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Analysis of Problem-Solving Scenes in Mongolian Primary School Science Videos: Using 'Multiple Comparison Analysis'

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This study explores how the curricula and their goals are reflected in the learning materials developed during the pandemic in Mongolia, where child-centred education was initiated after democratisation, identifies key considerations when creating learning videos. To achieve these objectives, Mongolian primary school science videos were analysed in comparison with Japanese videos to determine whether they followed a problem-solving process and were designed to make children think. Two rubrics were used to check whether the videos were problem-solving, and the Steel method, a non-parametric test, was used for the analysis. The six problem-solving scenes (background, problem, hypothesis, methods, results, and discussion). According to the findings, the Mongolian videos were significantly lower than the Japanese videos for 'hypothesis' and 'discussion' scenes. The results showed there were difficulties regarding the setting of these two scenes and in efforts to encourage children to think independently. The linkages in the problem-solving process were also rated low, suggesting a need to consider the links between the six scenes when developing video materials. From the above results, it cannot be concluded that the video materials reflect all of the government's educational and curricular goals.

Keywords: ICT, Mongolia, primary school, science, problem-solving, video, learning material

INTRODUCTION

Mongolia has undergone educational reforms since the country's democratisation in 1990. According to Ishihara and Kawaguchi (2022), Mongolia, like Afghanistan, Myanmar, Pakistan, and Bangladesh, required learning that encourages children's ideas and thinking, rather than traditional rote learning; however, the teachers were unable to cope with this challenge. The Japan International Cooperation Agency (JICA) was requested to assist with the development of a teacher manual for use in daily classroom practice. In response to this request, the 'Teaching Methods Improvement Project towards Children's Development' (Phase 1: 2006-2009, Phase 2: 2010-2013) was implemented in Mongolia. In Phase 1, teacher's manuals in eight subjects (Physics, Chemistry, Human and Environment, Human and Nature [equivalent to primary school science; hereinafter referred to as 'primary school science'], Arithmetic, Mathematics,

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IT, and Integrated Learning), with a focus on science and mathematics, were developed and lesson studies were conducted at model schools. In Phase 2, lesson studies were used to improve and disseminate teaching methods (JICA, 2009; Ishii & Suzuki, 2014). In 2014, the Primary Education Core Curriculum (Ministry of Education and Science (MoES[1]), 2014) (hereafter referred to as the Core Curriculum), which was developed based on child-centred principles, was published, reflecting the results of the JICA project (Miyamae, 2016).

The two goals of primary school science, as per the Core Curriculum, are 1) "to enable students to investigate and understand the nature, causes, and relationships of natural things and phenomena" and 2) "to learn scientific inquiry skills" (MoES, 2014, p58, translated by author). The latter goal encompasses six skills: "asking questions, making hypotheses, planning activities, implementing planned activities, developing information, and drawing conclusions" (MoES 2014, p58, translated by author). The goal of this Core Curriculum is similar to that of the Japanese Course of Study for Primary School Science, namely, 'to develop problem-solving skills'. Problem-solving is "the process by which children work with natural things and phenomena, identify problems, observe and conduct experiments based on their own expectations and hypotheses, organise and discuss the results, and acquire scientific views and ideas as a conclusion" (Murayama, 2011, p.1, translated by author). One of the goals of the Mongolian curriculum is 'to investigate and understand the nature, causes, and relationships of natural things and phenomena', similar to how 'children work with natural things and phenomena'. The six skills to be mastered in relation to the other goal of the Mongolian curriculum are similar to those of problem-solving, and by 'asking questions', students can 'identify problems'. 'Making hypotheses', 'planning activities', and 'implementing planned activities' help students 'observe and conduct experiments based on their own expectations and hypotheses'. 'Developing information' and 'drawing conclusions' facilitate students to 'organise and discuss the results' and 'acquire scientific views and ideas as a conclusion'. Nakayama and Saruta (2015) classified the problem-solving process into eight problem-solving scenes: 'background scene', 'problem scene', 'hypothesis scene', 'method scene', 'result scene', 'discussion scene', 'utilisation scene', and 'issue scene'. All cases that did not apply to the problem-solving process were categorised as 'other scenes'. Hikami (2020) analysed Mongolian primary school science textbooks, compared the results with those of Nakayama and Saruta (2015), and pointed out the similarities between the questions in each scene of the problem-solving process in the Mongolian and Japanese textbooks. Hikami (2020) also implied that Mongolian science classes integrating problem-solving lessons face several challenges.

In Mongolia, the Core Curriculum was revised in 2019 and the Second Edition of the Revised Primary Education Curriculum (MoES, 2019) (hereafter referred to as the Revised Curriculum) was published. There were no major changes compared to the 2014 Core Curriculum in terms of how problem-solving is viewed in science learning. Table 1 presents Nakayama and Saruta's (2015) classification of problem-solving process scenes and explanations of each scene as well as the content of the Mongolian Core Curriculum and the Revised Curriculum in an organised manner.

Table 1
The relationship between the Core Curriculum, the Revised Curriculum, and each scene of the problem-solving process

Problem-solving process scenes	Nakayama and Saruta's (2015) classification of problem-solving process scenes and explanation of each scene	Core Curriculum (2014)	Revised Curriculum (2019)
Background scene	Premise scene for setting up the problem	Investigate natural things and phenomena	Investigate natural things and phenomena
Problem scene	A scene where the children launch the problem they will be working on	Ask a question	Identify a problem
Hypothesis scene	A scene in which students' ideas and expectations are expressed, and they have a prospect to solve the problem	Make a hypothesis	Make a hypothesis
Method scene	A scene in which a method for solving a problem is examined through observation and experimentation	Plan activities	Plan tests, experiments and research
Result scene	A scene presenting and analysing facts obtained from observation and experimentation	Implement as planned, develop information	Produce and show facts and evidence
Discussion scene	A scene in which facts are interpreted and conclusions are reached in a manner that corresponds to the initial set of problems	Draw a conclusion	Review and explain evidence and results
Utilisation scene	A scene in which the knowledge gained is used once the answer to the problem has been found	—	—
Issue scene	A scene that raises new questions, etc	—	—
Other scenes	Scenes that cannot be matched from 'background' to 'issue'	—	—

Source. Created by author, based on the Core Curriculum (2014), Revised Curriculum (2019), and Nakayama and Saruta (2015).

As shown in Table 1, the scenes and descriptions of the problem-solving process in Nakayama and Saruta (2015) are consistent with the goals and skills of the Core Curriculum and Revised Curriculum, published in 2014 and 2019, respectively. These can also be regarded as problem-solving processes, following the process of children scientifically identifying and solving problems. In this sense, the goals of science education in Mongolia and Japan can be said to be similar in terms of problem-solving learning. In Japan, the foundation for the concept of 'problem-solving' in primary school science can be traced back to the 1947 Course of Study (draft) (Nozoe & Isozaki, 2014). Thus, comparing Mongolia, where problem-solving learning in science education is still developing, with Japan, where problem-solving learning has been practiced for a long time, can help us comprehend the status of science education in Mongolia and clarify its development process for science education.

Regarding the recent education situation around the world, since 2020, the coronavirus disease (COVID-19) pandemic has caused 188 countries to close schools, affecting more than 1.5 billion children and youth (United Nations Sustainable Development Group (UNSDG), 2020; OECD, 2022). In Mongolia, approximately 600,000 children were affected by school closures and semester breaks between February and September 2020 (the United Nations International Children's Fund (UNICEF), 2021). As reported by Dreesen et al. (2020), 68% of the 127 countries surveyed utilised a combination of digital and non-digital delivery methods (e.g. TV, radio, and take-home packages) for distance education. Furthermore, UNICEF (2020) indicated that, despite their limitation in terms of sharing materials, TV-based distance learning policies, have the greatest potential to reach students. The World Bank (2020) summarised the specific uses of EdTech (i.e. education technology) in each country. A total of 21 of the 37 countries and regions surveyed used TV for closed-school learning, and most used a combination of digital delivery, mobile apps, and radio in addition to TV. The Mongolian MoES developed video learning materials for all subjects from Grades 1–12 and responded quickly by airing them on TV immediately after the schools closed in February 2020. All videos were made available online to maintain children's learning. Currently, these videos are available on the e-learning platform 'Medle (Mongolian Education Learning System, https://medle.mn)', sponsored by the Center for Information Technology in Education, which is under the jurisdiction of the MoES, and on the smartphone application 'Medle'. A study of the perceptions of university undergraduates has demonstrated that one of the benefits of online learning during school closures is the availability of re-watching previous lectures and YouTube videos (Salame et al., 2023). TV programmes are now available online, with the added advantage of being able to watch 'Medle' videos on repeat.

As stated previously, numerous countries have attempted to ensure children's learning remains consistent through distance learning. Nevertheless, it remains unclear whether the quality of the materials used for distance learning, including their alignment with the curriculum, can be guaranteed. Among the various global research on video materials, the Independent Research Institute of Mongolia (IRIM) (2022) is the only entity to conduct a study that mentions curriculum alignment. The IRIM (2022) evaluated the 'tele-lesson' videos of *E-Content*, a portal site before it was updated to Medle. The videos published in this *E-Content* are the same as in Medle, and this evaluation is a comprehensive one, encompassing all grades, from kindergarten to high school, and all subjects, not just primary school science. The results of the evaluation that are particularly relevant to this study are presented in the Table 2.

Table 2
Strengths and weaknesses of Mongolian video materials according to IRIM research

Strengths	Weaknesses
・Good correlation and integration of Core Curriculum and tele-lessons ・Some lessons provide an opportunity to think critically by asking questions in order to review previous sessions ・Explains offered solutions comparing different angles based on the examples ・Problem-solving methods have been used for high school natural science lessons	・Objective and outcome of the lesson are not clearly defined ・Lack of explanation through examples of the practical use and importance of the topic ・Some lessons are too teacher-centred with the teacher talking for the majority of the lesson ・Lack of content (e.g. proposing examples, promoting critical thinking and problem solving by taking examples) ・Lack of planning to use terminologies based on experiments and lack of activities related to identifying and solving problems

Source. Created by author, based on IRIM (2022, p.29)
Note. Extracts from the IRIM survey results that are particularly relevant to this research

This evaluation was based on the premise that the results are not subject-specific, because the quality of the video content was analysed in one randomly selected subject at each grade level. Further, as a supplement to the results, it is noted that '... only one subject from each level was randomly selected for the expert analysis of the quality of the content. Therefore, it was not possible to conclude comprehensively whether all lessons at each level were of the same quality or were consistent with the Core Curriculum' (IRIM, 2022, p.25), and the evaluation of the specific subject of primary school science is not clearly indicated. The results of the IRIM study are based on questionnaires to high school students, teachers and parents, and quantitative analysis by educational experts, but do not provide detailed evidence. Therefore, this study will examine video learning materials for science in more detail from a problem-solving perspective.

As mentioned earlier, Mongolia's Core Curriculum and Revised Curriculum target mastery of the problem-solving process. Regarding whether these Medle primary school science videos are created in a problem-solving process, Hikami (2022) examined a unit on leverage and Hikami and Shimizu (2022) examined three units of leverage, magnet, and electricity by comparing them with Japanese video materials, but the other units have not been studied yet. Reviewing and evaluating the quality of these videos and educational activities enables us to better understand how the curricular goal of mastering the problem-solving process is reflected in learning materials in Mongolia. Furthermore, it facilitates discussions on how these Mongolian video materials can be used in school classrooms to return to normal levels after the pandemic. The use of video in primary school science lessons has been demonstrated to enhance learning outcomes, as evidenced by the positive impact of science learning media such as animated videos and motion graphic animation videos (Hapsari et al., 2019; Hanif, 2020; Ruli et al., 2021; Aulia & Perwita Sari, 2022; Mou, 2023). The use of Medle videos may show these same outcomes. According to the World Bank, the United Nations Education, Scientific, and Cultural Organization (UNESCO), and UNICEF (2021), school closures are not limited to COVID-19 but are also likely to occur in the future as a result of natural disasters, conflict, or public health emergencies. However, almost half of the 67 low- and middle-income countries analysed were unprepared for distance learning during emergency school closures, putting 200 million children at risk of future learning disruption. The analysis of COVID-19 distance learning materials during school closures also allows discussion on how current materials can be used during future disasters and what additional materials are needed. Based on the results, we can offer suggestions on what to keep in mind and what efforts should be made when developing new videos.

The purpose of this study is twofold: 1) to explore how the curricula and their goals are reflected in learning materials in Mongolia, where child-centred science education was initiated after democratisation and is still developing and 2) to identify what might have been overlooked and what needs attention when creating problem-solving learning videos. This will be achieved by analysing the alignment of Medle's primary school science video materials with the government's goal of 'teaching that encourages children's ideas and thinking' and the goal of the Core and Revised Curricula of 'mastering the problem-solving process'.

METHOD

Subject of analysis

The videos analysed by the author were primary school science lesson videos in the ‘tele-lessons’ of Medle, a website under the jurisdiction of the MoES. The lesson videos had aired on TV during the COVID-19 school closures and were later posted on Medle. The Background section notes that the goals of science education in Mongolia and Japan are similar. Thus, to promote learning based on problem-solving, the Mongolian video learning materials were compared with their Japanese counterparts. Two Japanese website videos on primary school science were used for comparison, i.e. (1) NHK for school (https://www.nhk.or.jp/school/rika/) of Nippon Hoso Kyokai (NHK, Japan Broadcasting Corporation), with material for ‘knowledge retention’, including a series of problem-solving scenes from background to discussion. (2) Chiba Tele-learning Study Net (hereinafter referred to as Chi-tele, https://sites.google.com/ice.or.jp/chi-tele2/), i.e. video materials provided by the Chiba Prefectural Board of Education.

To compare videos, the learning objectives and content must be the same. Therefore, only videos with similar learning objectives and content published on all three websites were included. Based on the above, six units were selected, including the leverage, magnet, and electricity units selected by Hikami and Shimizu (2022), as well as the units of change in the state of water, astronomy, and weather. There were 47 videos: 18 by Medle, 13 by NHK for school, and 16 by Chi-tele.

The videos on each website are based on the curricula and textbooks. In Mongolia, national textbooks are used, whereas in Japan, certified textbooks produced by private textbook publishers are used. In Chiba Prefecture, primary school science textbooks from three companies — Dainippon Tosho Co., Ltd., Tokyo Shoseki Co., Ltd., and Shinkoshuppansha Keirinkan Co., Ltd. — were being used for video development between 2020 and 2023, in public primary schools. Therefore, depending on the unit, up to three types of video material were available on Chi-tele. In this study, priority was given to videos created for children who used Dainippon Tosho textbooks, which have the largest market share in Chiba Prefecture. (https://sites.google.com/ice.or.jp/chi-tele2/小教科書でえらぶ/小理科大日本?authuser=0) When Dainippon Tosho Co., Ltd. did not have a video for the unit to be compared, videos from Tokyo Shoseki Co., Ltd. or Shinkoshuppansha Keirinkan Co., Ltd. were used.

Mongolian primary schools have a five-year system, and science is taught in grades four and five. Japanese primary schools have a six-year system, and science is taught in grades three through six. As the videos were selected based on the unit and content, some units were not the same in terms of grade level

Analysis Method

A method similar to that used by Hikami (2022) and Hikami and Shimizu (2022) in their analysis, was adopted for the procedure up to coding the problem-solving scenes and linkages of the problem-solving scenes in the videos. In this study, the gained codes were quantitatively analysed for comparison and discussion, as described below.

Transcription and problem-solving scene setting

The videos were first transcribed and then categorised into eight problem-solving and other scenes based on the descriptions of the scenes in Table 1. As Table 1 shows, the goals and skills of the Mongolian Core and Revised Curricula corresponded to only six scenes (from the background to the discussion) in the problem-solving process, as indicated by Nakayama and Saruta (2015). However, considering that there could be other corresponding scenes in video materials than these six, this study followed Nakayama and Saruta (2015), who included the above six scenes and classified them into the following nine scenes: 'background', 'problem', 'hypothesis', 'method', 'result', 'discussion', 'utilisation', 'issue', and 'other'. However, the Core and Revised Curricula do not include three of the scenes: utilisation, issue, and other.

Coding with rubrics

All videos were coded using the rubric developed by Hikami (2022) to examine the problem-solving scenes (Table 3) and the linkage of problem-solving scenes (Table 4) to maintain objectivity.

Table 3
Rubric of coding criteria for problem-solving scenes

	Requirements		
Code	Whether there is a scene	Whether there is a question	Whether there is a strategy to let children think
0	×	×	×
1	◯	×	×
2	◯	◯	×
3	◯	—	◯

Table 4
Rubric of coding criteria for linkages in problem-solving scenes

Code	Requirements
0	There is no linkage of scenes
1	There is a link between the problem and discussion scenes
2	In addition to the conditions of Code 1, there is a link to one of the following scenes: background, hypothesis, method, or result scenes
3	In addition to the conditions of Code 1, there are links to any two of the following scenes: background, hypothesis, method, and result scenes
4	In addition to the conditions of Code 1, there are links to any three of the following scenes: background, hypothesis, method, and result scenes
5	There are linkages between the six scenes from background to discussion

With the problem-solving scene rubric in Table 3, each scene was analysed from background to issue, excluding 'other' scenes that were not involved in the problem-solving process, out of the nine scenes. The points of view in classroom observation in Dornod Province, Mongolia (Hikami, 2020) were used as the criteria for each coding, and the following criteria were set: (1) whether each scene exists, (2) whether there is a question in the scene, and (3) whether an attempt is made to make the children think in the scene. The codes were made on a 4-point scale from 0 to 3, with '◯' indicating the presence of the criterion and '×' indicating its absence. The 'thinking' listed as a condition in Table 3 refers to 'whether attempts are made to make the children think', and was coded considering, 'whether questions are asked to encourage the children to think', 'whether time is provided to children to think', etc. When it was judged that the children were made to think about a certain scene, the code was set at three, even if there was no statement or question in that scene.

It is difficult to determine whether the videos are in line with the Core and Revised Curricula science goals and skills of having learners understand the problem-solving process by coding individual scenes based on the three criteria (1)–(3) used in the rubric for problem-solving scenes in Table 3. In addition, because it is important for the problem-solving process to have relationships between scenes, a linkage among the scenes of the problem-solving process was added to the analysis items. This was coded using the rubric listed in Table 4, except for the utilisation, issue, and other scenes. The relevance of the six basic scenes of the problem-solving process (background, problem, hypothesis, method, result, and discussion) was analysed. Regarding the requirements in the rubric, a relationship between the problem (i.e. the scene wherein the problem to be solved is initiated) and the discussion (i.e. the scene wherein the solution is provided, and a conclusion is drawn) scenes is most important. Therefore, the code was set to 1 when these two scenes were related, and 0, when they were not. The code was set up such that it increases by 1 as the number of relevant scenes increased; the maximum code was set at 5 when all six scenes were relevant, and the code was made on a 6-point scale.

Multiple comparisons (Steel method)

The procedure for creating a code set for multiple comparisons from the codes of each video is shown in Figure 1, using the background scene as an example.

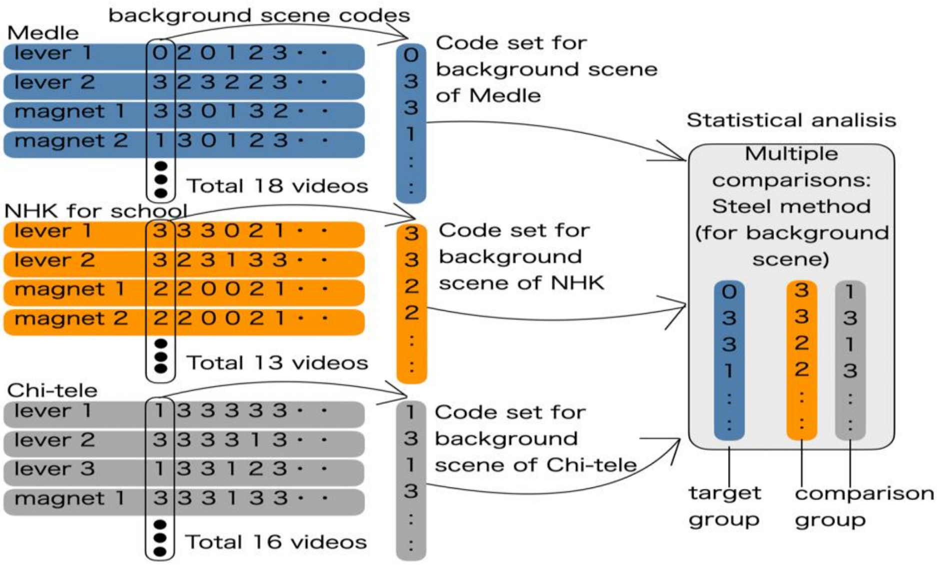

Figure 1
Procedure for creating a code set for the background for each website for the Steel method

The code sets for each website and each scene were created by collecting the codes for the applicable scene (given using Table 3) from each video. The codes for the linkage of problem-solving scenes, given using Table 4 were also created for each website in the same way. Then, with Medle as the target group, and NHK for school and Chi-tele as the comparison group, were examined for statistically significant differences, using the multiple comparison Steel method of nonparametric testing. To clarify the characteristics of each scene and linkage, the test was divided into nine items: eight scenes from background to issue, and a linkage from background to discussion scene, without summarising all the data. This was performed using the Nonparametric Multiple Tests: Steel Method (http://www.gen-info.osaka-u.ac.jp/MEPHAS/steel.html) from the Center for Genetic Information Experimentation website, Osaka University (Statistical Analysis Program for Experimental Biology).

FINDINGS

Figure 2 presents the mean codes for each of the eight problem-solving scenes from the background to the issue and the linkages between these scenes in each video. In the case of significant differences between the results of multiple comparisons for Medle and the other two websites, an asterisk was assigned to each bar graph.

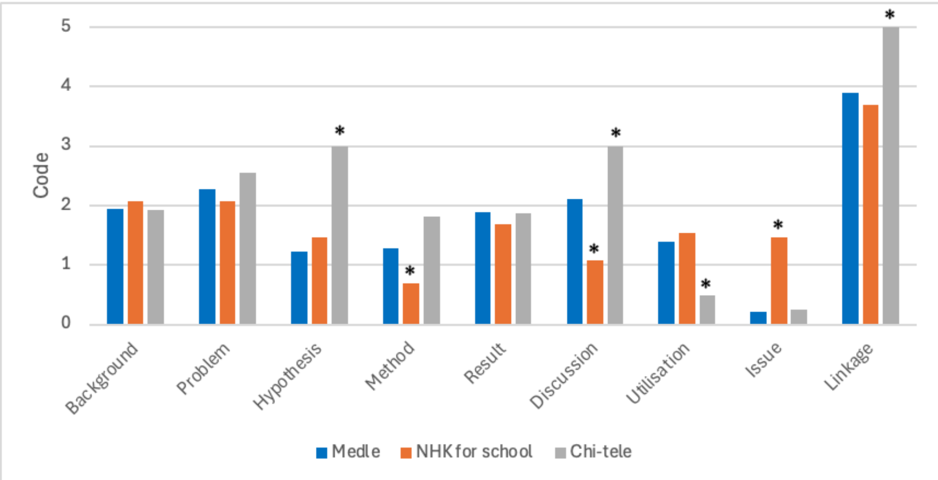

Figure 2
Comparison of the averages of the code values for the different scenes of the videos on the three websites. (Significant differences are based on the Steel method.)
* Significant difference from Medle at 5% alpha level.
Source. Author’s data
Note. Only linkage is rated on a 6-point scale (maximum = 5). The scenes from background to issue were rated on a 4-point scale (maximum = 3).

In problem-solving scenes, there were significant differences between Medle and NHK for school in method, discussion, and issue, with the former rated higher in method and discussion, and the latter, in issue. There were also significant differences between

Medle and Chi-tele in hypothesis, discussion, and utilisation, with the former scoring higher in utilisation and the latter, in hypothesis and discussion. There was no significant difference in the three scenes of background, problem, and result. There was no significant difference between Medle and NHK for school in the linkage of problem-solving scenes, but there was a significant difference between Medle and Chi-tele, the latter being rated higher.

DISCUSSION

This study aimed to explore how curricula and their goals are reflected in learning materials in Mongolia, and to identify what might have been overlooked and what needs attention when creating problem-solving learning videos by analysing the alignment of Medle's primary school science video materials with the goal of the Mongolian government (i.e. 'teaching to encourage children's ideas and thinking') and that of the Core and Revised Curricula (i.e. 'mastering the problem-solving process'). The comparisons of the Medle videos with Japanese videos focused on similar skills showed significant differences across several scenes. The resulting analysis yielded several implications for aligning the Medle video scenes with 'mastering the problem-solving process'.

This discussion focused on the following two points: (1) The six scenes from the background to the discussion were examined, excluding the utilisation and issue scenes, which are not described in the Core and Revised Curricula. (2) The results showed that Medle was significantly low, especially in the two scenes of hypothesis and discussion.

A discussion of NHK for school is described here to depict a limitation of this study. The results of the comparison between Medle and NHK for school show that the latter was rated lower in the method and discussion scenes, which may be related to the following two factors: (1) In order to analyse a sequence of problem-solving processes, the videos in this study were selected for comparison as 'videos recommended to be viewed at the end of a unit of learning', which include scenes from background to discussion. For this reason, the NHK for school videos were rated higher for the issue scene. NHK for school also has other videos that are recommended to be viewed 'just before or just after the activity' or 'at the introduction of the unit'. These videos were excluded from the comparison because their problem-solving processes could not be accurately evaluated and analysed using this study's method; for example, because they did not include results and discussion scenes. (2) Medle and Chi-tele were created for children's video-based learning during school closures due to the COVID-19 pandemic. However, NHK for school was created before the pandemic, and its videos were designed for use in face-to-face classes at schools. Although a detailed discussion is beyond the scope of this study, NHK for school videos can be used in the following ways, based on the above assumptions. Teachers can 'use the videos to review what has already been learned in class', 'supplement explanations in the videos', 'give children additional time to think', and so on. This study evaluates the videos on the assumption that they were watched at home.

Problem-solving scenes

Of the six basic problem-solving scenes (from the background to the discussion) Medle was significantly lower than Chi-tele in two scenes: the hypothesis and the discussion. For the two scenes where there were significant differences, the codes of each scene in the video were reviewed again, and the reasons for these differences were discussed.

The hypothesis and discussion scenes for all 16 Chi-tele videos were coded as 3. The hypothesis and discussion scene on Chi-tele consisted of the following: (1) a question was posed to the children for them to deliberate on, (2) instructions were provided to the children to pause the video and write their own ideas in a notebook or worksheet, and (3) instructions were provided to the children to replay the video after they had finished writing. In this way, time was allotted to the children to write down their thoughts in both scenes to encourage them to think.

In contrast to the Chi-tele videos, only six of the 18 Medle videos were coded as 3 for the hypotheses and discussion scenes. For some videos, time was allotted for the children to think; for example, music was played to give children time to think after the question to be considered was presented. However, ten videos had a code of 0 for the hypothesis scene. In other words, approximately half the videos did not contain a hypothesis scene. It can be said that the hypothesis scenes present challenges in setting up a scene. In the hypothesis scenes, two videos had codes of 2. In the discussion scenes, 11 videos were coded 1 or 2. These lessons were teacher-centred and did not demonstrate any attempt to encourage children to think, even if there was a scene or question in the video. As previously stated in Section 1, IRIM (2022) identified one of the weaknesses of Mongolian video materials to be that ‘some lessons are too teacher-centred with the teacher talking for the majority of the lesson’. The results of this study support this finding.

In the problem-solving process, it is important for children to formulate a hypothesis about a question by themselves and verify and discuss it. As in the Chi-tele video, improving the setting of the scene so that the video includes questions and time for children to think and write down their own ideas is one way to align the video with ‘teaching to encourage children’s ideas and thinking’ and ‘mastering the problem-solving process’.

There are two points that need to be added to the discussion, though it is not included in the previous scenes. First is utilisation scene. The Medle utilisation scene was rated higher than that of Chi-tele. As discussed in Section 1, utilisation is not a goal of the Mongolian curriculum. However, 11 of the 18 videos in Medle included utilisation scenes. One reason for this may be that utilisation scenes are present in classes at a practical level. In this study, utilisation scene is defined as “a scene in which the knowledge gained is used once the answer to the problem has been found”. IRIM (2022) pointed out the lack of explanation of practical uses and importance, but it was clear that more than half of the videos analysed had scenes that covered these things. In contrast, only three of the 16 Chi-tele videos had utilisation scenes. This may be due to the fact that Chi-tele’s videos focus on the basic part of the problem-solving process, from background to discussion scenes. Second is background scene. Although there was no significant difference in the background, however, based on the results of IRIM (2022), a discussion was included. It was stated that for the background, there were some lessons that gave students the opportunity to think critically by asking them questions about the previous review. Of the 18 videos analysed in this study, six had a code of 3. This indicates that, as with IRIM (2022), there were opportunities for children to think in some lessons.

Linkage of problem-solving scenes

There was a significant difference between Medle and Chi-tele in the links between problem-solving scenes. This difference was reviewed and the reasons for this difference was discussed.

All of the Chi-tele videos were coded 5 for the linkage of problem-solving scenes. A code of 5 indicates that all six scenes from the background to the discussion are linked to each other. In contrast, only seven of the Medle videos were assigned a code of 5. Eleven videos had codes of less than 5, including one video with a code of 0.

There are five reasons why Medle's videos were not coded 5. The most common reason was 'no hypothesis scene', for six videos. Next was the reason, 'no hypothesis scene plus no other scenes', valid for four videos. Therefore, a total of ten videos corresponded to the reason, 'no hypothesis scene'. From the above discussion, it can be said that 'no hypothesis scene' is one of the reasons for the significantly low linkage of problem-solving scenes. Other than the hypothesis scene focused on here, there were a relatively few videos without background, method, or result scenes, but they were present. The Mongolian curriculum sets goals for the abilities to be acquired in each scene of the problem-solving process. To enhance these skills, it is necessary to review the structure of videos and consider the scene settings.

One video was coded as '0'. This video did not contain a discussion scene. The video was about electricity conductors and insulators, and experiments were conducted to determine whether various objects, such as stationery, experimental tools, and everyday items around us conduct electricity. After the results of the experiment to conduct electricity through all the prepared objects were shown, the video ended without any concluding words. Therefore, the video was coded as having no discussion scene. The results of the experiment indicated whether each of the tested objects conducted electricity. However, if the video ends at this point, it is not possible to determine whether the non-tested objects conduct electricity. To make the video a problem-solving video, the teacher should organise which objects conduct, and which do not conduct electricity in a discussion scene after the experiment is over, including the conclusion of a rule for what kind of materials conduct electricity. Regarding the 'lack of clearly defined objectives and outcomes of lessons', which IRIM (2022) identified as a weakness of Mongolian video materials, this study showed that there was at least one video in which the outcomes of the experiment were not defined.

There are parts of the Medle videos that do not follow the curriculum, as mentioned previously. IRIM (2022) pointed out that there is a good correlation between the curriculum and the videos, and that the videos for high school lessons are designed to be problem-solving-based, however, there are issues with the videos for primary school science lessons.

CONCLUSION

This research has revealed the following:

The Mongolian Medle video materials were significantly lower than the Japanese Chi-tele video materials for the ‘hypothesis’ and ‘discussion’ scenes and the linkages between the problem-solving scenes. This can be attributed to three reasons. (1) Many of the videos do not include the hypothesis scene; (2) some videos are teacher-driven in the hypothesis and discussion scenes and are not designed to give children time to think; and (3) there is no linkage between the problem-solving scenes, such as the results and discussion. From the above results, it cannot be concluded that the video materials reflect all of the government’s educational and curricular goals. When creating videos for problem-solving learning, it should be noted that there are issues that may be overlooked in the following three points: (1) design the videos so that the problem-solving process includes not only the basic problem and discussion scenes but also other problem-solving scenes apart from those two scenes; (2) incorporate questions and attempt to encourage children’s thinking in each problem-solving scene; and (3) correlate all problem-solving scenes with each other.

As the COVID-19 pandemic ends and schools reopen, the recovery of children's learning has become an important issue. The impact of utilizing Medle videos in the classroom on student learning outcomes represents a topic for future research. How video content can relate effectively to classroom problem-solving activities in schools, how current materials can be used in future disasters, and what additional materials are required are important topics for future research.

LIMITATIONS

Only videos with similar learning objectives and content published on the three websites were included in the analysis. The videos currently available on ‘Medle’ and ‘Chi-tele’ do not cover all of the content studied at each grade. The results of this research would be further developed if those videos of units and content that have not yet been published were available and analysed.

NOTE: This study is a reorganised version of papers presented at the 47th Annual Meeting of the Japanese Society for Science Education (Hikami & Shimizu 2023) and the online annual *Conference of the Society of Japan Science Teaching* (Hikami & Shimizu 2024), with additions and corrections. The test statistics and code figures in Hikami (2022), Hikami & Shimizu (2022), and Hikami & Shimizu (2023) differ from those in this paper because the way the scenes are delimited was changed as a result of examining the connections between the problem-solving scenes.

NOTE 1: The Mongolian Ministry of Education and Science (MoES), referred to in this paper, has been renamed the Ministry of Education, Culture, Science, and Sports. However, we use the former name through this paper.

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