatives are offered in place of questions that include diagrams, figures, or equations.*

Similarly, a science subject expert in CDC identified problems in assessing theoretical concepts as well. He emphasized the use of inclusive assessment practices in science that utilize various tools and techniques in evaluating the science achievement of VI students. He suggested, *Assessment needs to be diversified, and should incorporate oral tests, tactile identification, and concept-based questions.*

Inclusive Assessment Policy and Practices

The inclusive approach of achievement assessment of students is one that allows all students to respond as they express in multiple styles. It is a more extended mode of alternative approach that uses both formative and summative modes of assessing on preference based. In the research queries related to inclusive academic testing and assessment of students with VI or disability, most head teachers univocally remarked we lack in-service teacher training about inclusive education and differentiation techniques of evaluation systems. *As a principal remarked that there is also diversity in the ability of teachers; some teachers are newcomers with new knowledge, while many teachers are not updated with newer educational technology and techniques. Therefore, our professional competency seems to be not that much enough to make the examination and evaluation inclusive*.

In this research finding, most of teacher respondents expressed unawareness of conducting specialized assessment for learning of visually impaired students, particularly among general school teachers. Science subject expert of CDC asserted *alternative formats, such as oral assessments or tactile demonstrations, are essential for visually impaired students. However, these methods are rarely implemented due to a lack of teacher training and insufficient resources*. Another policy expert of CDC perceived *without inclusive policies and professional development for teachers, even well-designed curricula fail to achieve the desired outcomes*. Diversifying assessment methods and equipping teachers through targeted training are essential for the effective implementation of inclusivity in school education. In the same vein, experts of NEB also highlighted *the needs of training programs on inclusive assessment tools and frameworks as a part of teacher development initiatives*. Most teachers teaching Science and Mathematics also commonly expressed the need *of training on the use of multiple assessment strategies and digital technologies tailored for learners with visual impairments is necessary in school education*.

Likewise, NEB experts in KII expressed that our *job is not to directly get involved in the examination and evaluation process. However, their involvement remains mostly in terms of policy implementation and monitoring. Indeed, expressions of learners with diversity should be incorporated in the examination through various ways such as real-life skill demonstration, oral, observation or written form based on the needs of learners*. He further said there is no such system, if there is such provision to measure and evaluate the educational achievements in an alternative way students could explore their potentiality. For this, the curriculum also needs to be flexible. Due to the lack of professional competence among teachers, the educational evaluation system has not been able to be disability-friendly and inclusive. If students' diversity is to be accepted, formative assessment should be practiced.

Thus, the results of this study revealed a lack of separate inclusive assessment policy guidelines specifically aimed at assessing the learning of students with visual impairments. Although various inclusive education programs, directories, and plans exist, there remains a significant gap in their practical implementation. The study also found that science and mathematics teachers lacked training in inclusive evaluation techniques and alternative assessment strategies. While policies encourage flexible, differentiated assessments, their practical adoption is minimal due to limited resources, insufficient teacher capacity, and outdated practices. As most of the respondent teachers emphasized without professional development and systemic reforms, the goal of equitable assessment practice for students with VI remains unfulfilled.

The results of the study points to critical areas where science and mathematics assessments practice for students with VI could be positively improved. The findings indicate the doubt of learning potential of students whether is fully captured or not by the current practice of paper-pencil based tests that gives a few accommodations by providing additional time or assistant writers in exams. An assessment system that incorporates alternative formats, such as tactile materials, auditory resources, and oral or performance-based assessments, seems to be required in order to be assessing systems more inclusive and responsive. According to the study, learning outcomes can be better supported by integrating inclusive strategies into curriculum, pedagogy, and assessment. Providing schools with assistive technology and educating teachers on subject-specific inclusive assessment are crucial ways to address challenges.

Results of Survey

The result of quantitative study has been presented in this section (Table 3) for science subject. Based on the objectives of the study, the thematic analysis of the results reveals three major themes: learning problems and facilitation, assessment challenges, and areas for improvement in science education for students with visual impairments (VI).

Learning Problems and Facilitation in Science

First, the findings highlight significant learning problems and inadequate facilitation experienced by VI students in science education. The overall mean score of 2.78 indicates that the current learning environment is only moderately responsive to their needs. Key barriers include limited accessibility of science laboratory resources (M = 2.57) and exclusion from practical activities (M = 3.14), which limit students' participation in experiential learning. Although some science textbooks and learning materials are available in Braille, audio, and large print formats (M = 3.00), they are not sufficient or consistently provided. Similarly, the current text and fonts size of science has challenges to access for learners with low vision as reflected in the item eleven. Moreover, many students find it difficult to understand visual content such as pictures and graphs, even with educational adaptations (M = 2.66). Assistive technologies such as screen readers, 3D models, and talking thermometers are not widely used (M = 2.63), and students often lack adequate training in using such tools (M = 2.61). These results suggest that both the curriculum and instructional practices remain largely inaccessible, leading to limited engagement and learning among VI students.

Challenges in assessing science learning various challenges of learning achievement assessment in science are evident in the findings. Although some accommodations exist such as oral exams and extended time students and stakeholders perceive that the assessment methods are not fully appropriate or inclusive. The mean scores for assessment accommodations (M = 2.99) and appropriateness of assessment methods (M = 2.95) are relatively higher than other areas, yet they still fall below satisfactory levels. This reflects concerns that standard testing practices do not adequately reflect the abilities or learning outcomes of VI students, especially in science, where assessments often rely heavily on visual materials and practical demonstrations.

Facilitating and Enhancing Learning and Assessment

Third, the study points to several suggestions for improving learning and assessment in science for students with VI. There is a clear need to strengthen the implementation of Individualized Education Plans (IEPs) (M = 2.72) to address specific learning needs. Teachers should be encouraged and trained to use diverse instructional strategies (M = 2.88) and integrate assistive materials and technologies (M = 2.76) to foster a more inclusive learning environment. The findings call for the development of adapted science resources in multiple accessible formats, the promotion of inclusive practical learning opportunities, and the use of innovative technologies to bridge the accessibility gap. Without such measures, students with visual impairments will continue to face systemic barriers that hinder their full participation and achievement in science education.

Table 3: *Science learning and barriers experienced by students with VI*

S.N.	Statement	Mean	SD
1	The content of the science curriculum is VI learner (with blindness and low vision) friendly.	2.74	1.14
2	Pictures and graphs in science are understandable through educational adaptations and accommodations.	2.66	1.18
3	Science laboratory resources are accessible to students with VI.	2.57	1.35
4	Individualized Education Plans (IEPs) are developed and implemented to address the science learning needs of VI students.	2.72	1.32
5	Science learning materials are available in Braille, tactile, and audio formats.	2.82	1.27
6	Science textbooks and resources are adapted and provided in Braille, audio, and large print formats.	3.00	1.13
7	Teachers use diverse instructional methods to ensure effective science learning for all students	2.88	1.25
8	The science curriculum and textbooks are appropriate and accessible for students with visual impairments	2.63	1.19
9	The school provides sufficient assistive materials, tools, and technologies to support learning in science subjects	2.76	1.18
10	Students with VI are excluded from participating in practical science activities.	3.14	1.24
11	Screen readers, readable text and font size, magnified text, science-related apps, 3D models, and talking thermometers are used in teaching science.	2.63	1.28
12	The school provides training to students with VI on the use of assistive technologies.	2.61	1.31
13	Tactile, Braille, and audio materials are sufficiently available to explain science concepts.	2.57	1.28
14	Science examinations accommodate students with VI through oral exams, extended time, or practical assessments based on the student's ability.	2.99	1.16
15	The methods used to assess science learning are friendly and appropriate for students with VI.	2.95	1.12
	Overall Mean	2.78	1.23

In conclusion, the results demonstrate that students with VI face considerable obstacles in both learning and assessment in science subjects. While some support systems exist, they are not sufficiently developed or consistently applied. This highlights the urgent need for inclusive curriculum reforms, accessible teaching-learning materials, effective use of assistive technologies, and equitable assessment strategies to ensure that students with visual impairments can succeed in science education.

The results of the quantitative data of mathematics subject are presented in this section based on thematic paragraphs of the objectives. Only mean and standard deviation were utilized in the analysis.

Learning Problems and Facilitation in Mathematics

The results show that students with VI encounter significant learning problems in mathematics (Table 4), with an overall mean of 2.77, indicating only a moderate level of accessibility and support. The content of the mathematics textbook is not considered very friendly or accessible (M =2.70), and visual elements like pictures and graphs are not made adequately understandable for VI students (M = 2.66). Learning geometric shapes, graphs, and other visual concepts poses a particular challenge, as students report that their specific needs are often not prioritized by teachers (M = 2.62). Although some teachers do adopt varied instructional strategies (M = 2.68), this is not consistent or comprehensive across schools. Students also indicate that the development of accessible learning resources (M = 2.72) and the provision of such materials by schools (M = 2.88) are insufficient. Moreover, the absence of tactile mathematical materials such as charts, graphs, and geometric shapes (M = 3.04) further restricts conceptual understanding. These challenges reveal a gap between inclusive education policy and actual classroom practice, leaving many VI students struggling to engage fully with mathematics learning.

Challenges in Assessing Mathematical Learning

Assessment-related challenges are also prominent in the findings. While schools appear to allow the use of assistive technologies during examinations (M = 3.17), other aspects of the assessment process are less inclusive. The methods currently used to assess VI students in mathematics are perceived as inappropriate or unfriendly (M = 2.50), and the use of multiple-choice formats (M = 2.59) may not align well with the abilities and learning styles of these students. This suggests that assessments often fail to accommodate the needs of students who require tactile or auditory modes of communication. Despite some efforts to incorporate Braille and digital tools (M = 2.57), the overall system of assessment is still not sufficiently adapted to ensure fair evaluation of mathematical understanding for VI learners.

Suggestions for Improving Facilitation and Enhancing Learning and Assessment of Students with VI

The data also offer insights into possible improvements. There is a clear need for the adjustment of font size of math text for student with low vision development and integration of tactile and auditory-based materials (M = 2.84) and better training for teachers and students on how to use assistive technologies such as Braille Mathematics tools and digital devices (M = 2.76). Although some students report that teachers use multiple teaching methods to support concept understanding (M = 3.09)—one of the more favorable responses, these practices need to be systematically implemented across schools. The availability of specialized assistive technologies like Braille writers and note takers remains limited (M = 2.55), which points to a need for increased investment in inclusive infrastructure. Additionally, the use of Individualized Education Plans (IEPs) to address students' specific mathematical learning needs (M = 2.64) should be strengthened and more consistently applied.

These overall results show that the students with visual impairments face considerable barriers in learning and assessment in mathematics. The moderate overall mean of 2.77 reflects widespread gaps in curriculum accessibility, teaching strategies, and availability of assistive technologies. While there are encouraging practices in certain schools—such as use of varied instructional methods and support for assistive technologies during exams—these remain uneven and insufficient. The findings underscore the urgent need for systemic reforms in curriculum adaptation, teacher training, material development, and inclusive assessment design to ensure equitable and meaningful mathematics learning experiences for students with visual impairments.

Table 4*: Mathematical learning and barriers experienced by students with* VI

SN	Statements	Mean	SD
1	The content of the mathematics textbook is friendly and accessible for students with VI.	2.70	1.06
2	Text and font size and visual contents such as pictures and graphs in mathematics are not made understandable for students with visual impairments.	2.66	1.18
3	Teachers adopt different instructional strategies specifically for students who are fully or partially visually impaired in mathematics learning.	2.68	1.20
4	My learning needs are prioritized by the teacher when helping me understand concepts related to geometric shapes, graphs, and images in mathematics.	2.62	1.18
5	My mathematics learning problems and needs are addressed through an Individualized Education Plan (IEP) at the school.	2.64	1.33
6	In my opinion, mathematics learning resources are developed in accessible formats.	2.72	1.35
7	I find mental math (mental calculations) difficult.	2.89	1.24
8	To help me understand new mathematical concepts and activities, teachers use multiple teaching methods.	3.09	0.98

9	Our school provides necessary learning resources for students with total or partial visual impairments to learn mathematics.	2.88	1.21
10	There is a lack of tactile charts, graphs, and geometric shapes in our school.	3.04	1.32
11	Our school has made good arrangements for tactile and auditory-based mathematical materials	2.84	1.21
12	Assistive technologies necessary for learning mathematics—such as manual Braille writers, Braille note takers, or Braille input/output devices—are available at our school.	2.55	1.49
13	I have experienced the use of Braille embossers, Braille printing, tools to convert math materials into Braille, and graphic tactile tools in my school.	2.57	1.23
14	Our school provides training for teachers and students on the use of Braille mathematics and digital assistive technologies.	2.76	1.08
15	Our school allows the use of assistive technologies for examination and assessment purposes for students with VI.	3.17	1.10
16	While assessing mathematics learning for students with VI, our school uses multiple-choice formats.	2.59	1.22
17	The current methods of assessing mathematics learning are friendly and appropriate for students with visual impairments.	2.50	1.14
Overall Mean		2.77	1.22

Prerequisites and Strategies to Address the Problems and Challenges

To ensure equitable access to science and mathematics education for students with VI, it is essential to address existing gaps in curriculum design, teaching practices, and assessment. This requires subject-specific policy alignment, accessible resources, trained teachers, and inclusive strategies. During the Key Informant Interview (KII), officials from the CEHRD stated that many Science and Mathematics teachers believe that students with visual impairments can neither learn nor need to learn Mathematics. Therefore, there is a need to change teachers' perceptions. For that training programs seem to be essential. Besides Braille materials, this center has not developed subject-specific resources focused on teaching science and mathematics.

Similarly, in FGD with students with VI in Rupandehi they expressed that in science and math classes, we have basic tactile learning materials. If there were a virtual science lab we could use with screen readers, it would help a lot. We want to learn equitably, not just given extra time in exams to solve our problems. Likewise, in KII the head teacher in Kathmandu district shared that our curriculum of science and math lacks subject-specific guidelines and learning resources for teaching students with VI. Students' involvement in the curriculum developing process so there is need for policy-level changes in the contents of curriculum.

In an interview, the parent of a student with visual impairment from Kapilvastu district shared that my child struggles in mathematics and science because the content is too visually oriented. If books and lessons were in audio or tactile formats, it would help. Correspondingly in KII in Jhapa district, the head teacher shared inclusive education should mean more than just enrollment. Students with VI need adapted learning materials and flexible assessments. We recommend training for science and mathematics teachers to ensure no child is left behind in science and mathematics. Furthermore, in IDI, a science teacher in Kavre district noted that teaching science to visually impaired students is difficult during practical lessons. Most experiments are visual, and we don't have tactile models or auditory alternatives. There's also no clear training or guideline on how to adapt these. Adapted learning materials could help students access the lab. We also need proper science kits, manuals, and continuous training to use inclusive strategies and tools effectively in our classrooms.

Similarly in IDI, a mathematics teacher in Siraha district expressed that Mathematics concepts like geometry, graphs, and algebra are very visual. We face real challenges when we don't have tactile graph boards, talking calculators, or large print materials. Most of us haven't received any training on inclusive math teaching. If we had manuals, tactile aids, and access to regular training, we could modify our teaching. Assessment is also a problem—oral or tactile-based evaluation could be more effective than traditional written tests for VI learners.

The above findings highlight the prerequisites and strategies needed to improve science and math education for students with VI. As the CEHRD official's remark reveals misunderstandings among teachers about visual impairment that indicates need for attitudinal change with teacher training. Despite policy commitments, there is a lack of subject-specific, accessible learning materials and clear curricular guidelines. Most students demand screen-reader-friendly virtual labs, while parents emphasize the need for audio and tactile formats. Head teachers stress curriculum reform and inclusive assessment strategies. Science and mathematics teachers reported real classroom struggles due to the absence of tactile resources, manuals, and continuous professional support. Thus, findings indicate the need for teacher capacity building, development of inclusive teaching aids, policy-level reforms, stakeholder involvement and introducing National Virtual Science Lab.

Congruence between the Findings of Qualitative and Survey Studies

Data analysis collected through both qualitative approach and survey indicates similar findings about learning interest and expectation, problems, facilitation and assessment practices. As students were assigned to respond on two separate science and mathematics related Likert items questionnaires, they responded to moderate difficulties, problems and challenges on learning science and mathematics contents. Similarly, other participants such as subject teachers, head teachers, subject experts, etc. who qualitatively expressed their opinions also ascertained learning interest and progress, difficulties and achievement of students with VI are moderately addressed and facing significant challenges. Overall quantitative scores for both science and mathematics indicated moderate results aggregated from 15 science and 17 mathematics related items revealing 3.78 mean scores for science and 2.77 for mathematics subjects. This source of triangulation is supported by the expressions of the participants whose statement also indicates the students with VI face considerable barriers in learning and assessment in science and mathematics.

Regarding the learning problems experienced by students with VI, qualitative findings indicated difficulties in several areas and types. Accordingly, reading and conceptualizing the pictorial contents and diagrams, graphs of both science and mathematics subjects were indicated as quite challenging for students with VI that creates their learning. It might lead them to perceived narration that these subjects are not for them. These findings are strongly corroborated by the data analysis indicating moderate difficulties and challenges. The relevant items highlight the core difficulties by aggregated mean scores such as understanding pictorial and graphs mean score was 2.55 for science and 2.65 for math, accessibility of science laboratory mean score 2.57, mean score related to practical and problem-solving tasks was 3.14. Thus, these sets of data and consecutive findings seek a detailed plan to reduce barriers by identifying problems in learning science and mathematics learning.

On the other hand, learning facilitation appeared with diverse responses since it mostly relies on the individual teacher's professional knowledge, exposure to different trainings and workshops and proactive initiatives. Some schools and teachers have been adopting Science Technology, Engineering and Math (STEM) practice, peer support, extra class and routine feedback, etc. that have been found effective in enhancing students' learning and exam scores. However, some respondents expressed that they were unaware how to teach science and math subjects for students with VI which is crucial to translate science and mathematics' curricular expectations into accessible learning achievement.

The key areas they lack are limited knowledge about the methods and strategies to teach students with VI, often missing braille literacy, lacking specialized training, less availability of VI friendly materials, providing individual support, etc. These findings from qualitative analysis align with the findings of quantitative findings. Some quantitative scores confirm a similar pattern of findings that moderate instructional delivery in addressing learning expectations and difficulties experienced by students with VI. For example, teachers' facilitations to learning science indicated moderate students' perception such as inclusion in practical activities (M=3.14), adaptations (M=2.66), availability and use of assistive technologies used (M=2.63). The scores related to the teachers' facilitation to mathematics learning also appeared in similar patterns. The patterns aggregated from students' perceptions indicated insufficient efforts and availability to address unique mathematical learning needs of students with VI. This can be illustrated as teachers' adaptation of varied instructional strategies (M=2.68), development of accessible learning resources (M=2.72), availability of materials (M=2.88) and tactile mathematical materials (M=3.04). Both qualitative and quantitative data sets strongly seek individualized multisensory and methods for effective facilitation in learning science and mathematics contents, and could be substantiated by tactical and audio materials.

Another area of analysis of this study was to explore challenges and limitations of current assessment practices in science and mathematics. Analysis of both qualitative and quantitative data sets showed that the findings are on the similar patterns indicating students with visual impairments were moderately satisfied with the current learning assessment practice. Participants expressed that assessment practice largely relies on a contingent model since it only allows limited flexibility such as adding extra time, assistant writer, large braille print etc. Data triangulation suggested that there are inaccessible formats that rarely provide opportunities for students with VI to express their true knowledge and learning potentialities. Narratives expressed by the participants highlight the challenges as visual bias, assessment like for regular students, inadequate or incompetent assistant writers, incorrect braille symbols in exam papers, limited teachers' knowledge and awareness about flexible and inclusive assessment as well as lack of a system that accommodates flexible assessment. Similarly, the findings from quantitative analysis also identified some key areas that indicate moderate to justified learning assessment.

Regarding accommodation in science examination (i.e., oral exams, extended time, practical assessment) scored as mean =2.99 and perceived appropriateness of assessment model mean=2.95 while learning assessment in Mathematics also had similar estimations. Mean scores of the key areas includes use of assistive technologies during examinations (M=3.17), appropriate or friendly assessment practice (M=2.50) and incorporate Braille and digital tools (M=2.57). Based on these qualitative and quantitative findings, students with VI are relatively satisfied with the current assessment practice compared to the other areas like addressing learning difficulties and problems, learning facilitation etc., but not at a satisfactory level. Thus, the triangulation certainly indicates the crucial implication in curricular reforms that suggest developing a system where assessment could fairly measure true progress of the students with VI.

CHAPTER: FIVE

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter outlines the major findings derived from the desk review and field-based data analysis. Based on these findings and the accompanying discussion, the study' s conclusion is drawn. Finally, the chapter offers some recommendations aimed at providing ways forward for the further improvement and development of school education, with a particular focus on students with visual impairments.

Key Findings

Aligning with study objectives, the findings of the study are presented below regarding desk review, results of qualitative study, survey and in recommendations:

Subject-Specific Policy Alignment

As the results of the study revealed, although national policies promote inclusive education, science and math curricula lack disability- and subject-specific guidelines in policy. The study exposed that visual content is not adapted into tactile or auditory formats, creating a major learning barrier. There is a strong demand for auditory-based Virtual Science Lab to address the lack of accessible practical science experiences and ensure equitable learning opportunities.

Curriculum Design

The results of study showed the existing science and math curricula lacking subject-specific adaptation guidelines for VI learners. In the case of students with low vision, they expressed their concerns about smaller font size uses in science and mathematics subjects' curriculum, textbooks and reading materials. Furthermore, the key stakeholders (students and teachers) of this study noted a critical absence of content differentiation and inclusive teacher manuals designed for non-visual learners. The study indicated that limited involvement of students with VI, resource teachers, and parents in curriculum development processes is a key challenge. Their participation is critical to align curriculum content and assessments with the real needs and learning styles of VI learners.

Learning Problems

The study revealed that students with VI have been facing difficulty in learning science and math due to the heavy reliance of these subjects on visual content like diagrams, graphs, chemical equations, and geometry. These challenges are intensified by the lack of adapted materials such as tactile diagrams and auditory resources.

Learning Facilitations

The study exposed that science and math subject teachers applied various instructional strategies to facilitate learning of students with VI. Braille, large-print, and audio materials were used, though access to science and mathematics-specific materials seemed to be limited. Teachers were found using verbal explanations, extended time, lecture mode, peer-assisted learning and self-sustained learning to deliver content of science and mathematics.

Availability of Accessible Resources

As the study exposed, most schools lack essential accessible materials like Braille textbooks, tactile diagrams, 3D models, and screen-reader-compatible content. This shortage severely affects the facilitation of science and math learning, especially in understanding abstract or visual concepts.

Professional Competence

The study revealed that many science and math teachers are unprepared to teach inclusively due to a lack of training in assistive technology and alternative pedagogical strategies. This results in ineffective facilitation, especially when teaching practical science or visual math concepts such as geometry, graphs, or equations.

Learning Assessment Practices

This study revealed that present assessment systems rely heavily on paper-pencil tests. Alternative evaluations (e.g., oral, tactile, or practical tasks) are rare. Assistant writers are often untrained and unavailable.

Coordination Across Agencies

The study has also exposed needs of effective coordination among the apex body of secondary schools such as the CDC, the NEB and the CEHRD for effectively facilitating learning and assessment while designing curriculum of science and math, delivery of content, developing VI friendly science and mathematics learning resource materials and assessment practices.

Discussion

The study's findings underscore critical gaps in the inclusive delivery of science and mathematics education for students with visual impairments (VI), despite national policies promoting inclusive education. While inclusive education is emphasized in overarching frameworks, there remains a lack of subject-specific guidelines and practical adaptations in science and math curricula (Brand & Dalton, 2012; Loh et al., 2024). This misalignment leads to continued reliance on visual content without adequate tactile or auditory alternatives, hindering access to core concepts such as diagrams, graphs, and chemical equations (Smith, 2007). The expressed demand for Virtual Science Labs reflects the need for accessible practical learning environments to ensure equity (Grasse et al., 2016).

Curriculum development remains largely non-participatory, with limited involvement of students with VI, parents, and special educators. This restricts the alignment of content with learners' actual needs (Loh et al., 2024). Inaccessible font sizes and a lack of inclusive teacher manuals were noted as significant concerns by both teachers and students. The absence of differentiation contradicts the principles of Universal Design for Learning (UDL), which advocate for multiple means of representation, engagement, and expression (Brand & Dalton, 2012; Leinenbach & Corey, 2004).

Learning challenges persist due to science and math's visual dependency. Although some instructional strategies—such as Braille materials, peer-assisted learning, and lecture-based explanations—are employed (Lamichhane, 2017), the scarcity of accessible materials such as tactile diagrams, 3D models, and auditory content continues to obstruct conceptual understanding (Smith & Smothers, 2012; Monteiro et al., 2019).

Teacher preparedness is a further barrier. Many educators lack training in assistive technologies and inclusive pedagogical approaches, limiting their effectiveness in teaching abstract and practical concepts (Muradyan, 2023; Kashefimehr, 2018). The limited integration of assistive tools—such as screen readers, tactile diagrams, and adaptive lab equipment—points to missed opportunities for inclusive engagement (Mulloy et al., 2014; Kelly, 2018).

Assessment practices remain conventional and largely paper-based, offering few alternatives like oral or tactile assessments. Moreover, assistant writers—when provided—are often untrained, undermining the reliability of assessment results (Adzanku et al., 2021).

Finally, the study highlights the need for coordinated efforts between national agencies such as CDC, NEB, and CEHRD. Fragmented policy implementation and lack of synergy among these bodies impede systemic change (Wardhani, 2023). To ensure inclusive and equitable science and mathematics education, there must be greater collaboration in curriculum design, teacher training, resource development, and assessment planning.

Conclusion

The key findings of study have exposed problems and challenges experienced by the students with visual impairments (VI) in learning, facilitation, and assessment of science and mathematics subjects. Despite the presence of progressive national policies such as the Constitution of Nepal (2015), Disability Rights Act (2017), and National Curriculum Framework (2019), their implementation remains inconsistent, especially in inclusive STEM education. The findings from both qualitative and quantitative data revealed systemic barriers related to curriculum content, instructional practices, learning materials, and assessment approaches. Science and mathematics curricula remain predominantly visual, with limited integration of tactile, auditory, or assistive modalities. Students with VI often struggle to engage with diagrams, chemical structures, and geometric figures due to the lack of adapted resources like Braille texts, tactile models, and audio-based supports.

In the study, teachers widely reported limited training in inclusive pedagogy and access to subject-specific assistive technologies. As a result, students are frequently passive recipients of information rather than active learners. Moreover, assessment practices heavily rely on conventional written exams with little to no accommodation in terms of oral testing, extended time, or the use of assistive devices, thereby misrepresenting the actual knowledge and skills of VI learners.

The study also documents a few encouraging practices in some schools such as peer-assisted learning and locally created tactile materials, though these efforts are inconsistent and not systemically supported. To address these issues, the study recommends aligning curriculum with Universal Design for Learning principles, producing and distributing adapted learning materials, and investing in teacher capacity building for inclusive practices. Assessment systems must evolve to allow students with VI to demonstrate learning through multiple, accessible formats. Additionally, federal and local governments must prioritize funding for assistive technologies and create structures that promote inclusive learning environments.

Most importantly, participants of this study raised their voices for establishing a national digital lab equipped with accessible tools that would enable them to engage more independently, practically, and equally alongside their sighted peers. Thus, unless meaningful reforms are adopted at policy levels, inclusive science and math education for students with visual impairments will remain aspirational rather than a practical reality.

Recommendations

This section responds to the third objective and fifth research question of this study and thus it is intended to provide suggestions for improving the learning, learning facilitation and achievement assessment of science and mathematics for students with VI. Based on the findings of the study, following recommendations are suggested to federal level and local and school level stakeholders.

For Federal Level

At federal level, the key findings of this study recommend to CDC, NEB and CHERD to align the current teaching learning and assessment practice of Science and Mathematics curricula as per learning needs of students with VI in the following ways:

For Curriculum Development Centre

- As per the results of this study to facilitate learning in science and math subject Curriculum Development Center (CDC) is suggested for developing science and mathematics subjects specific separate teacher's guidelines to address learning difficulties and challenges faced by students with VI along with incorporating large fonts size of text, tactile, auditory, and digital alternatives to visual content of both subjects. Further to address access to contents of curriculum of science and math for learners with low vision there is need to enlarge font size of text as per their needs.
- Addressing accessibility issues in science lab related activities CDC is recommended to integrate a fully accessible, audio-narrated and screen-reader-compatible Virtual Science Lab into science curriculum as an inclusive alternative to the existing practice of laboratory experiences for students with visual impairments. This virtual platform should be designed to simulate key science experiments and practical concepts through auditory and tactile interaction. In this regard, Curriculum Development Centre (CDC)may take the lead in designing, coordinating, and institutionalizing the Virtual Science Lab to bridge the existing gap in science practical learning and needs of visually impaired learners.
- Consult students with visual impairments, resource teachers, subject teachers from integrated classes, and experts in visual impairments in the curriculum development process—through workshops or seminars—to ensure that the content is responsive to the needs of learners with visual impairments.

- Institutionalize science and math subject-specific Individualized Education Plan (IEP) in the policy provisions of curriculum. and ensure the integration of assistive technologies like audio calculators, DAISY books, screen readers, and braille displays into teaching practice.

For National Examination Board

- Develop comprehensive inclusive examination and assessment guidelines to facilitate the effective academic evaluation practice of science and math in measuring learning performance of learners with disabilities VI.
- Differentiate and accommodate current practice of the same set of SEE exam questions paper as per the needs of students with VI because of their unique needs and nature.
- Though the provision of providing extra time and assistant writers reflects a positive effort in the assessment process, the spirit of inclusive education calls for greater flexibility and meaningful accommodations in learning assessment practices to address the needs of students with visual impairments in science and math subjects.
- There is a need for standardized guidelines to adapt science and math assessment tools and content (e.g., tactile question papers, oral and interactive assessments) and training provision for examiners and assistant writers in inclusive assessment practices.

The Cross-Cutting Systemic Mechanism

Overall, the key findings of this study recommend for developing of a cross-cutting systemic collaborative mechanism among the stakeholders (CDC, NEB and CEHRD) cooperate closely to:

- Ensure inclusive curriculum development that integrates non-visual content delivery methods.
- Institutionalize teachers' capacity building training and program in inclusive teaching learning and assessment for science and math pedagogy.
- Collaborate to develop VI-friendly and accessible science and mathematics subject specific learning facilitation and achievement assessment resource materials.

For Local and School Level

The key findings of this study recommended that local governments (municipalities), school principals, and School Management Committees (SMCs) align science and mathematics teaching, learning, and assessment practices with the learning needs of students with visual impairments (VI).

For Local Level

- Make budgetary arrangements to manage integrated and resource classes of visually impaired learners for their access to tactile, braille and assistive technologies for the effective uses in teaching science and mathematics.
- Organize workshops and trainings for capacity-building of mathematics and science teachers focusing on inclusive pedagogy and transforming visual content into tactile and auditory forms.
- Promote locally developed and low-cost tactile models created with wood or clay and peer-to-peer learning systems.
- Strengthen local monitoring mechanisms to track implementation of inclusive practices and invest in improving access to school infrastructure for mobility and digital access for students with VI

For School Level

- Head teacher and SMCs should prioritize the development implementation of subject-specific Individualized Education Plans (IEP) that addresses adaptations required for students with VI in science and math instruction, materials, and assessment.
- Head teachers should collaborate with local government for the availability and use of VI-friendly learning resources including braille textbooks, tactile diagrams, geometry kits, audio-supported tools and adapted science lab equipment.
- Head teachers should facilitate flexible and inclusive assessment practices, such as tactile and oral evaluations, interactive practical assessments, and adapted exam formats.
- Furthermore, SMCs have to take a proactive role in advocating, building partnerships with NGOs, and monitoring the school's inclusive education efforts.
- HT and SMC should create a least restrictive environment (LRE) with accessible infrastructure and digital resources being integrated into school improvement plans (SIP).

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ANNEX -I

KII Guidelines for CDC Expert

नामः ...., लिङ्गः ...., उमेरः ...... वर्ष, जातजातिः ....

शैक्षिक योग्यता ....

जिल्लाः ...., पालिकाः ....कार्यालयः ...., पदः ......

१) पाठ्यक्रम निर्माणको क्रममा दृष्टिसम्बन्धी अपाङ्गता भएका बालबालिकाहरुको गणित र विज्ञान विषयका सिकाई कठिनाई र आवश्यकताको पहिचान गरिएका छन् ?

२) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको लागि विज्ञान र गणित विषयका पाठ्यक्रम निर्माण गर्दा के कुरामा ध्यान दिनु हुन्छ ?*(विषयवस्तु, सिकाइ सहजीकरण, मूल्याङ्गनका तरिका)*

३) तपाईंको विचारमा गणित र विज्ञान विषयका केही विषयवस्तुहरुलाई दृष्टि सम्बन्धी अपाङ्गता भएका बालबालिकाहरुले पनि सिक्न सक्ने बनाउन के कस्ता उपायहरु अपनाउनु पर्ला ?*(लचकता वा अनुकूलन)*

४) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सिकाइ उपलब्धी मूल्याङ्कनमा के कस्ता कठिनाई तथा चुनौतिहरु पाउनु भएको छ ?*(समावेशी वा बैकल्पिक मूल्याङ्कन तरिकाहरु)*

५) तपाईंको विचारमा समावेशी मूल्याङ्कन पद्धतिको विकास गर्न के कस्ता नीतिगत व्यवस्थाहरु आवश्यक देख्नुहुन्छ ?

६) दृष्टिसम्बन्धी अपाङ्गता भएका बालबालिकाहरुलाई ध्यान दिई गणित र विज्ञान विषयका पाठ्यक्रम निर्माणमा भएका कुनै उल्लेखनीय असल अभ्यास देख्नु भएको छ कि ?

७) दृष्टिसम्बन्धी अपाङ्गता भएका बालबालिकाहरुमा गणित र विज्ञान विषयको सिकाइमा हुने कठिनाई र सहजीकरण गर्ने उपायहरुबारे पाठ्यक्रम निर्माणकर्ता र शिक्षकहरु कति तालिमप्राप्त भएको पाउनु भएको छ ?*(सचेतना, दक्षता, प्रविधिको ज्ञान र प्रयोग, अभिमूखीकरण तथातालिमको आवश्यकता)*

८) तपाईंको विचारमा के कस्ता नीतिगत परिवर्तनहरुको आवश्यकता देख्नुहुन्छ ?

ANNEX -II

KII Guidelines for National Examination Board (NEB)Expert

नामः ...., लिङ्गः ...., उमेरः ...... वर्ष, जातजातिः ....

शैक्षिकयोग्यता ....

जिल्लाः ...., पालिकाः ....कार्यालयः ...., पदः ......

१)विद्यालय शिक्षाको पाठ्यक्रममा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयको परीक्षा तथा मूल्याङ्कन सम्बन्धमा के कस्ता प्रावधान राखिएका छन् ? *(विषयगत रुपमा कुनै प्रावधानहरू राखिएको छ कि छैन?)*

२) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई परीक्षामा सामेल गर्दा तथामूल्याङ्कन गर्दा के कस्ता समस्या र चुनौतिहरु महसुस गर्नु भएको छ ?

३) के परीक्षा तथा मूल्याङ्कनका तरिकामा अनुकुलनहरु गर्न मिल्ने गरी पाठ्यक्रमले ठाउँ दिएको छ ?*(छ भने के कस्ता अनुकूलनहरु गर्न सकिन्छ ?)*

४) ब्रेलबाट हल गर्न नसकिने गणित र विज्ञानका प्रश्नहरुको समाधान वा विकल्प के हुन सक्ला ?

५) परीक्षामा सहयोगी राख्दा विद्यार्थीको अभिव्यक्ति वा उत्तरहरु उत्तरकापीमा रुपान्तरण गर्न के कस्ता चुनौतिहरु देख्नु हुन्छ ? *(तिनलाई कसरी न्यून गर्न सकिएला)*

६) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयको परीक्षामा सहयोगी प्रविधिहरु प्रयोग गर्न सक्ने व्यवस्था के कस्तो छ ?*(कुनकुन सहयोगी प्रविधिहरु प्रयोग गर्न पाउँछन् ?)*

७) समावेशी मूल्याङ्कन पद्धतिको विकासमा के कस्ता कार्यहरु भएका छन् ?*(के ती पर्याप्त छन्; के कस्ता चुनौतिहरु देख्नु हुन्छ ?)*

८) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयको मूल्याङ्कन सम्बन्धी कुनै असल अभ्यास को देख्नि भएको छ कि ?

९) दृष्टि अपाङ्गता भएका विद्यार्थीहरुलाई पनि उपयुक्त हुनेगरी गणित र विज्ञान विषयहरुका परीक्षा तथा मूल्याङ्कन पद्धतिमा के कस्ता नीतिगत परिवर्तन आवश्यकता महशुस गर्नु भएको छ ?

ANNEX-III

KII Guidelines for Center Education and Human Resource Development (CEHRD) Expert

नामः ...., लिङ्गः ...., उमेरः ...... वर्ष, जातजातिः ....

शैक्षिकयोग्यता ....

जिल्लाः ...., पालिकाः ....कार्यालयः ...., पदः ......

१)दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको लागि पाठ्यपुस्तक तथा सामग्रीको विकास गर्नु हुन्छ कि हुँदैन ?*(के कस्ता सामग्रीहरु विकास गरिएका छन्)*

२) के पाठ्यक्रमले गणित र विज्ञान विषयका सामग्रीहरु दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई उपयुक्त हुनेगरी विकास गर्न आवश्यक लचकता तथा अनुकूलनको स्थान दिएको छ ?

३) सामग्रीहरुको विकास गर्दा न्यून दृष्टि र दृष्टिविहीनताका लागि के कस्ता अनुकूलन गरी सामग्री विकास गर्नुहुन्छ ?*(ब्रेल, अडियो, ट्याक्टाईल सामग्री आदि)*

४) गणित र विज्ञान विषयका सामग्रीहरु पहुँचयुक्त बनाउन सहयोगी प्रविधि प्रयोग गरी सामग्रीको विकास गरिएका छन् ?

५) गणित र विज्ञान विषयका सामग्रीहरु पहुँचयुक्त बनाउन के कस्ता चुनौतिहरु अनुभव गर्नुभएको छ ?

६) CEHRD को प्रदेश तथा स्थानीय तहबीच सामग्रीको विकास तथा प्रशिक्षणमा के कसरी समन्वय हुन्छ ? त्यसमा के कस्ता चुनौतिहरु अनुभव गर्नुभएको छ ?

७) पाठ्यक्रम र विषयगत सामग्रीहरुको विकासलाई प्रभावकारी बनाउन के कस्ता नीतिगत व्यवस्थाहरु आवश्यक देख्नुहुन्छ ?

८) दृष्टिसम्बन्धी र अपाङ्गतासम्बन्धी के कस्ता कुराहरुलाई तालिममा समावेश गरिएको छ ? क- कसलाई तालिम दिइएको छ ? तालिममा के कस्तो परिमार्जन गर्नुपर्ला ?

ANNEX-IV

Key Informant Interview Guideline for Headteacher

नामः ...., लिङ्गः ...., उमेरः ...... वर्ष, जातजातिः ....शैक्षिक योग्यता ....

जिल्लाः ...., पालिकाः ....विद्यालय ...., प्र.अ. वर्षः ......

१) तपाईंको विद्यालयमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुको गणित र विज्ञान विषयप्रतिको रुचि र उपलब्धी कस्तो पाउनुभएको छ ?

२) अपांगताभएकै कारण उनीहरुमा गणित र विज्ञान सिकाइमा के कस्ता कठिनाई तथा चुनौतिहरु देखिन्छन् ? तिनलाई कम गर्न के कस्ता सहजीकरण गर्नुभएको छ ? *(शैक्षिक सामग्रीमा पहुँच, बसाइ व्यवस्थापन, सिकाइ सहजिकरण र मूल्याङ्कन र कक्षोन्नति)*

३) पाठ्यक्रमले गणित र विज्ञान विषयहरु अध्यापन गर्नको लागि सिक्न गाह्रो हुने विषयवस्तुलाई अनुकूलन वा लचकताको रणनीति अपनाउने ठाउँ दिएको छ त ?*(के कस्ता लचकता वा अनुकूलन)*

४) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुलाई गणित र विज्ञान विषय शिक्षणका चुनौतिहरु के कस्ता पाउनु भएको छ ? कसरी न्यूनीकरण गरिरहनु भएको छ ?

५) विद्यालयमा गणित र विज्ञानका विषयवस्तुहरु सिक्न सहयोगी सामग्रीहरु उपलब्ध छन् ? (*जस्तै, थ्री डी सामग्री, ब्रेल नोटेशन, कम्प्युटर, मोबाइल तथा सुन्ने वा छामेर पढ्न मिल्ने सामग्री)*

६) विद्यालयमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुको परीक्षा र सिकाइ मूल्याङ्कन गर्न के कस्ता उपायहरु अपनाउनु हुन्छ ? पाठ्यक्रमले दिएका प्रावधानहरु अनुकूल र पर्याप्त छन् त ?

७) तपाईंको विद्यालयका शिक्षकको दक्षता तथा तालिमप्राप्त शिक्षकको अवस्था कस्तो छ ?

८) दृष्टि अपाङ्गता भएका बालबालिकाहरुलाई गणित र विज्ञान सिकाइमा भएका कुनै उल्लेखनीय असल अभ्यास देख्नुभएको छ कि ? तपाईंको विद्यालयमा पनि कुनै उदाहरणीय अभ्यास छ कि ?

९) दृष्टि अपाङ्गता भएका विद्यार्थीहरुलाई दृष्टिगत गरी गणित र विज्ञान विषयका पाठ्यक्रमको कार्यान्वयनलाई सहज बनाउन स्थानीय सरकारको संवेदनशीलता कस्तो पाउनुभएको छ ? आगामी दिनमा के कस्ता प्रयासहरु गर्नुपर्ने महशुस गर्नुभएको छ ?

१०) तपाईंको विचारमा के कस्ता नीतिगत परिवर्तनहरुको आवश्यकता देख्नुहुन्छ ? दृष्टिविहीन विद्यार्थीहरुले गणित र विज्ञानका विषयवस्तुहरु पहुँचयुक्त बनाउन नीतिगत रुपमा के कस्ता परिवर्तनहरु आवश्यक होला ?

ANNEX-V

Indepth Interview Guideline for Mathematics Teacher

Accessibility

१)दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई गणित विषय (जस्तै समूह, अङ्कगणित, बीजगणित, ज्यामिति, त्रिकोणमिति, तथ्याङ्कशास्त्र र सम्भाव्यता सिक्नकस्ताशामाग्रीहरु आवश्यक पर्छन् (थीम:प्रविधी सम्बन्धी र अन्य)

२) तपाईंको कक्षामा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूसँग ब्रेल वा ट्याक्टाइल ग्राफिक्स वा अन्य सामग्रीको उपलब्धता कस्तो छ ? साथै त्यसको प्रभावकारी व्यवस्थापन गर्न कस्को भूमिका कस्तो हुनुपर्ला ?

३) तपाईंको विद्यालयमा गणित विषय शिक्षणसँग सम्बन्धित ब्रेल वा ट्याक्टाइल ग्राफिक्स वा अन्य सामग्रीको उपलब्धता कस्तो छ ? शिक्षणमा त्यस्ता सामग्रीहरुको व्यबस्थापन तपाइँ शिक्षकको हैसियेतले कसरी गरिराख्नुभएको छ ? त्यसको प्रभावकारी व्यवस्थापन गर्न कस्को भूमिका कस्तो हुनुपर्ला ?

Curriculum and Instructional design

४) हालको गणित विषयको पाठ्यक्रम दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूका लागि कत्तिको सान्दर्भिक छ । यसलाई थप सुधारका लागि गणितको कुन क्षेत्रलाई (जस्तै समूह, अङ्कगणित, बीजगणित, ज्यामिति, त्रिकोणमिति, तथ्याङ्कशास्त्र र सम्भाव्यता) सुधार वा परिमार्जन गर्नुपर्ला ?

५) तपाईंको विचारमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई गणित (जस्तै समूह, अङ्कगणित, बीजगणित, ज्यामिति, त्रिकोणमिति, तथ्याङ्कशास्त्र र सम्भाव्यता) शिक्षण गर्न कस्ता रणनीति अपनाउँदा प्रभावकारी हुन्छ ?

६) गणित विषय (जस्तै समूह, अङ्कगणित, बीजगणित, ज्यामिति, त्रिकोणमिति, तथ्याङ्कशास्त्र र सम्भाव्यता) पढाउँदा तपाईंले मल्टि-सेन्सरी (श्रवण, स्पर्श, मौखिक वर्णन) विधिद्वारा के कस्ता अभ्यासहरू गराउनुहुन्छ ? कुनै ठोस उदाहरण दिन सक्नुहुन्छ ?

७) गणित विषयका विभिन्न क्षेत्रहरु जस्तै समूह, अङ्कगणित, बीजगणित, ज्यामिति, त्रिकोणमिति, तथ्याङ्कशास्त्र र सम्भाव्यता शिक्षणमा कस्ता सामग्रीहरु प्रयोग गर्दा प्रभावकारी हुन्छ ? तपाईंले त्यस्ता सामग्रीहरु कतिको प्रयोग गर्नुहुन्छ ?

८) गणितका अमूर्त अवधारणाहरूलाई सहज बनाउन तपाईंले के कस्ता उपायहरु अपनाउनु हुन्छ ?

ट्याक्टाइल (स्पर्श) ढाँचा वा व्यवहारिक गतिविधिहरूको प्रयोग गर्नुहुन्छ र दृष्टिविहीन विद्यार्थीहरुको त्यसमा कत्तिको सहभागिता देखाउँछन् ? (थीम:अवधारणा विकास, व्यवहारिक सिकाइ)

९) समावेशी शिक्षण विधि वा सिकाइको विश्वव्यापी ढाँचा (यु डि एल्) प्रयोग गर्नुहुन्छ ? गर्नुहुन्छ भने कस्ता शिक्षणका रणनीतिहरु अपनाउनु हुन्छ ?

१०) समावेशी शिक्षा तथा युडिएल सम्बन्धी तालिम लिनुभएको छ ? (थीमः समावेशी शिक्षा तथा युडिएल सम्बन्धी तालिम, व्यवसायिक दक्षता विकास)

Support services with ATS

११) के तपाईंले गणित विषय शिक्षण गर्दा सहायक प्रविधि (जस्तै टकिङ्ग क्याल्कुलेटर वा ब्रेल प्रिन्टर) को प्रयोग गर्नुहुन्छ ? यदि प्रयोग गर्नुहुन्छ भने, कुन उपकरण बढी प्रभावकारी देख्नुभएको छ ? (थीमः सहायक प्रविधि पहुँच, प्रविधिको प्रयोग प्रभावकारिता)

Learning assessment

१२) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित विषयको सिकाइ उपलब्धि मापन गर्न कस्ता गतिविधिहरु अवलम्वन गरिराख्नुभएको छ । (जस्तै ब्रेल, मौखिक उत्तर, चित्रको वर्णनात्मक व्याख्या) (थीमः समावेशी वा वैकल्पिक मूल्याङ्कन तरिका)

१३) विद्यमान सिकाइ मूल्याङ्कन पद्धतिलाई थप सुधार गर्न के गर्न सकिएला ? (थीमः मूल्याङ्कन सुधार, नीतिगत सिफारिस)

१४) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सिकाइ (आलोचनात्मक सोच, रचनात्मकता, सहकार्य, र सञ्चार) र गृहकार्य तथा परियोजना कार्यमा कत्तिको सक्रियता पाउनुभएको छ ? विद्यार्थीहरूको सिकाइ र गृहकार्य तथा परियोजना कार्यमा सहभागिता बढाउन कस्ता उपायहरु अवलम्वन गरिराख्नुभएको छ ?

Policy and practice

१५) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुको लागि गणित सिकाइलाई सहज बनाउन, पाठ्यक्रममा के कस्ता परिवर्तन गर्नु पर्ला ? (पाठ्यक्रम)

१६) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित सिकाइलाई थप प्रभावकारी बनाउन

शिक्षक तालिम, स्रोत व्यवस्थापन, तथा नीतिगत पक्षमा के कस्ता सुधारका व्यावहारिक सुझाव दिनुहुन्छ ? (थीमः नीतिगत सिफारिस, प्रणालीगत सुधार)

ANNEX-VI

In-depth Interview Guideline for Science Teacher

नामः ...., लिङ्गः ...., उमेरः ...... वर्ष, जातजातिः ....

शैक्षिक योग्यता ....

जिल्लाः ...., पालिकाः ....विद्यालयः ...., विषयः: ......

Interest, and Participation

१. दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुको विज्ञान विषयप्रतिको रुचि कस्तो पाउनुभएको छ ? उनीहरुको समग्र सिकाइ उपलब्धीको स्तर कस्तो छ ?

२. दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुको सिकाइ सहभागिता कस्तो छ ? के कस्ता विषयवस्तु र क्रियाकलापमा सहभागिता राम्रो र कस्तामा कम पाउनुभएको छ ? सहभागिता बढाउन के गनुपर्ला ?

Accessibility

३. ब्रेल, ट्याक्टाइल मोडेल, कम्प्युटर एवं श्रव्य सामग्री कत्तिको उपलब्ध छ ? Probes: सामग्रीको उपलब्धताको अवस्था के कस्तो छ ? उपलब्ध स्रोत सामग्रीले विषयगत शैक्षिक आवश्यकताको सम्बोधन हुन्छ वा हुँदैन ? थीमकोडिङः स्रोत सामग्रीको उपलब्धता र आवश्यकताको सम्बोधन वा पहुँच

४. कक्षाकोठामा बसाइ व्यवस्थापन के विधार्थीको विशेष आवश्यकतालाई ध्यान दिएर गरिएको छ ? के पुस्तकालय, प्रयोगशाला, कम्पयुटर ल्याबमा पहुँच सुनिश्चित गरिएको छ ? के विज्ञान अध्ययन गर्न आवश्यक सामग्रीको व्यवस्था गरिएको छ ? प्रयोगको अवस्था कस्तो छ ?

Instructional design & Curriculum

५. दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूलाई विज्ञान विषय अध्यापन गर्दा कस्ता किसिमका शिक्षण रणनीति अपनाउनु हुन्छ ? Probes: श्रवण विधि, ब्रेल वा ट्याक्टाइलको प्रयोग ? प्रयोगशालामा उनीहरूको सहभागिता र पहुँच ? व्यक्तिगत पाठयोजना निर्माण वा विषयवस्तुको अनुकूलन थीम कोडिङ शिक्षण विधि र अनुकूलन ।

६. क्षेत्रगत रुपमा भौतिक, रसायन, जीव र भूर्गभ तथा खगोल विज्ञानका विषयवस्तुमा विद्यार्थीहरुले कुन क्षेत्रमा सहज र कुनकुन क्षेत्रमा कठिनाई महसुस गर्नुहुन्छ ? कारण के होला ?

७. विज्ञान विषयसँग सम्बन्धित प्रयोगात्मक प्रक्रियाहरू (जस्तै परीक्षण, अवलोकन, विश्लेषण) शिक्षण गर्दा तपाईंले के-कस्ता उपायहरू अपनाउनु हुन्छ र के कुरा गर्न सक्नुभएको छैन् ? किनहोला ? Probes: प्रत्यक्ष अनुभवमा आधारित सिकाइ कत्तिको सम्भव हुन्छ ? वैकल्पिक अभ्यास वा मापन विधि प्रयोग गर्नुहुन्छ ? थीमकोडिङ, अनुभवजन्य अभ्यास र वैकल्पिक विज्ञान शिक्षण ।

८. उनीहरुलाई विज्ञान विषय शिक्षण सिकाइका मुख्य कठिनाई तथा चुनौतीहरू के-के देख्नुहुन्छ ? Probes: अवधारणात्मक वा प्रयोगात्मक पक्ष कुन बढी कठिन र चुनौतिपूर्ण ? थीमकोडिङः विषयवस्तुको कठिनाई र चुनौतिहरू ।

Support services with ATs

९.तपाईंले विज्ञान विषयको शिक्षणमा प्रयोग हुने सहायक प्रविधि (Assistive technology) र त्यसको प्रभावकारिता के कस्तो देख्नुभएको छ ? Probes: सहयोगी प्रविधि जस्तै टेक्टाइल/ब्रेल किट, tactile kit को उपलब्धता, पहुँच र प्रयोग अवस्था ? थीमकोडिङः प्रविधिको उपलब्धता, प्रयोग र प्रभावकारिता

१०.तपाईंले समावेशी विज्ञान शिक्षणका लागि कुनै विशेष तालिमप्राप्त गर्नुभएको छ ? त्यसले शिक्षण प्रक्रियामा के कस्तो सहजता प्रदान गरेको छ ? (Probes: तालिमको प्रकृति ,व्यवहारिक उपयोगिता र के अझै थप तालिम आवश्यक लाग्छ ? थीम कोडिङः क्षमता विकास र प्रभाव)

Learning assessment

११ उनीहरुको समग्र सिकाइ उपलब्धीको स्तर कस्तो छ ? उपलब्धीमा के कुराहरुले बढी प्रभाव पारेको छ होला ? उपलब्धी बढाउन के गर्नुपर्ला ?

१२ दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको लागि विज्ञानको मूल्याङ्कन गर्दा कस्ता अनुकूलनका तरिका अपनाउनुहुन्छ ? (Probes: Braille, मौखिक परीक्षा, ट्याक्टाइल चित्रप्रयोग, मूल्याङ्कनले वास्तविक क्षमता मापन गर्छ त ? थीम कोडिङ : मूल्याङ्कनमा पहुँच र समावेशिता)

१३. प्रयोगात्मक शिक्षण क्रियाकलापमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको सहभागिता र चुनौतिहरु कस्ता पाउनुभएको छ ? Probes: दृष्टिविहीन विद्यार्थीहरूलाई प्रयोगात्मक क्रियाकलापमा सक्रिय रुपले सहभागी गराउने अन्य उपायहरू छन् ? समूहमा कामगर्ने अवसरहरू दिनुहुन्छ ?

Policies

१४. दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको लागि विज्ञान विषयको पाठ्यक्रम, सिकाइ तथा मूल्याङ्कनका क्षेत्रमा के-कस्ता कमी रहेका छन् ? सुधारको लागि तपाईंका सुझावहरू

Probes: पाठ्यक्रम, तालिम, स्रोत सामग्रीमा के सुधार आवश्यक छ ? सहायक प्रविधि प्रयोग कसरी सशक्त बनाउन सकिन्छ ? थीम कोडिङ : नीतिगत सुधार र व्यवहारिक सुझाव ।

ANNEX -VII

Focus Group Discussion Guidelines for Students

१.कृपया तपाईंहरुको विज्ञान र गणित विषयको सिकाइ अनुभव भन्नु हुन्छ कि ?

२. तपाईंको विचारमा विज्ञान र गणित विषयको पाठ्यवस्तुमा समावेश गरिएका के कुरा सिक्नमा कठिनाइ अनुभव गर्नुभएको छ ? प्रोब्सः कुन खालका पाठहरू वा शीर्षकहरू बुझ्न सबैभन्दा गाह्रो हुन्छ ? पाठ्यपुस्तकमा ब्रेल/श्रव्य/स्पर्शमा आधारित व्याख्या कत्तिको प्रयोग भएको छ ?

३. विज्ञान र गणित विषय सहज रुपले सिक्नमा शिक्षकहरूले के-कस्ता फरक-फरक सिकाइ विधि अपनाउनु हुन्छ कि, सबैलाई एउटै तरिकाले पढाउनु हुन्छ ? प्रोब्स शैक्षिक आवश्यकताअनुसार शिक्षण समायोजन, प्रयोग गरिने दृश्य सामग्रीको बुझाई ।

४.तपाईंको विद्यालयमा विज्ञान र गणित विषयवस्तु सहजरुपले सिक्नका लागि के-कस्ता दृष्टि अपाङ्ग मैत्री शैक्षिक सामग्री उपलब्ध छन् ? प्रोब्सः ब्रेल पुस्तक, श्रव्य सामग्री स्पर्शीय चार्ट आदिको उपलब्धता ।

५. कक्षामा गणित र विज्ञान विषयको सिकाइमा के-कस्तो सहजीकरण वा अनुकूलन पाउनुहुन्छ ? प्रोब्सः अतिरिक्त समय वा मौखिक उत्तरमा कस्तो सहजीकरण तपाईंलाई उपयोगी लाग्छ ?

६. तपाईंको विज्ञान र गणित विषयको शैक्षिक आवश्यकता सम्बोधन गर्न व्यक्तिगत शैक्षिक योजना (IEP) निर्माण गरिन्छ ? प्रोब्सः विद्यालयले IEP को व्यवस्था गरे वा नगरेको, गरेको भएमा कति पटक शिक्षक वा विद्यालयले तपाईंको IEP अद्यावधिक गर्छन् ? IEP ले तपाईंको वास्तविक सिकाइ आवश्यकता सम्बोधन गरेको छ कि छैन ?

७.विज्ञान विषयको प्रयोगशालामा तपाईंको पहुँचको अवस्था के-कस्तो छ ? प्रोब्सः तपाईंले विज्ञान प्रयोगहरू प्रत्यक्ष रूपमा गर्ने मौका पाउनुहुन्छ ? प्रयोगशालामा स्पर्शयोग्य मोडल वा श्रव्य मार्गदर्शन उपलब्ध छन् ? प्रयोग गर्दा तपाईंलाई कसले र कसरी सहजीकरण गर्छ ?

८.तपाईंको कक्षा समावेशी र पहुँचयोग्य के कस्तो छ होला ? प्रोब्सः कक्षाकोठा प्रवेश, बसाइको स्थान, सामग्रीको पहुँच र कक्षागत छलफलमा भागलिन प्रोत्साहन ।

९. शिक्षकले विज्ञान र गणित विषय सिकाउँदा तपाईंको सिकाइ आवश्यकतालाई के कस्तो प्राथमिकता दिनुहुन्छ ? प्रोब्स : शिक्षण विधिमा बहु-विकल्प वा सहजीकरण ।

१० विज्ञान र गणित विषयको सिकाइ मूल्याङ्कनका क्रममा समावेशी वा वैकल्पिक के कस्ता विधिहरू प्रयोग गरिन्छ ? प्रोब्सः ब्रेल, मौखिक वा अन्य विकल्पहरू ।

११. विज्ञान र गणित विषयको समावेशी सिकाइ वा तावरण सृजना गर्न तपाईंको सल्लाह सुझाव केही छ कि ? प्रोब्सः पाठ्य विषयवस्तु , शैक्षिक विधि र स्रोत सामग्री अनुकूलन वा अन्य सम्बन्धमा ।

ANNEX-VIII

Interview Guideline for Parents

नामः ...., लिङ्गः ...., उमेरः ...... वर्ष, जातजातिः ....

शैक्षिकयोग्यता ....

जिल्लाः ...., पालिकाः ....

१) तपाईंको बच्चाको गणित र विज्ञानको सिकाइ स्तर कस्तो छ ? (सिक्ने रुचि, सक्रियता, उपलब्धी स्तर)

४) गणित र विज्ञानका विषयवस्तु सिक्न के कस्ता कठिनाइहरु देख्नुभएको छ ? बच्चालाई घरमा सिकाइ सहजीहरण गर्न के प्रबन्ध गर्नु भएको छ ?

५) गणित र विज्ञान विषयका किताबमा भएका कुनकुन विषयवस्तु सिकाउनलाई गाह्रो हुन्छ ?

६) तपाईंको घरमा वा विद्यालयमा गणित र विज्ञानका विषयवस्तुहरु सिक्न सहयोगी सामग्रीहरु के के उपलब्ध छन् ? (ब्रेलमा लेखिएका सामग्री, सुन्ने वा छामेर पढ्न मिल्ने सामग्री, घरमा उपलब्ध सामग्री)

७) विद्यालयले तपाईंको बच्चालाई सिकाइमा सहयोग पुग्ने कस्ता खालका तालिम वा सहयोगहरु जस्तै, हिडडुल, ब्रेलमा लेख्न पढ्न, परामर्श, प्रविधिको प्रयोग आदिमा सहयोग वा तालिम प्रदान गरेको छ ?

८) दृष्टि अपाङ्गता भएका बालबालिकाहरुलाई सिकाइ सहजीकरण गर्न परिवारको भूमिका कस्तो हुनुपर्दछ होला ?

९) गणित र विज्ञानको सिकाइलाई राम्रो तथा समावेशी बनाउन शिक्षक र विद्यालयले के के गर्दा राम्रो होला ? स्थानीय सरकार र अरुमाथिका सरकारले के गर्नु पर्ला ?

ANNEX XI

Interview Guideline for School Management Committee Members

नामः ...., लिङ्गः ...., उमेरः ...... वर्ष, जातजातिः ....

शैक्षिकयोग्यता ....

जिल्लाः ...., पालिकाः ....कार्यालयः ...., पदः ......

१) विद्यालय व्यवस्थापन समितिको तर्फबाट दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयका सिकाइ कठिनाइहरुको पहिचान र सहजीकरण गर्न के कस्ता प्रयासहरु गर्नु भएको छ ?

२) विद्यालय व्यवस्थापन समितिको वैठकमा विशेष आवश्यकता भएका बच्चाहरुसम्बन्धी छलफल कत्तिको हुन्छ ? के कस्ता निर्णयहरु गर्नुभएको छ ? के कसरी सहयोग गर्ने योजना र कार्यक्रम तय गर्नुभएको छ ?

३) तपाईंको विचारमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयका सिकाइ मूल्याङ्कनका के-कस्ता समस्या र चुनौतिहरु देख्नुहुन्छ ?

४) पाठ्यक्रम तथा सिकाइ मूल्याङ्कनलाई दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयका सिकाइलाई प्रभावकारी बनाउन के कस्ता व्यवहारिक र नीतिगत उपायहरु अपनाउनु पर्ला ?

ANNEX -X

Interview Guidelines for Location Education Officer

नामः ...., लिङ्गः ...., उमेरः ...... वर्ष, जातजातिः ....

शैक्षिकयोग्यता ....

जिल्लाः ...., पालिकाः ....कार्यालयः ...., पदः ......

१) स्थानीय स्तरमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयका सिकाइ कठिनाइहरुको पहिचान गरिएका छन् ?

२) यससम्बन्धी विद्यालय र शिक्षकहरुसँग छलफल गरी स्थानीय नीतिहरु पनि बनाउनु भएको छ कि ? के कस्तो नीती बनेको छ ? र कार्यान्वयन गर्न के कार्यक्रमहरु छन् ?

३) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयका सिकाइमा स्थानीय शिक्षा कार्यालयको तर्फबाट के कस्ता सहजीकरण गर्नु भएको छ ?

४) दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयका सिकाइ मूल्यांकनका समस्या र चुनौतिहरु पहिल्याउनु भएको छ ?

५) पाठ्यक्रम तथा सिकाइ मूल्याङ्कनलाई दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरूको गणित र विज्ञान विषयका सिकाइलाई प्रभावकारी बनाउन के कस्ता व्यवहारिक र नीतिगत उपायहरु अपनाउनु पर्ला ?

६) दृष्टि अपाङ्गता सम्बन्धी के कस्ता कुराहरुलाई तालिममा समावेश गरिएको छ ? क-कसलाई तालिम दिइएको छ ? तालिममा के कस्तो परिमार्जन गर्नु पर्ला ? नीतिगत रुपमा के सुधार गनुपर्ला ?

ANNEX-XI

Survey Questionnaires for Students

Learning Science and Mathematics Subject for Students with Visual Impairment

पाठ्यक्रम विकास केन्द्र, सानोठिमी, भक्तपुर र काउन्सेल एण्ड काउन्सेल, बानेश्वर, काठमाडौँबीच दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुलाई गणित तथा विज्ञान सिकाइ, सिकाइ सहजीकरण र सिकाइ मूल्याङ्कनका विविध पक्षमा अनुसन्धान गर्न सम्झौता भई यस विद्यालयमा हामी आएका छौँ । यस अध्ययनमा तपाईंले माथि उल्लेख गरिएको विषयमा आफ्ना धारणाहरु व्यक्त गरी उपयुक्त लागेको विकल्पमा चिन्ह लगाई यस अध्ययनमा सहयोग गर्नुहुन विनम्र अनुरोध छ ।

विद्यार्थीको नाम (ऐच्छिक): ....उमेर (वर्षमा):.................लिङ्गः महिला□पुरुष□अन्य□

अपाङ्गताको तहः (क) पूर्ण दृष्टिविहीनता□ (ख) न्यूनदृष्टि □

विद्यालयको प्रकारः क) विशेष विद्यालय□ ख) एकीकृत विद्यालय□ग) स्रोत कक्षा□ घ) समावेशी□

अध्ययनरत कक्षाः .... विद्यालयको नामः ....

प्रदेशको नामः ....विद्यालय रहेको जिल्लाः ....पालिकाको नामः ....

Part I: Learning Science Subject for Students with Visual Impairment

कथन	SD	D	N	A	SA
विज्ञान विषयमा भएका विषयवस्तु दृष्टिसम्बन्धी अपाङ्गता (पूर्ण दृष्टि अपाङ्गता वा न्यून) दृष्टिमैत्री छन् ।					
कक्षामा विज्ञान विषयका चित्र वा ग्राफ सहज रुपले बुझ्न शैक्षणिक अनुकूलन र सहजीकरण गरिन्छ ।					
विज्ञान विषयको प्रयोगशालाका स्रोत सामग्री दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुलाई पनि पहुँचयोग्य छन् ।					
विद्यालयमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीको विज्ञान विषयको सिकाइ आवश्यकतालाई सम्बोधन गर्न वैयक्तिक शिक्षा योजना (आईईपी) निर्माण गरी प्रयोग गरिन्छ ।					
विज्ञान विषयका स्रोत सामग्रीहरु ब्रेल, स्पर्श र श्रव्यमा आधारित छन् ।					
विज्ञानका पाठ्यपुस्तक तथा सामग्रीहरुको अनुकूलन गरी ब्रेल, श्रव्य तथा प्रिन्ट गरी ठूला अक्षरमा गराइन्छ ।					
विज्ञान विषय प्रभावकारी सिकाइमा शिक्षकले विविध प्रकारका शिक्षण तरिकाहरु अपनाउनु हुन्छ ।					
विज्ञान विषयको पाठ्यक्रम र पाठ्यपुस्तक दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीलाई उपयुक्त हुने खालका छन् ।					
विद्यालयमा विज्ञानका विषयवस्तु सिक्न प्रयाप्त सहयोगी सामग्री वा प्रविधि र उपकरणहरु उपलब्ध छन् ।					
विज्ञानका प्रयोगात्मक कार्यहरुमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुलाई समावेश गरिँदैन ।					

विज्ञान विषयको सिकाइमा स्क्रिन रिडर, अक्षर ठूलो गरी हेर्ने सिसा वा साइन्स एप, थ्री डी मोडलहरु, टकिङ थर्मोमिटर प्रयोग गरिन्छ ।					
विद्यालयले दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुलाई सहायक प्रविधि प्रयोगसँग सम्बन्धित तालिम दिने गर्छ ।					
विद्यालयमा विज्ञानको अवधारणा बुझाउन ट्याक्टाइल, ब्रेल वा अडियो सामग्री पर्याप्त छन् ।					
विज्ञान विषयका परीक्षाहरुमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीका लागि विद्यार्थीको क्षमताअनुसार मौखिक परीक्षा, थप समय, प्रयोगात्मक कार्यबाट मूल्याङ्कन गर्ने व्यवस्था छ ।					
विज्ञान विषयको सिकाइ मूल्याङ्कन गर्ने तरिका दृष्टि अपांगतामैत्री छन् ।					

Part II: Learning Mathematics Subject for Students with Visual Impairment

कथन	SD	D	N	A	SA
गणित विषयको पाठ्यपुस्तकका विषयवस्तु दृष्टिसम्बन्धी अपाङ्गतामैत्री छन् ।					
दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीका लागि गणित विषयका चित्र वा ग्राफलाई सहज रुपले बुझ्न अनुकूलन गरिन्छ ।					
शिक्षकले गणित सिकाइमा पूर्ण दृष्टि बिहीनता वा न्यून दृष्टि भएका विद्यार्थी लक्षित गरेर फरक शिक्षण रणनीति अपनाउनु हुन्छ ।					
गणितका ज्यामितीय आकार, ग्राफ, चित्रको अवधारणा र सम्बन्ध बुझ्नमा मेरो शैक्षिक आवश्यकतालाई शिक्षकले प्राथमिकता दिनुहुन्छ ।					
विद्यालयमा मेरो गणित विषयको सिकाइ कठिनाई र आवश्यकतालाई व्यक्तिगत शैक्षणिक योजना (आइ ई पी) द्वारा सम्बोधन गरिन्छ ।					
मेरो विचारमा गणित विषयका स्रोत सामग्रीहरु पहुँचयोग्य ढाँचामा विकास गरिएको छ ।					
मलाई मेन्टल म्याथ (मस्तिष्कीय गणना) मा गाह्रो लाग्छ ।					
मलाई गणितका नयाँ विषयवस्तु वा कार्यहरु बुझाउन शिक्षकले बहु शिक्षण विधिहरुको प्रयोग गर्नुहुन्छ ।					
हाम्रो विद्यालयमा पूर्ण दृष्टिविहीनता वा न्यून दृष्टि भएका विद्यार्थीका लागि गणित सिक्न आवश्यक स्रोत सामाग्री उपलब्ध छन् ।					
विद्यालयमा गणितीय आकृति, ग्राफ, र ट्याक्टाइल चार्टहरुको अभाव छ ।					
हाम्रो विद्यालयले स्पर्श र श्रवणमा आधारित गणितीय सामग्रीहरुको राम्रो व्यवस्थापन गरेको छ ।					
गणित सिक्न आवश्यक पर्ने सहायक प्रविधिहरु जस्तै : ब्रेल अक्षर लेख्न प्रयोग गरिने म्यानुअल टाइपर, ब्रेल नोट टेकर वा ब्रेल इनपुट र आउटपुटको माध्यमबाट गणित लेख्न र पढ्न मिल्ने प्रविधि विद्यालयमा उपलब्ध छन् ।					
मलाई विद्यालयमा ब्रेल इम्ब्रोजर, ब्रेल प्रिन्ट, गणित सामग्रीलाई ब्रेलमा रुपान्तरण गर्ने प्रविधि, ग्राफिक्स टेक्टाइल टुल्स आदि प्रयोग गरेको अनुभव छ ।					
हाम्रो विद्यालयले शिक्षक र विद्यार्थीहरुलाई ब्रेल गणित वा डिजिटल सहायक प्रविधिको प्रयोगसम्बन्धी तालिम दिने गर्छ ।					
हाम्रो विद्यालयमा दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीहरुको परीक्षा तथा सिकाइ मूल्याङ्कनको लागि सहायक प्रविधिको प्रयोग गर्न दिइन्छ ।					
विद्यालयले दृष्टिसम्बन्धी अपाङ्गता भएका विद्यार्थीको गणित विषयको सिकाइ मूल्याङ्कन गर्दा बहु-विकल्पको उपयोग गर्दछ ।					

वर्तमान गणित विषयको सिकाई मूल्याङ्कन प्रणाली दृष्टिसम्बन्धी अपाङ्गता मैत्री छन् ।					

ANNEX XII

Document Review Guideline

Thematic areas	Guidelines
Accessibility	How are accessibility learning materials, forms, medium (language) and settings are practiced?
Curriculum & instructional design	Does the document explicitly present the specific challenges and implication of flexibility, adaptability in curriculum appropriate to the learning, facilitation and achievement of Mathematics and science subjects for students with VI?
Support services with ATs	What are the newly adapted and recommended assistive technologies/devices in education for children with VI in learning, facilitation and achievement of Mathematics and science subjects?
Learning assessment practice	How are the assessments differentiated for students with VI?
Policy & Practices	What are the prevailing policies and their relevancies to the learning, facilitation and achievement of Mathematics and science subjects for students with VI?

ANNEX XIII

Sample Schools

Province	Area/ District	Schools	Type of school
Sudurpash - chim		Bhuwaneshwori Ma. Vi, No schools found of VI at Kanchanpur	
	Kailali	2) Karnali Ma. Vi.	Integrated
	Kailali	3) Raghu Ma. Vi.	Resource
	Kailali	4) Panchodaya Ma. Vi.	Integrated
Karnali	Surkhet	1) Krishna Sanskrit Ma. Vi, Birendranagar	Resource
	Surkhet	2) Shikhar Ma. Vi. (Ramghat, Bheriganga Na. Pa.)	Resource
	Jajarkot	3) Laxmi Secondary School (Bheri Na. Pa., Jajarkot)	Resource
Lumbini	Rupandehi	1) Shanti Namuna Ma. Vi, Rupandehi	Integrated
	Palpa	2) Damkada Ma. Vi. Palpa	Resource
	Kapilvastu	3) Ma. Vi. Odari (Badganga, Kapilvastu)	Resource
Gandaki	Baglung	1) Janata Dhan Ma. Vi, Baglung Integrated	Integrated
	Kaski	2) Amarsingh Ma. Vi, Kaski Integrated	Integrated
	Tanahun	3) Bedbyash B.S. (Byash Na. Pa., Tahanun)	Resource
Bagmati	Kathmandu	1) Laboratory Ma. Vi. (Kathmandu)	Integrated
	Lalitpur	2) Aadarsha Soul Ma. Vi. (Lalitpur) Integrated = Deaf-blind	Integrated
	Kavre	3) Sanjibani Ma. Vi (Kavre)	Integrated
	Sindhu palchok	4) Bandevi B.S. (Chautara Na. Pa., Sindhupalchok)	Resource
Madhesh	Mahottari	1) Janata Ma. Vi. (Gauredanda, Bardibas, Mahottari)	Resource
	Sarlahi	2) Mahabir Janta Ma. Vi. (Haripur Na. Pa., Sarlahi)	Resource
	Siraha	3) Pasupati Ma. Vi. (Lahan Na. Pa., Siraha)	Integrated
Koshi	Sunsari	1) Gyanchakshu Ma. Vi. (Dharan, Sunsari)	Special

	Morang	2) Kabir Ma. Vi., Belbari (Morang) Resource Class	Resource
	Jhapa	3) Sarswati S.S., Damak (Damak, Jhapa)	Resource
	Jhapa	4) Durga Ma. Vi. (Garamuni, Jhapa)	Resource

ANNEX XIV

Detail Sample of Participants

S.N.	Attribute	Participants	Remarks
1	Key Informant Interview (KII)	●Head teachers (HT) (21) ●Center for Education and Human Resource Development (CEHRD) 1 ●National Education Board (NEB) (1) ●CDC Experts (3) – (Official 1, Math Expert 1, Science Expert 1)	26 participants for KII
2	In-depth Interview (IDI)	Subject Teachers (14- 7 science + 7 math)	14 respondents for IDI
3	Interview	Parents of students with VI (7)	7 parents for interview
4	Focus Group Discussion (FGD)	Students FGD (4 FGDs – 2 from basic & 2 from secondary)	4 FGDs (each FGD will include 4-6 participants)
5	Stakeholder Interview	Interview (14)	● School Management Committee (SMC-7) ● Local Education Officials (LEO-7)
6	Student	Survey (14) – Schools and participants	● Students from grade 8 representing basic education ● Students from grade 9-10 representing secondary education

ANNEX XV

Codes Used for Participants for their Verbatim and Expression

Particular	Attributes	Code used	Remarks
Interview	Key Informant Interview	KII	
Interview	In-depth Interview	IDI	
Parent Interview	Parent Interview	PI	
Discussion	Focus Group Discussion	FGD	
Management	School Management Committee	SMC	
Local Education officers	Local Education officers	LEO	
Teacher	Science Teacher		
Teacher	Math Teacher		
Teacher	Headteacher		Examples: i) HT-KII Kanchanpur = Headteacher KII from Kanchanpur district ii) ST-IDI Surkhet = Science teacher IDI from Surkhet iii) FGD-Rupandehi = FGDRupandehi
District	Kanchanpur	Kanchanpur	
	Kailali	Kailali	
	Surkhet	Surkhet	
	Jajarkot	Jajarkot	
	Kapilvastu	Kapilvastu	
	Rupandehi	Rupandehi	
	Palpa	Palpa	
	Baglung	Baglung	
	Kaski	Kaski	
	Tanahun	Tanahun	
	Kathmandu	Kathmandu	
	Lalitpur	Lalitpur	
	Kavrepalanchok	Kavrepalanchok	
	Sindhupalchok	Sindhupalchok	
	Sarlahi	Sarlahi	
	Siraha	Siraha	

Mahottari	Mahottari
Morang	Morang
Jhapa	Jhapa

Note: FGD refers to students' focus group discussion

ANNEX XVI

Field Snapshots