Proposal on how to use assurance cases for learning the mindset to respect diversity

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Abstract

Goal Structuring Notation (GSN), which expressing an assurance case, is possible to visualize structuralizing the application targets with multiple viewpoints. However, the above visualization can only handle multiple viewpoints that users of the assurance case can recognize. In other words, it is difficult to visualize as well as structuralize multiple viewpoints that users of the assurance case cannot recognize. Therefore, the purpose of this study is to confirm whether the users can learn the ability to consider every state and make a judgment based on the understandings by using an assurance case with others, in order to learn the mindset to respect diversity. Next, we will indicate that 1) using an assurance case continuously will lead to learn the mindset to respect diversity, and 2) respecting diversity is nearly equal to the ability to consider every state and make a judgment based on the understandings. The evaluation method of this study is to confirm whether the users can learn the ability to consider every state and make a judgment based on the understandings as well as to learn the mindset to respect others using assurance case in communication between others by writing out assurance case together as a pair. Specifically, one person is a listener and another one is a speaker. The listener listens to what the speaker considers correct, and they write and confirm an assurance case. This study evaluates by using questionnaire and interview after writing the assurance case. As a result, this study suggested that using an assurance case with the other users is effective in order to learn the mindset to respect the diversity that the users cannot recognize. Finally, this study concludes future research topics.

Keywords: Multiple Viewpoints, Structuralizing, Goal Structuring Notation, D-Case, Assurance Case

1. Introduction

The previous study \cite{1} states that assurance cases have recently attracted attention as an international standard mandated by ISO 26262 \cite{2} and other standards \cite{3}, IEC 62853 \cite{4}, which is open systems dependability, defines assurance cases as follows; "Reasoned, auditable artefact created that supports the contention that its top-level claim (or set of claims) is satisfied, including systematic argumentation and its underlying evidence and explicit assumptions that support the claim (s)." The previous study \cite{5} states that the validity of assurance cases depends not only the argument structure but on the content information of assurance cases. Additionally, Kobayashi et al. \cite{6} have shown that it is possible to improve the feasibility of accomplishing management vision and management strategy by describing management vision, management strategy, business process and IT system with the use of GSN \cite{7}, which expresses the argument structure and the content information of assurance cases. Therefore, as research for GSN progresses, it is more likely that we can describe more concretely the relationship among describing management vision, management strategy, business process and IT system. In other words, as research for GSN progresses, companies that use GSN will be able to improve the feasibility of their management vision.

Goal Structuring Notation (GSN) \cite{7}, which expressing an assurance case \cite{3}, is possible to visualize structuralizing the application targets with multiple viewpoints \cite{8}. However, the above visualization can only handle multiple viewpoints that users of the assurance case can recognize. In other words, it is difficult to visualize as well as structuralize multiple viewpoints that users of the assurance case cannot recognize. Therefore, the purpose of this study is to confirm whether the users can learn the ability to consider every state and make a judgment based on the understandings by using an assurance case with others, in order to learn the mindset to respect diversity. In this study, we refer to diversity as various states including states that seem contradictory. In order to explain the relationship between diversity and state in this study, we show an example of diversity and two states as follows. One state is that a person considers meeting others within the COVID-19 pandemic, in order not to get infected with COVID-19. Another state is that a person considers not to meet others within the COVID-19 pandemic, in order not to get infected with COVID-19. Another state is that a person considers meeting others within the COVID-19 pandemic, in order not to get infected with COVID-19. Another state is that a person considers meeting others within the COVID-19 pandemic, in order not to get infected with COVID-19.

Next, we will indicate that 1) using an assurance case continuously will lead to learn the mindset to respect diversity, and 2) respecting diversity is nearly equal to the ability to consider every state and make a judgment based on the understandings. Finally, this study concludes future research topics.

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on the understandings. This study will explain the reasons for the above two points. Firstly, the users of assurance cases are required to have multiple viewpoints in advance, or the ability to accept multiple viewpoints that they did not recognize. If the users cannot accept multiple viewpoints or viewpoint they did not recognize, they would have difficulty in describing the assurance case. In other words, the above will indicate that there is a mindset required for users of the assurance case. Actually, Kobayashi et al. show that each individual can gain multiple viewpoints by using the assurance case in discussion [8]. Thus, we consider that using the assurance case continuously leads to learning the mindset to respect diversity. According to Komatsuda (2018) [9], "respecting diversity" is defined as follow; It is to try to seriously accept and understand the natural appearance of people with different attributes, such as sex, age, occupation, physical condition (presence or absence of illness or "disability"), and economic situation, additionally consider and correspond in accordance with the person and the situation. The reason for learning the mindset to respect diversity is to better understand conventional claims and to recognize the need for deeper analysis of problem by doubting assumption [10]. In other words, learning the mindset to respect diversity is important in order to consider and accept how to solve the problem from various perspectives without sticking to conventional claims. Actually, according to Kate et al. [10], Two different teams, "Chocolate is good for you" and "Chocolate is bad for you", handle the results of students working on contradictory claims using assurance cases. Using the assurance case therefore requires to decide whether to adopt each way of thinking depending on each situation. The reason is that the decision of whether to adopt each way of thinking needs in order to assure the claims. From the above, the second reason is that using an assurance case with others in daily life communication will lead to learn the ability to consider every state and make a judgment based on the understandings. An assurance case [7] is a method to think about how to convince each other about a problem without correct answer and to logically express the balance between each other. Therefore, we considered that Komatsuda's [9] "respecting diversity" and considering every state using assurance case and make a judgment based on the understandings are same in terms of respecting diversity. The above are the reasons we set “Proposal on how to use assurance cases for learning the mindset to respect diversity” as a purpose of this study.

The evaluation method of this study is to confirm whether the users can learn the ability to consider every state and make a judgment based on the understandings as well as to learn the mindset to respect others using assurance case in communication between others by writing out assurance case together as a pair. Specifically, one person is a listener and another one is a speaker. The listener listens to what the speaker considers correct, and they write and confirm an assurance case. This study evaluates by using questionnaire and interview after writing the assurance case.

Next, we explain the novelty of this study as follow. The structure from multiple viewpoints shown by Kobayashi et al. [8] is shown based on the contents expressed by GSN. Additionally, the previous study [11] proposes a quantitative evaluation method for evaluating the ability to structuralize systems with multiple viewpoints of users describing GSN. Using the above proposal, the previous study [12] concretely presented the quantitatively evaluated results from GSN users’ ability to structuralize systems with multiple viewpoints by using GSN. Therefore, the research, which the users of assurance cases evaluate the ability to structuralize systems with multiple viewpoints quantitatively using GSN, is progressing. In order to improve the feasibility of accomplishing management vision and management strategy, future research using GSN may clarify the relationship between respecting diversity and the ability to structuralize systems with multiple viewpoints. However, the above previous studies are not aimed to consider every state and make a judgment based on the understandings in order to learn the mindset to respect diversity. The other previous study has proposed an assurance case description method to reduce misunderstanding caused by the difference of grasping the objects managed in various departments as a monolithic system or a System of Systems [13]. The other previous study proposed a description method for agreeing to information security policies between a parent company and its subsidiary or subsidiaries merged or acquired, based on the framework of Information Security Management System (ISMS; ISO 27001) [14] by using the assurance case [12] [15]. The previous study [5] proposes a review method for assurance cases based on the content information that is represented by the systemigram [16]. The above studies are not a study aimed to consider every state and make a judgment based on the understandings in order to learn the mindset to respect diversity. Kate et al. [10] stated that the reason for learning the mindset to respect diversity is to better understand conventional claims and to recognize the need for deeper analysis of problem by doubting assumption. However, the previous study is not aimed to acquire the ability to consider every state and make a judgement based on the understandings using the assurance case in communication with others, in order to learn the mindset to respect diversity. The other previous study [12] [15] is shown based on the framework of Information Security Management System (ISMS; ISO 27001) [14] by using the assurance case [12] [15]. The previous study [5] proposes a review method for assurance cases based on the content information that is represented by the systemigram [16]. The above studies are not a study aimed to consider every state and make a judgment based on the understandings in order to learn the mindset to respect diversity. Kate et al. [10] stated that the reason for learning the mindset to respect diversity is to better understand conventional claims and to recognize the need for deeper analysis of problem by doubting assumption. However, the previous study is not aimed to acquire the ability to consider every state and make a judgement based on the understandings using the assurance case in communication with others, in order to learn the mindset to respect diversity. The other previous study [12] [15] is shown based on the framework of Information Security Management System (ISMS; ISO 27001) [14] by using the assurance case [12] [15]. The previous study [5] proposes a review method for assurance cases based on the content information that is represented by the systemigram [16].
results in Chapter 5. We indicate the discussion for the evaluation results in Chapter 6. Finally, we present conclusions and future research topics in Chapter 7.

2. Previous Studies

GSN [7], which was proposed by Kelly, is one of the notation methods used for assurance cases [17]. The assurance case can express the discussion of the entire quality with an acceptable level. D-Case (Dependability-Case) [18] is a description method that extends GSN. D-Case is a description method using six nodes, including Goal node, Context node, Strategy node, Evidence node, Monitoring node, and Undeveloped node [18] [19] [20]. Table 1 shows the six nodes. The strategy node used in this study is present in both D-Case and GSN, respectively, and this study believes that the strategy node relates to structuralizing with multiple viewpoints. The reason is that structuralizing with multiple viewpoints utilizes the viewpoint of decomposing the target to be discussed by using the strategy node. We show a description example, which was written by participants at the time of evaluation, of GSN in Figure 1.

| Node     | Figure | Explanation                                                                 |
|----------|--------|-----------------------------------------------------------------------------|
| Goal     |        | Goal node describes what to assure, with a combination of a subject and predicate. |
| Strategy |        | Strategy node describes how to break down the Goal into sub-goals leading to the lower layer. |
| Context  |        | Context node describes the state, or environment and conditions of the System, and shows ways to lead to the Goal and Strategy. |
| Evidence |        | Evidence node eventually assures that we can reach the Goal, and shows ways to lead to the Goal. |
| Monitoring |    | Monitoring node is intended to represent Evidence available at runtime, corresponding to the target values of in-operation ranges. |
| Undeveloped | ♦  | Undeveloped node shows the status that there is no Evidence or Monitoring, or discussion supporting the Goal. |

3. The relationship that how to logically assure top goals for acceptance among stakeholders using assurance cases is one method for learning the mindset to respect diversity

In order to infer the reason realizing one’s learning the mindset to respect diversity using assurance cases, we tried to show the relationship that how to logically assure top goals for acceptance among stakeholders using assurance cases is one method of learning the mindset for respecting diversity. In order to show the above relationship, we consider using three following procedures; Procedure 1 shows the steps for respecting diversity, Procedure 2 shows the relationship among the assurance cases and the steps for respecting diversity, and Procedure 3 shows the relationship that how to logically assure top goals for acceptance among stakeholders using assurance cases is one method for learning the mindset to respect diversity. We show each procedure as follows.

Procedure 1:
We show the steps for respecting diversity as Procedure 1. In Chapter 1, we explained that respecting diversity is nearly equal to the ability to consider every state and make a judgment based on the understandings. Additionally, in order to understand the state, we consider that the users need to recognize the viewpoints and accept the viewpoints. That is because shown in chapter 1, if the users cannot accept multiple viewpoints or viewpoint, they did not recognize, they would have difficulty in describing the assurance case. In other words, users who cannot accept viewpoints cannot understand the state explained using the viewpoints which users cannot accept. Therefore, in order to explain the steps for respecting diversity, in Figure 2, we decomposed into two 2-axes diagrams; One 2-axes diagram uses the axis of "understanding the state" and "not understanding the state," and the axis of "judging the state" and "not judging the state.". The reason why we prepared one 2-axes diagram is to show the consideration of every state and support judgments based on the understandings. Another 2-axes diagram uses the axis of "recognizing the viewpoints" and "not recognizing the viewpoints," and the axis of "accepting the viewpoints" and "not accepting the viewpoints," in order to visualize the recognition about the viewpoints and acceptance about the viewpoints.

We state the relationship among a)-d) and (1)-(8) in Figure 2. We show (1)-(8) in Figure 2 as each part of quadrant, and show a)-d) in Figure 2 as the steps for respecting diversity. We create (5)-(8) in Figure 2 by decomposing the relationship between (3) and (4) in Figure 2, in order to explain "understanding the state." Thus, (3) in Figure 2 equals (5) in Figure 2, performing both a) and b) in Figure 2 equal c) in Figure 2. From the above, the steps for respecting diversity are a), b) and d) in Figure 2.

Procedure 2:
Next, using a)-d) and (1)-(8) in Figure 2, we state the relationship among the assurance cases and the steps for respecting diversity as follows.
Step a): Move from (8) "not recognizing the viewpoints" to (7) "recognizing the viewpoints."

In order to understand how the goal node is decomposed by using the strategy node, the users confirm the viewpoints to each other by looking through the description result of strategy nodes for decomposing goal nodes. As a result, if the users find the viewpoints that the users do not recognize, they will notice the viewpoints that the users did not recognize. Concretely, the goal node of G_1 in Figure 1 decomposes into the place and the purpose by using the strategy node of S_2 in Figure 1. Therefore, if the viewpoints that the users do not recognize is the viewpoint decomposing into the place and the purpose, the users can notice the viewpoints that the users did not recognize.

Additionally, in order to understand how the goal node was decomposed by using the strategy node, the users confirm the states (the content of goal nodes) which the users assure in the assurance case, to each other by confirming goal nodes decomposed using strategy nodes. As a result, if the users find the states that the users do not recognize, the users will get to know the states that the users did not recognize. Concretely, the goal node of G_1 in Figure 1 decomposes into the two states, which are the goal nodes of both G_2 and G_3 in Figure 1, using the strategy node of S_2 in Figure 1. Therefore, if the users
did not recognize \( G_2 \) and \( G_3 \) in Figure 1, they can get to know the states that the users did not recognize.

From the above, the users obtain the recognition about the viewpoints that the users could not recognize previously and recognize the states that the users could not recognize previously. In other words, we consider that the users can recognize the diversity that the users could not recognize previously.

![Diagram](image)

**Figure 2**: Two 2-axes diagrams to explain the steps for respecting diversity

**Step b)**: Move from (7) "not accepting the viewpoints" to (5) "accepting the viewpoints."

In order to agree with how the goal node is decomposed by using the strategy node, the users need to understand and accept the viewpoints to each other by seeing through the description result of strategy nodes for decomposing goal nodes. Therefore, if the users find the viewpoints that the users did not understand and/or accept, the users need to understand and accept the viewpoints that the users did not understand or accept. Concretely, the users need to understand and accept that the goal node of \( G_1 \) in Figure 1 decomposes into the two states, which are the goal nodes of both \( G_2 \) and \( G_3 \) in Figure 1, using the strategy node of both \( G_2 \) and \( G_3 \) in Figure 1. The reason is that, in order to establish a purpose (a state) writing to the top goal node in the assurance case, the users discuss "Why is that the goal nodes of both \( G_2 \) and \( G_3 \) in Figure 1 are bad or good" and "The goal nodes of both \( G_2 \) and \( G_3 \) in Figure 1 are bad or good" using the assurance case. Therefore, if the users find that the two states are one or two states that the users do not understand and/or accept, the users need to understand and accept the viewpoints that the users did not understand and/or accept. As a result, the users accept the states including the states that the users did not accept previously.

From the above, the users accept the viewpoints that the users could not accept previously, and accept the states that the users could not accept previously. In other words, we consider that the users can accept the diversity that the users could not accept previously.

**Step d)**: Move from (3) "not judging the state" to (1) "judging the state."

In order to assure that the users satisfy the states using the assurance case, the users judge to assure the states written to the assurance case by agreeing to all nodes (goal nodes, context nodes, strategy nodes, evidence nodes and monitoring nodes) in assurance cases. Concretely, In order to assure that the users satisfy the states using the assurance case in Figure 1, the users judge to assure the states written to the assurance case in Figure 1 by agreeing to all 17 nodes in Figure 1. The reason is that, in order to establish a purpose (a state) writing to the top goal node in the assurance case, the users discuss "Why is that all nodes in Figure 1 are bad or good" and "All nodes are bad or good" using the assurance case. Therefore, if the users find the states that the users did not satisfy, the users need to satisfy the states using the assurance case. As a result, we consider that the users accept, understand and judge the states which the users write in the assurance case.

From the above, through Step a), b) and d), which are the steps for respecting diversity, we showed leading to respect diversity by activities agreeing to all nodes within assurance cases. In other words, if the users need to establish the assurance case, the users perform activities’ agreement to all nodes within the assurance case. If the users do not need to establish the assurance case, the users may not perform activities’ agreement to all nodes within the assurance case. Thus, the limitation of this study is If the users do not need to establish the assurance case, the users may not perform activities’ agreement to all nodes within the assurance case.

**Procedure 3:**

We show the relationship that how to logically assure top goals for acceptance among stakeholders using
assurance cases is one method for learning the mindset to respect diversity as Procedure 3. We consider that repeating activity of using an assurance case is a part of activity to respect diversity. That is because in Procedure 2, we showed leading to respect diversity by activities agreeing to all nodes within assurance cases, in order to agree with the content of the assurance case. Therefore, we consider that using an assurance case continuously will lead users to learning the mindset to respect diversity.

4. Evaluation Method

The evaluation method of this study is to write out the assurance case and confirm it together with pairs. Users naturally perform Step a), b) and d), which are the activities about agreement toward all nodes within assurance cases, in Figure 2. One is a listener and another one is a speaker. The evaluation of this study used the two top goal nodes as follows; One of the top goal nodes is "It is better to have more choices when the persons decide something." Another of the top goal nodes is "It is better to have fewer choices when the persons decide something." The reason why we set those two top goal nodes is, through using assurance cases, we confirm to work on contradictory claims and a problem without correct answer. Using the above top goal nodes, the listener listens to what the speaker considers correct, and they write out the assurance case together. Then, listener assure what the speaker was trying to affirm using the assurance case. The listener and the speaker team up with each other who have not directly involved, in order not to be able to consider each other. The answers to questions shown in Table 2 were collected by five-point ordinal scale.

Table 2: Corresponding between the evaluation items and the questions.

| Evaluation Items | Questions |
|------------------|-----------|
| A)               | Do you think that you can acquire the ability to consider every state and make a judgement based on the understandings using assurance case? |
| B)               | Was it possible to express how you thought about a problem that did not have a correct answer in a way that you agreed with each other using assurance case? |
| C)               | Do you think using the assurance case will lead to learn the mindset to respect diversity? |

Responses were given on a five-point ordinal scale, ranging from 1-"disagree," to 5-“agree," with 3 representing "neither agree nor disagree." Scores from 4 to 5 were assumed to be valid for "Evaluation Items" in Table 2. This study also collected the opinion for evaluation items A), B) and C) shown in Table 3, using free description columns in the questionnaire. The number of participants were shown in Table 3.

Regarding the qualitative data analysis, free descriptive answers were used as the data, and analyzed by the following procedure, using qualitative coding methods [21].

Step 1: Picking up the interviewer’s answer related to the assurance case from the descriptive answers in survey, and decide the viewpoint, which is going to be used to categorize the Affinity Diagram in the next step. The viewpoint was set as "the thought of the ability to consider every state and make a judgement based on the understandings using assurance case" to verify that using an assurance case will help to learn the mindset to respect diversity.

Step 2: Based on the viewpoint in Step 1, sort the descriptive comments with similar meaning into groups according to the Affinity Diagram.

Step 3: Write titles for each group that summarizes the essence of the group, at a slightly higher level of abstraction (called "Open coding results" in this study).

Step 4: Count the number of descriptive answers related to open coding results.

Table 3: Cross-tabulation table of “Year of working experience” and “Age”.

| Year of working experience / Age | Total |
|----------------------------------|-------|
| 5-15                            | 9     |
| 15-20                           | 14    |
| 20-25                           | 19    |
| 25-30                           | 1     |
| Total                           | 40    |

5. Evaluation results

Table 4 shows the results of the effective number of evaluation items and the results of One Sample T-Test for evaluation items. We set that the effective number in Table 4 is the number of over 3 based on "neither agree nor disagree" within five-point ordinal scale. Table 5 shows the correspondence between open coding results and evaluation items.

Table 4: The effective number of evaluation items and the results of One Sample T-Test for evaluation items.

| Evaluation Items | effective number / Total | Average p-value | Standard deviation |
|------------------|--------------------------|-----------------|--------------------|
| A)               | 17/20                    | 4.15            | 0.000              | 0.9333             |
| B)               | 16/20                    | 3.85            | 0.001              | 0.9333             |
| C)               | 15/20                    | 3.75            | 0.003              | 0.9666             |

6. Discussion

We will discuss the results of a five-point ordinal scale and open coding results. The differences were confirmed.
to be statistically significant as to the test value (based on "neither agree nor disagree" = 3), with $p = 0.000$, $p = 0.001$ and $p = 0.003$ as shown in Table 4. Thus, Table 4 has suggested the effectiveness of the evaluation items A), B) and C) since the average value exceeded three. However, we consider that the effective number of the evaluation item C) (75%) smaller than the effective number of the other evaluation item. The reason is that the participants need to repeat performing all of Step a), b) and d) in Figure 2. In fact, in the evaluation of this study, they could not repeat the activities that they use an assurance case, thus we consider that recognizing the effectiveness of the evaluation item C) was difficult.

6.1 Discussion for the effectiveness of evaluation items A) using open coding results

We will try to confirm to learn the ability to consider every state and make a judgment based on the understandings by using an assurance case, in order to evaluate the effectiveness of evaluation items A). “We acquire an attitude to look at things from multiple viewpoints by using an assurance case.”: The comment states that we try to catch things from multiple viewpoints. In other words, the assurance case expresses multiple viewpoints using strategy node [8], and able to consider next decomposition. As a result, we consider that using a strategy node to select viewpoints [8] lead to consider every state and make a judgment.

“We can set a convenient viewpoint or a convenient condition to pass the claim by using an assurance case.”: The comment states that we can set a convenient viewpoint to pass the claim using strategy node, and to set conditions using context node. The reason is that recognizing a disadvantageous situation is necessary in order to consider an advantageous situation. As results, we considered that understanding every state leads to the thinking that consider every state and make a judgment.

“It is effective to reduce the options and to apply any verification to those options.”: In order to reduce the number of options, we define the context. Therefore, we consider advantageous and disadvantageous situations. In other words, the above leads to understand every state. In addition, we consider that applying any verification for those options are effective, it leads to judgment of grounds considering the situation. As a result, we will get the thinking to judge.

“We can use the assurance case naturally by repeating logical thinking while decomposing the word of subject and define each word.”: The comment states that logically decomposing the words of the subject naturally is possible by repeating the steps. Concretely, in order to decompose the words of the subject and define each word to the context node, the steps are to decompose the words of the subject logically using a strategy node. In other words, the above shows understanding the situation through the steps of deciding each definition. As results, the comment states that to consider every state and the steps of decomposing each word using a strategy node leads to the thinking to judge.

| No. | Open Coding Results | Count | Evaluation Items |
|-----|---------------------|-------|-----------------|
| 1   | We acquire an attitude to look at things from multiple viewpoints by using an assurance case. | 16 | o x o |
| 2   | We can set a convenient viewpoint or a convenient condition to pass the claim by using an assurance case. | 13 | o o x |
| 3   | It is effective to reduce the options and to apply any verification to those options. | 13 | o o o |
| 4   | We can use the assurance case naturally by repeating logical thinking while decomposing the word of subject and define each word. | 8 | o o o |
| 5   | We can understand the results but we cannot agree with the results. | 7 | o x x |
| 6   | We were able to agree with each other's ideas. | 6 | o o o |
| 7   | If the users do not understand the assurance case, the users cannot discuss any topics using the assurance case. | 6 | x x x |
| 8   | By thinking about MECE (Mutually Exclusive and Collectively Exhaustive), the use of assurance case had a feeling of possible impression. | 5 | o o o |
| 9   | It was difficult for us to understand each other, if the logic of the evidence is disjointed. | 4 | x x x |
| 10  | Without any knowledge of the subject, we cannot consider strategy, goal, evidence and context that are sufficient to argue. | 2 | x x x |
| 11  | We cannot express each other's thinking process or the process of discussion. | 1 | x x x |
| 12  | If we have a guideline to the constructive discussion rather than assurance, the discussion is connected by respect. | 1 | x x x |

“'We can understand the results but we cannot agree with the results.'': The comment states that although user can understand various options are available, he/she cannot accept various options. In this case, an assurance case has nodes to express he/she cannot accept, using the undeveloped node [7]. In other words, the comment states
that although he/she can understand the order of his/her thinking by using the strategy node, he/she could not reach to acceptable evidence or answers. Therefore, the comment states that he/she can learn the ability to consider every state and make a judgment based on the understandings, however, cannot reach to have acceptable evidence or answers.

“"We were able to agree with each other's ideas."": In order to fit each other's ideas, it is necessary to understand the goal using goal node, to understand the decomposed situation using strategy node, and to understand the thinking that judged OK using the evidence node [22]. The above starts with understanding one answer despite the existence of many answers. Next, considering the situation is to understand the decomposed situation using the strategy node. Additionally, we consider that the thinking to judge lead to judge using an evidence node [22].

"By thinking about MECE (Mutually Exclusive and Collectively Exhaustive), the use of assurance case had a feeling of possible impression."": The comment means users are required to break down the goal node into MECE [8] when using the assurance case. In order to break down the goal node into MECE, it is necessary to agree on the viewpoint to be decomposed into MECE among the participants using a strategy node. In addition, in order to agree among the participants, as a result of trying to match the recognized state among the participants, the viewpoints recognized by each other can be matched [8]. Therefore, the ability to consider every state and make a judgment is acquired in order to try to understand the viewpoints recognized by each participant.

6.2 Discussion for the effectiveness of evaluation items B) using open coding results

We confirmed from the open coding results, B) that by using an assurance case, it is possible for the participants to express ideas in a way that is mutually acceptable for problems that do not have correct answer.

“We can set a convenient viewpoint or a convenient condition to pass the claim by using an assurance case.”: This comment indicates that the participants can claim the goal by defining the premise conditions of the goal node in the context node. In other words, the participants can be understood and expressed the premise condition before solving the problem that does not have correct answer. The reason is that it is necessary to agree among each other in order to select a convenient viewpoint when there are various premise conditions.

“"It is effective to reduce the options and to apply any verification to those options."": The comment states that an assurance case makes it possible for the participants to consider how to solve the problem that do not have correct answer by reducing options. The comment also states that the participants can conduct any verification and can express that they performed verification accepted by each other.

“We can use the assurance case naturally by repeating logical thinking while decomposing the word of subject and define each word.”: The act of both decomposing the words of the subject and deciding the definitions of each word is to express to the context node what participants agreed with each other. Furthermore, repeating logical thinking, it becomes possible to express your thoughts in a way that convinces each other in the strategy and goal nodes.

“"We were able to agree with each other's ideas."": We believe that the act of putting each participant's ideas together leads to the act of expressing what they agreed with each other. The reason is that reconciling participant's ideas is difficult, if participants cannot agree with each other.

"By thinking about MECE, the use of assurance case had a feeling of possible impression.”: The participants can express what they agreed with each other by thinking about MECE [8]. The reason is that the expression itself shows the case where there is no omission. However, this is limited to the case where there is no omission and each other thinks that the division is correct.

6.3 Discussion for the effectiveness of evaluation items C) using open coding results

We confirmed from the open coding results, C) whether the participants can learn the mindset that respects diversity by using an assurance case.

“We acquire an attitude to look at things from multiple viewpoints by using an assurance case.”: The participants will be able to express multiple viewpoints [8] with a strategy node using the assurance case. The participants will confirm the diversity of viewpoint by comparing multiple viewpoints in order to set lower goal nodes using the strategy node. Since selecting a viewpoint to fill in multiple viewpoints into the strategy node is to choose from diverse viewpoints. This shows that when describing a viewpoint that is not the answer that each other thought in the strategy node, it leads to respect for diversity.

“"It is effective to reduce the options and to apply any verifications to those options."": In order to reduce the options, it is necessary to agree to decompose using a strategy node. In other words, it leads the act of confirming and selecting different ideas from options. The act of confirming and selecting different ideas from options needs to agree on different idea that each participant has in order to select the viewpoint. Furthermore, the above leads to accept various verification methods in order to decide how much verification is effective to the viewpoint.

“We can use the assurance case naturally by repeating logical thinking while decomposing the word of subject and define each word.”: The comment states that the act of both decomposing the words of the subject and deciding each definition leads to consider in a way that is convincing to each other, as a result, the act leads to accept different ideas. Furthermore, repeating logical thinking
leads to consider in a mutually convincing which lead to accept different thinking.

“We were able to agree with each other's ideas.”: The act of agreeing with each other's ideas will lead to learn the mindset to respect diversity. If the participants cannot agree with each other's ideas, the participants do not accept diversity. In this case, having considered the participants agreed with each other's ideas, we therefore consider that the comment leads to respect diversity.

“By thinking about MECE, the use of assurance case had a feeling of possible impression.”: The participants can show the decomposed viewpoint in a way that is convincing with each other by thinking about MECE [8]. As a result, the comment suggests that this way of thinking contribute to accept different ideas. The reason is that if participants consider MECE, participants may show other viewpoints that the participants do not recognize and other states that the participants do not recognize.

This study therefore suggested that it is effective to acquire the ability to consider every state and make a judgment based on the understandings as well as to learn the mindset to respect others using assurance case in a communication between others by writing out assurance case together.

7. Conclusions

The purpose of this study is to confirm whether the users can learn the ability to consider every state and make a judgment based on the understandings by using an assurance case with others, in order to learn the mindset to respect diversity. As a result, this study suggested that using an assurance case with the other users is effective in order to learn the mindset to respect the diversity that users cannot recognize.

The limitations of this study, which are future research topic, are as follows:
- Participants can't respect diversity including the viewpoints that their own don't agree.
- Participants cannot respect diversity including the viewpoints that cannot describe by a pair of two people.
- It may be possible to understand the boundaries of groups that cannot accept some thinking by describing strategy nodes using an assurance case.
- If the users do not need to establish the assurance case, the users may not perform activities agreeing to all nodes within the assurance case.

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