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An Academic Presentation Support System Utilizing Structural Elements

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SUMMARY In academic presentation, the structure design of presentation is critical for making the presentation logical and understandable. However, it is difficult for novice researchers to construct required academic presentation structure due to the flexibility in structure creation. To help novice researchers revise and improve their presentation structure, we propose an academic presentation structure modification support system based on structural elements of the presentation slides. In the proposed system, we build a presentation structural elements model (PSEM) that represents the essential structural elements and their relations to clarify the ideal structure of academic presentation. Based on the PSEM, we also designed two evaluation indices to evaluate the academic presentation structure. To evaluate the proposed system with real-world data, we construct a web application that generates evaluation and feedback to academic presentation slides. The experimental results demonstrate the effectiveness of the proposed system.
key words: *academic presentation, education support, presentation slides, structural model, presentation feedback*

1. Introduction

Academic presentation is a very important part of the academic activities in a university laboratory, which requires the novice researchers to convey their research contents to others [1]. These academic presentations can help researchers connect with each other via both face-to-face events and online environment. To conduct high-quality presentation, researchers need to organize their presentation slides logically and explain the contents with consistency. When the logic of the presentation is broken, the audience is likely to focus on the brokenness of the presentation, which may impede their understanding of the content in the presentation [2]. However, it is difficult for novice researchers who only has limited presentation experience to be aware of the requirements. In addition, it becomes more challenging for novice researchers when there exists an implicit structure that varies depending on the style of the laboratory, the research field, and the time limit of presentation [3]. Traditionally, supervisors help novice researchers to modify academic presentations slides while it is time consuming and requires significant human resources.

To solve the above-mentioned problems, existing research tried to collect presentation slides and analyze the presentation structure in the slides [3]. However, only the occurrence order of the slides is considered in the approach. In this research, we focus on analyzing the global balance of different elements in the slides and generate specific related feedback according to the analysis. Specifically, we propose an academic presentation support system that focuses on supporting presentation structure modification. The support targets in this research are set to the novice researchers who come to a laboratory shortly after. The proposed system extracts the structural elements from the presentation slides made by the novice researchers and compares these elements with the elements extracted from the presentation style and characteristics of the laboratory to which the novice researcher belongs. To extract structural elements, we propose a presentation structural element model (PSEM) that summarizes the types of essential structural elements and outlines their relations from academic presentations. The comparison of structural elements between individual researcher and the research group can be computationally conducted based on the PSEM. The results of the comparison will be evaluated and utilized to provide feedback to the novice researchers. In the experiments, a web application is developed run the structural elements extraction, comparison and feedback generation. The comparison of the structural elements extraction and the feedback generated to the novice researchers are validated in the experiments.

The rest of this paper is organized as follows. Section 2 introduces the related work of this research. Section 3 provides a detailed explanation of the proposed system. Experiments and experimental results are demonstrated in Sect. 4. Section 6 concludes this paper.

2. Related Work

In this section, we reviewed the related work from two perspectives, presentation improvement support before making a presentation (i.e., preparation stage) and presentation improvement support during making a presentation (i.e., conduction stage).

2.1 Presentation Improvement Support in the Preparation Stage

One of the approach is to support presentation by targeting the preparation stage of making a presentation. These approaches aim to help researcher organize presentation contents. Roels and Signer proposed a conceptual framework that unifies both classic and next generation presentation concepts and presented a new content model for presentation

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solutions [4]. Oida et al. focus on sharing and reusing presentation construction knowledge and develop a slide retrieval system that help construct presentation more efficiently [5]. Kojiri et al. proposed a method to make beginners aware of logical relationships by creating a concept map (content map) that organizes the contents of the presentation, with restrictions that allow a logical structure to be established [6], [7]. This approach focused on the preliminary stage of slide creation by considering content organization and derivation other than the stage of presentation revision and improvement. Zhang et al. proposed a design support system for presentation slides generation with the consideration of both structure design and content generation [8]. Hanaue and Watanabe proposed a method for representing scenarios, which are the logical structure of a presentation, in a structured mind map format [9]. This method allows the presenter to create slides directly from scenarios, while it is burdensome because the presenters have to create the scenario from scratch, and it requires prior knowledge of scenario construction methods. Tanida et al. defined a presentation schema, which is the semantic structure of a typical presentation in a laboratory, and proposed a method to help beginners understand the logical structure by presenting it as a scaffold [10]. However, the presentation schema presented in this method is difficult for novice researchers to understand because of its complex tree structure, and novice researchers may not be able to apply their own research contents to it successfully.

While the objective of this paper is to deepen students' understanding of structural elements through the revision and improvement of their presentation slides. We focus on supporting the beginner in understanding the structure of the presentation and evaluating the structure of the created presentation. Furthermore, by combining evaluation indices that diagnose the validity of individual presentation structures from multiple perspectives, we aim to evaluate presentation structures with the same index while adapting to different laboratory styles.

2.2 Presentation Improvement Support in the Conduction Stage

How to improve the skills and quality of the presentation is a research topic that have attracted much research interest. To conduct an academic presentation, both presentation quality and documentation (slides) quality are important. Some research target the presentation practice (rehearsals) part, they proposed the approaches that support self-review by observing one's own rehearsals and noticing areas for improvement [11], [12]. An effective environment for self-review can be created by replaying the presenter's rehearsal with an avatar or robot on a computer. Yamada et al. built a support tool for post-rehearsal discussions [13]. This tool helps presenters to improve their presentations by generating draft revisions that are examined by all participants based on audience comments and suggestions. These work focus on the practice process of the presentation while our work focus on improving the presentation slides. From this perspective, one approach focus on supporting presentation slides improvement by utilizing viewpoints of audience [14]. An information system mechanism was proposed to offer advice to presentation correction and improvement with audience models and presentation scenarios. Another approach was proposed to analyze and improve the visual clarity of slides [15]. They generated a dataset of slides with ratings of visual clarity and use machine learning techniques to analyze visual clarity. Specifically, the video of the presentation was analyzed by machine learning and 14 types of impressions were evaluated, and feedback was provided such as a heatmap showing areas for improvement on the slides. However, there is a problem that it is difficult to collect data for training because the composition of slides changes depending on the research field, laboratory, presentation time, and so on. There are also concerns that the evaluation criteria are not known because machine learning technique is used. And those points for improvement, such as impression evaluation and heat maps, are not clear.

In our research, we adopt statistical processing methods that focus on clarifying points for improvement in the feedback instead of machine learning techniques because we target the feature analysis of laboratory-based presentations, where only a small amount of data exists.

3. Presentation Structure Elements Model (PSEM)

3.1 Composition of PSEM

The PSEM should be a simplified model that shows the minimum necessary elements for presentation (structural elements) and their structural relationships in a way that can be easily understood by novice researchers, although the amount may vary depending on the research field and laboratory style. To define the PSEM, first it is necessary to organize and clarify the structural elements and their structural relationships. Hanaue and Watanabe argued that the subject of the presentation consists of the concepts of objective, method, and conclusion [9]. As objective can be divided into background, problem consciousness, and related research, it indicates that there are core components with these three concepts. Based on these work, we define five sorts of main structural elements for PSEM. Specifically, these elements are subject, background, approach, evaluation and conclusion. Background demonstrates social and academic background and awareness of the issues in the research field. Subject is the most important element of a presentation, indicating what the presenter will argue in the presentation. Approach explains the proposed techniques to solve the related problem in the research. Evaluation contains the purpose and methods of case studies and evaluation experiments. Conclusion is a summary of the presentation.

After the structural elements get organized, the relation between the elements should be clarified. The first relation is between subject and background where subject is the proposal for the problem to be solved based on the background.

Another relation is set between subject and approach, where approach is designed to achieve the objective described in the subject. In addition, there is also a relation between approach and evaluation, where the effectiveness and validity of the approach are described in the evaluation. Furthermore, there is a relation between evaluation and conclusion where conclusion is presented based on the results discussed in the evaluation.

The main structural elements are the typical elements that are assumed as essential in the presentation slides. To precisely describe the contents in the slides, PSEM subdivides the main elements into sub-elements. For instance, there can be sub-elements such as term explanation, importance and existing problems in the main element background. In this research, we assume that only one sub-element exists per slide. Since the importance of the sub-elements varies depending on the style of the laboratory, sub-elements will be formatted in a way that allows a certain degree of freedom in this research. To explain the idea of utilizing the proposed PSEM to represent structural composition of presentation slides, we use a real-world data based example to elaborate the details.

3.2 A Real-World Data Based Example

This time, only Japanese presentations are included since the structures of English and Japanese are somewhat different. To elaborate the details of PSEM, we extracted the presentation structure from past presentations in our laboratory by using PSEM. The presentation slides we used are the ones used in the master's thesis review presentation. In total, we collected 23 sets of slides used in our laboratory. The presentation time is 15 minutes and the reviewers of the presentation are researcher who have different areas of expertise. By using PSEM, the general structure of the presentation slides in our laboratory can be represented in Fig. 1.

In this example, there four sorts of sub-elements in background, two sorts of sub-elements in subject, five sorts of sub-elements in approach, two sorts of sub-elements in evaluation and two sorts of sub-elements in conclusion. The relation between main elements are represented by the arrows. It is also noteworthy that there are additional slides that explain information such as table of contents and reference in the real-world presentation slides. These slides are counted as others (i.e., additional slides) and no structural elements are extracted.

3.3 PSEM-Based Presentation Structure Evaluation

In this research, we aim to compare the presentations made by the research beginners with a model that includes the general style and characteristics of each laboratory, and to use the differences to provide feedback. A certain amount of deviation and a degree of freedom in the creation of presentations are allowed rather than correcting all presentations in a uniform manner. To compare presentations and provide feedback, first compare the structure extracted from the

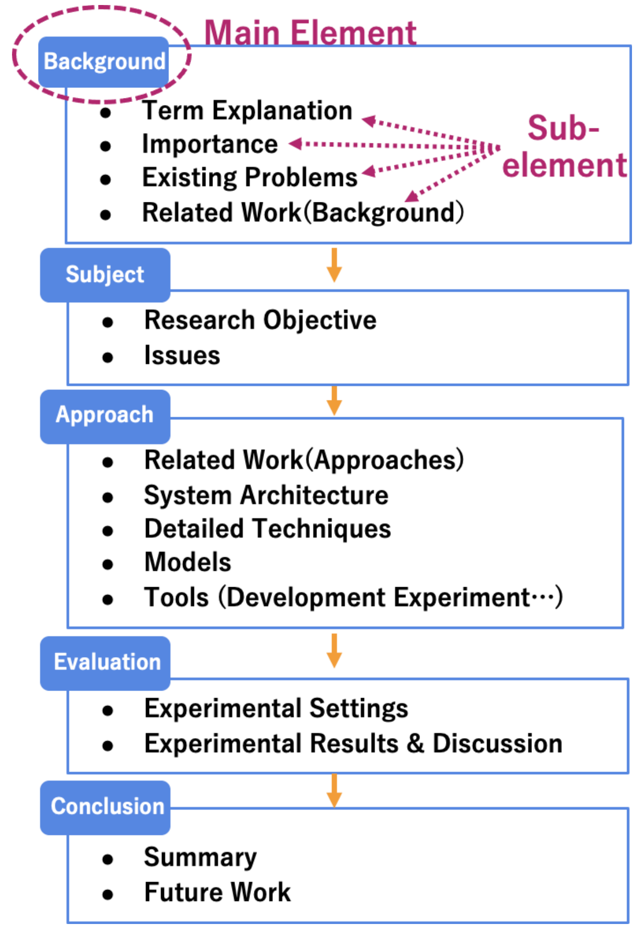

Fig. 1 An example of presentation structural elements model

presentation made by the novice researcher and the general presentation structure extracted from the related research group and take the difference. The difference is measured by the evaluation indices. Two sorts of indices are defined to measure the differences between the presentation structures as follows.

- Balance of the main elements
- Importance of the sub-elements

3.3.1 Balance of the Main Elements (BME)

In general, the presentation time is fixed for research presentations, and a verbose presentation or too brief presentation may not convey the content sufficiently. Similar problem may happen if one part of presentation is verbose or too brief. BME is designed for representing the balance of each main element. The calculation of BME for element i is shown in Eq. (1).

$$BME_i = \frac{num_{s_i}}{num_{s_{total}}} \times 100\% \quad (1)$$

where num_{s_i} denotes the slides number of main element i and $num_{s_{total}}$ denotes the total number of slides in the presentation. General BME of each element in a group is

Algorithm 1 BME-based Evaluation Point Calculation and Feedback Determination

Input: $B, B_L, D_L,$
Output: P_{BME}, generated feedback
initialize $P_{BME} = 10 * |B_L|$
for each BME value B_i in B **do**
  if $B_i == 0$ **then**
    $P_{BME} = 0$
    Generate B_i related feedback
  else if $B_{L_i} - D_{L_i} \le B_i \le B_{L_i} + D_{L_i}$ **then**
    $P_{BME} = P_{BME}$
  else if $B_{L_i} - 2 * D_{L_i} \le B_i \le B_{L_i} + 2 * D_{L_i}$ **then**
    $P_{BME} = P_{BME}$ - $0.4 * |B_L|$
  else if $B_{L_i} - 3 * D_{L_i} \le B_i \le B_{L_i} + 3 * D_{L_i}$ **then**
    $P_{BME} = P_{BME}$ - $|B_L|$
    Generate B_i related feedback
  else
    $P_{BME} = P_{BME}$ - $2 * |B_L|$
    Generate B_i related feedback
  end if
end for
return P_{BME}, generated feedback

Algorithm 2 ISE-based Evaluation Point Calculation and Feedback Determination

Input: M_L, I, I_L, Q_L
Output: P_{ISE}, generated feedback
initialize $P_{ISE} = 10 * |M_L|$
for each main element M_{L_i} in M_L **do**
  for each sub-element $I_{L_{i,j}} \wedge (Q_{L_{i,j}} == 1)$ **do**
    if $(I_{L_{i,j}} \notin I)$ **then**
      $P_{ISE} = P_{ISE} - 2 * |M_L|$
      Generate $I_{L_{i,j}}$ related feedback
    end if
  end for
  $I_{R_i} = \emptyset$
  for each sub-element $I_{L_{i,j}} \wedge (0.5 \le Q_{L_{i,j}} < 1)$ **do**
    add $I_{L_{i,j}}$ into I_{R_i}
  end for
  if $I_{R_i} \cap I == \emptyset$ **then**
    $P_{ISE} = P_{ISE} - |M_L|$
    Generate I_{L_i} related feedback
  end if
end for
if $P_{ISE} \le 0$ **then**
  $P_{ISE} = 0$
end if
return P_{ISE}, generated feedback

calculated by averaging BME number in each presentation.

From the BME point of view, whether feedback should be given to the novice researcher is decided by using Algorithm 1.

In Algorithm 1, three inputs are necessary. First, each novice researcher is assigned with a set B, which is a set that contains each BME value of element B_i ($B_i \in B$) calculated by Eq. (1). B_L is a set that contains elements' average BME values in the research lab L to which the novice researcher belongs. D_L is a set that contains elements' standard deviation values in research lab L. B_{L_i} ($B_{L_i} \in B_L$) and D_{L_i} ($D_{L_i} \in D_L$) represents the average value and standard deviation value of BME element i in lab L, respectively. The output are the evaluation point P_{BME} of the novice research with the consideration of BME and all the generated feedback. When the algorithm starts, the initial P_{BME} value is decided by the number of main elements that are required in the research lab. If one sort of main elements is missing in the presentation, the evaluation point P_{BME} is set to 0 directly and system generates feedback that tells B_i is missing. Evaluation point is calculated based on the comparison between each BME value in the presentation and the ideal BME value boundary. Feedback is generated along with the point subtraction which is equal to or more than $|B_L|$. Whether the number of slides is more, or less than the ideal number can be told be the system when the subtraction is $|B_L|$. When the subtraction is $2 * |B_L|$, the feedback is that the number of slides is much more, or much less than the ideal.

For instance, in a research lab that requires 5 sorts of main elements in the presentation slides, the initial value of P_{BME} is 50. If one novice researcher makes 7 slides about the main element Evaluation in the presentation while the average number of Evaluation in the research lab is 5 with a standard deviation of 0.7. The P_{BME} value will get a 5 points subtraction and receive the feedback that there are more slides of Evaluation.

3.3.2 Importance of the Sub-Elements (ISE)

The sub-elements defined in the PSEM are elements that are included as explanatory content for the main elements. The importance of these sub-elements may vary depending on the style of the laboratory and the research field. In this research, the importance of the sub-factors by the research group is expressed in terms of probability of occurrence and treated as an evaluation index. We propose a method of expressing the probability of occurrence of sub-elements in a main element as a conditional probability. The evaluation is assumed to be performed in such a way that the sub-elements in the actual presentation should be within the acceptable range of occurrence probabilities, but if sub-elements deviate from the acceptable range, feedback can be pointed out. The calculation of occurrence probability of sub-elements is shown in Eq. (2).

$$P(s|m) = \frac{P(m \cap s)}{P(m)} \tag{2}$$

where $P(m)$ and $P(s)$ denotes the existence probability of main element and sub-element in presentations, respectively. The joint probability of a sub-element and its related main element in presentations is denoted by $P(m \cap s)$.

Algorithm 2 explains the calculation of the ISE value. Four sorts of inputs are required. M_L is set that contain all sorts of main elements in research lab L, $M_{L_i} \in M_L$. I and I_L is the set that consists of all the sub-elements in the novice researcher's presentation and the required sub-elements in L, respectively. Since each sub-element is categorized under a main element, $I_{L_{i,j}}$ ($I_{L_{i,j}} \in I_L$) represents the sub-element j that is categorized under the main element i. Q_L is a set that

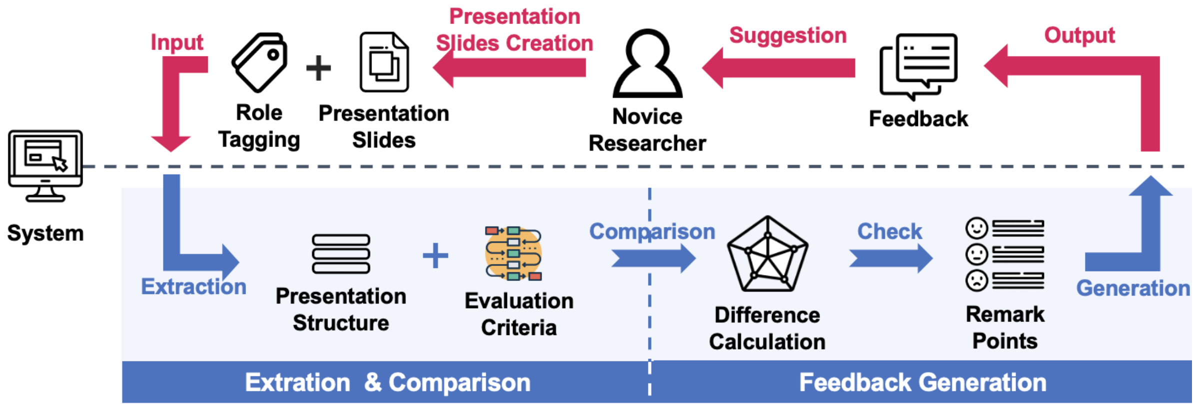

Fig. 2 System architecture

contains the occurrence probability of each sub-element that is calculated by Equation in research lab L 2. $Q_{L_{i,j}}$ ($Q_{L_{i,j}} \in Q_L$) represents the occurrence probability of sub-element j in main element i. The output are the evaluation point P_{ISE} of the novice research with the consideration of ISE and all the generated feedback. The original sub-element evaluation point P_{ISE} is decided by the number of main elements. Since there can be multiple sub-elements categorized under one each main element, sub-elements are checked by each (lines 2-17). In details, if one sort of essential sub-element whose occurrence probability is 1 is missing, the ISE point will do a $2 * |M_L|$ points subtraction (lines 3-8). Feedback will be generated to tell related essential sub-element $I_{L_{i,j}}$ should be added. After this, if none of the important sub-elements whose existence probability is equal or bigger than 0.5 exists, a $|M_L|$ points subtraction will be done to the ISE point (lines 9-17). Feedback will be generated to tell at least one sort of related important sub-elements under main element I_{L_i} should be added. I_{R_i} is set that is used to collect all the important sub-elements under main element i. In addition, the minimum ISE point is set to 0.

For instance, in a research lab that contains 5 sorts of main elements in the presentation slides, the initial value of P_{ISE} is 50. When a novice researcher makes slides about the conclusion that contain sub-element Summary while the research group requires both Summary (with occurrence probability as 1) and Future Work (with occurrence probability as 0.9) as sub-elements in the conclusion. The P_{ISE} will get a 5 points subtraction and the system will generate the feedback that the important sub-element Future Work is missing.

3.4 System Development

To evaluate the proposed approach in real-world situations, we develop a PSEM based system to help novice researchers improve their academic presentation slides. This system is developed as a web application with the Python-based web application framework Flask. The system architecture is shown in Fig. 2. When novice researchers want receive feedback from the system, system asks for the created presentation slides and related tags for each slide based on the sub-element definition. Based on the created slides and tags, system extracts the structure of the presentation. The difference between created presentation slides and ideal slides is calculated based on the evaluation criteria introduced in the Sect. 3.3. Evaluation points are generated according to the calculated difference and related feedback is suggested to the novice researcher.

4. Experimentation

In this section, we explain the experiment settings and experimental results of evaluating the proposed approach.

4.1 Comparison of PSEM in Different Research Environments

To evaluate the proposed PSEM in representing structural elements, we ran an experiment to compare the generated structural models from different research environments. In this experiment, three sorts of research environments (RE) are created based on real-world presentation slides from three research labs. The details of three REs are shown in Table 1.

RE1 represents presentations of master thesis defense in our laboratory. RE2 are presentations of undergraduate thesis defense in one lab from Kansai University. Presentations in RE3 are undergraduate mid-term presentations that come from a lab in Chiba Tech University. The research domain of all the laboratories is similar. They focus on educational technology and learning technology.

4.1.1 BME Analysis

With the presentation models that are collected from three different research environments, we first analyze their BME and show the results in Table 2. Three sorts of general presentation structures are generated from three REs. The numbers in Table 2 show the average distribution percentage of each main element in the related general presentation structure. In RE1 and RE2, approach and evaluation constitute higher proportions than other main elements while the proportion of background and approach are much higher than other main elements in RE3. This means that approach and evaluation are considered as more important elements in

Table 1 Three research environments

	RE1	RE2	RE3
Presentation Sets Number	**23**	**11**	**25**
Presentation Objective	Master Thesis Defense	Undergraduate Thesis Defense	Undergraduate Mid-term Presentation
Presentation Time	**15** mins	**15** mins	**6** mins

Table 2 Balance of the main elements (BME) in three research environments

Element	RE1	RE2	RE3
Background	**13.8**	**7.57**	**17.6**
Subject	**5.54**	**8.10**	**8.78**
Approach	**42.2**	**44.8**	**47.2**
Evaluation	**23.7**	**23.3**	**7.84**
Conclusion	**6.3**	**8.10**	**8.81**
Others	**8.48**	**8.10**	**9.80**

RE1 and RE2, which reflects general requirement in the thesis defense presentation. While in RE3, higher proportion of background and approach reflects the situation that students should pay more attention to the research background and proposed approach in their mid-term presentation. We can also notice that the background element needs to be explained more in RE1 than in RE2. This indicates the requirement for the similar presentation objective in different research labs. All these results demonstrate that our proposed model can show the characteristics of presentation in different research environments.

4.1.2 ISE Analysis

The results of ISE in the generated three presentation models are shown in Table 3. Each number represents the existence probability of one sort of sub-element with the related main element in one RE. We can find the differences of ISE in different REs. For instance, when we focus on the main element background, we find that both importance and problem are considered as important sub-elements in RE1 while only problem is considered as more important than other sub-elements in RE2 and RE3. In contrast with RE1 and RE3, the term explanation is not required in RE2. Another noteworthy point is that different REs can have different arrangement for the same sub-elements. One example is the sub-element support objects & contents, which is located in the main element subject in RE3 while in the main element approach in RE2. Besides the differences of ISE in REs, there are also identical features such as the sub-elements summary and future work & discussion. Both of the sub-elements are essential for the main element conclusion in all the three REs. The results in ISE analysis can also demonstrate that our proposed model can show the characteristics of presentation in different research environments.

4.2 Evaluation of Generated Feedback by PSEM

After evaluating the comparison of presentation structural model in different research environments, we also evaluate the feedback that novice researcher can receive from the based on the presentation structural model. In this experiment, we recruited five 1st year master students (i.e., participant A, B, C, D and E) as participants. These participants are considered as novice researchers and are asked to modify three sets (i.e., set a, b and c) of selected slides that are from the same research environment. Slide set a, b and c contains 31 slides, 55 slides and 13 slides, respectively. The assumed objective of the slides is that they are prepared for master thesis presentation. In the modification, participants can decide to keep or delete, as well as change the order of the slides in each slide set. In particular, in slide set c, participants can decide to add new slides if they consider it as necessary. And for each slide, the participants are asked to choose a sort of sub-elements that the slide contents contain.

In total, we collected 15 sets of slides from five participants. After the collection, we put these slides into our system to receive feedback. We also ask the supervisor of the research environment to give feedback to these modified slides. The results are shown in the following subsections.

4.2.1 Evaluation and Feedback Based on BME

The feedback generated based on BME is shown in Table 4. First, we can find that the BME-based evaluation point results can generally reflect the BME-based quality of the modified slides. The system gives the feedback (shown in column 4) of related main elements based on the BME. And the column 5 shows the feedback generated from the supervisor. We use symbol − and symbol + to represent the slides number is less or more than the ideal number. For instance, the system gives feedback to participant A about slide set b to suggest that there are less slides about main element Approach and more slides about main element Conclusion. The N/A is also considered as one sort of feedback which means no modification is required. In total, the system generated 18 BME-related feedback and the accuracy is 0.50. The supervisor generated 21 BME-related feedback and the recall of the system is 0.43. These results evaluate the ability that the system can generate useful feedback based on BME.

4.2.2 Evaluation and Feedback Based on ISE

The feedback generated based on ISE is shown in Table 5. We find that the ISE-based evaluation point results can also generally reflect the ISE-based quality of the modified slides. In total, the accuracy of the ISE-based feedback is 0.76 and the recall of the supervisor's feedback is 0.65. According to the supervisor's feedback in this experiment, the sub-element Technical Elements related to main element Approach and the sub-element Result & Discussion related to main element Evaluation are considered as highly important sub-elements which should be defined as essential in the system's feedback. These two essential sub-elements in the supervisor's

Table 3 Importance of the sub-elements (ISE) in three research environments

Main Elements	Sub-elements	RE1	RE2	RE3
Background	Term Explanation	0.261	-	0.467
	Importance	0.783	0.429	0.333
	Problem	0.870	0.714	0.810
	Related Work (Background)	0.304	0.143	0.429
Subject	Objective	0.909	1.000	0.769
	Support Objects & Contents	-	-	0.231
	Research Issue	0.682	-	-
Approach	System Function	-	0.909	0.960
	Support Objects & Contents	-	0.727	-
	Related Work (Approach)	0.696	-	0.078
	Overview	0.609	0.636	0.760
	Technical Elements	1.000	0.545	0.360
	Model	0.609	0.091	-
	Used Tools	0.435	-	-
Evaluation	Experiment Overview	0.957	1.000	0.727
	Result & Discussion	1.000	1.000	0.455
Conclusion	Summary	1.000	-	-
	Future Work	1.000	-	-
	Summary & Future Work	-	1.000	1.000

Table 4 Evaluation and feedback based on balance of the main elements (BME)

Participant	Slide Set	Evaluation Point	System Feedback	Supervisor Feedback
A	a	50	N/A	N/A
	b	31	Approach(-), Conclusion(+)	Approach(-), Evaluation(+)
	c	45	Conclusion(+)	N/A
B	a	48	N/A	N/A
	b	40	Conclusion(+)	N/A
	c	46	N/A	N/A
C	a	50	N/A	Approach(+), Evaluation(+)
	b	46	N/A	Subject(+), Approach(+), Evaluation(+)
	c	50	N/A	Evaluation(+)
D	a	50	N/A	Subject(+)
	b	48	N/A	Approach(+), Evaluation(+)
	c	48	N/A	N/A
E	a	0	Background(-), Evaluation(-), Conclusion(+)	Background(-), Approach(-), Evaluation(-)
	b	50	N/A	N/A
	c	43	Evaluation(+)	Approach(-), Evaluation(+)

Table 5 Evaluation and feedback based on importance of the sub-elements (ISE)

Participant	Slide Set	Evaluation Point	System Feedback	Supervisor Feedback
A	a	50	N/A	N/A
	b	40	Approach: Technical Elements	Approach: Technical Elements
	c	45	Approach: Related Work(Approach) or Overview or Model	N/A
B	a	50	N/A	Approach: Used Tools
	b	50	N/A	N/A
	c	40	Conclusion: Summary & Future Work	N/A
C	a	50	N/A	N/A
	b	50	N/A	N/A
	c	50	N/A	N/A
D	a	50	N/A	N/A
	b	50	N/A	N/A
	c	50	N/A	N/A
E	a	30	Background: Importance or Problem Evaluation: Experiment Overview Evaluation: Result & Discussion	Background: Problem Approach: Overview Approach: Used Tools Evaluation: Result & Discussion
	b	45	Approach: Related Work(Approach) or Overview or Model	Background: Related Work(Background) Approach: Overview
	c	45	Approach: Related Work(Approach) or Overview or Model	Approach: Related Work(Approach) Approach: Overview

feedback are successfully given by the system as feedback to slide set b of participant A and slide set a of participant E. The sub-elements Problem in Background, Overview in Approach and Related Work (Approach) in Approach are defined as important sub-elements which can be selectable in the system's feedback. For the five selectable sub-elements in the supervisor's feedback, four of them are successfully pointed out by the system. While the sub-elements Related Work (Background) in Background and Used Tools in Approach are considered as less important sub-elements which can be added or omitted according to the researcher's own decision. Two less important sub-elements exist in the supervisor's feedback and these feedback is not reflected in the system's feedback. To summarize, these results evaluate the ability that the system can generate useful feedback based on BME.

5. Discussion

In Sect. 4, we receive positive results in presentation structural model comparison and feedback evaluation. In the comparison of presentation structural models generated from different research environment shown in Table 2 and Table 3, we understand characteristics of presentations change according to research environment and research objective. For instance, in the middle stage of the research, the ratio of background explanation is higher while evaluation explanation constitutes a higher proportion in the conclusion stage of the research. It is noteworthy that approach is considered important in all the research environments in the experiments. In the BME-based feedback evaluation shown in Table 4, the accuracy and recall are not very high. From the system feedback point of view, the reasons are that system generate much feedback that suggests there are too much conclusion. This implies the ideal range of the conclusion is stricter than the supervisor. From the supervisor feedback point of view, the reason is that feedback of subject and approach get pointed out by the supervisor but not by the system. This reason may be the students' motivation to introduce more details of the work that they have done. This implies that the presentation motivation of the presenters should be considered in the feedback generation. In the ISE-based feedback evaluation shown in Table 5, the sub-element Overview in Approach is mostly mentioned by the supervisor. This suggests that supervisor's personal feedback tendency is another factor that should be considered in the feedback generation system.

6. Conclusion

In this research, we proposed a presentation structural element model to help novice researchers improve their presentation structure in the academic presentation slides. The concepts of main element and sub-element are introduced in the proposed model. The experimental results demonstrate the effectiveness of the proposed system in representing the features of presentation structures in different research environment and generating useful feedback to the novice researchers. As one direction of future work, we plan to develop automated element detection approach that determine main elements and sub-elements from the slides. And another future work direction is to modify the proposed model with the consideration of presenters' motivation and consider the supervisors' personal tendency in constructing feedback generation.

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