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THE INNOVATIVE GROUP LEARNING DESIGN: INSTRUCTIONAL GROUP ACTIVITIES

Research Article

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Abstract

The Instructional Group Activities Design (IGAD) refers to activities which aim to improve professional development and learning skills, in which a learning-centered teaching process is adopted and students study in small groups. The study aimed to both introduce the IGAD and determine pre-service science teachers' opinions on IGAs that were performed during the practice hours of the course "Special Teaching Methods I." In line with this aim, opinions of 56 pre-service science teachers on the practices were received. An opinion form, which includes open and close-ended questions, was used as a data collection tool. According to the results of the study, pre-service science teachers stated that the practice mostly contributed to their professional and social development areas. Regarding the negative aspects of the practices, pre-service science teachers underlined that they had difficulty regarding time and experienced certain group problems. Based on these findings, positive and negative aspects of the instructional group activities design for teacher training were discussed, and some recommendations were presented.

Keywords: instructional group activities, teacher training, group learning design, science education

1. Introduction

It can be stated that teacher training programs have entered a process of transition towards the social constructivist approach and experience-based and peer learning is the main quality in this new horizon. Inquiry-based learning is mainly considered as the way to ensure experience-based learning. Inquiry-based learning is based on social constructivism, and it is in the center of curriculum reforms made in science teaching in recent years. The content of science reforms consists of the activities carried out with small group studies, expressed with inquiry-based learning and application-based learning terms. As a result, teacher training curricula have entered a transition process towards the social constructivist approach (Lockhorst, 2004), and active learning and cooperation with peers are the main qualities in the new paradigm (Ruys, Van Keer & Aelterman, 2010). According to Forbes (2011), practice-based teacher training programs help candidates in eliminating the disconnection between their programs and the classroom environment.

In practice-based studies carried out in teacher training, this kind of practices was named and used differently. In their studies, while Birren and van den Kieboom (2017) named these practices as core teaching practices, Arias and Davis (2017) named them as a practice-based program, Weiland, Hudson and Amador (2014) named them as research-based practices and core practices, Aydın et al. (2013) named them as CoRe-based mentoring-enriched practicum, and Wilson and Kittleson (2012) named them as reform-based science instruction. However, all of them have significant common features. These features can be summarized as instructional practices, educational design or activities having a structure that aims to develop teaching skills, supports the student-centered and constructivist philosophy, aims to

ensure in-depth conceptual understanding, is generally maintained with small-group studies, and combines theory and practice.

According to Hennissen, Beckers, and Moerkerke (2017), teacher trainers around the whole world try to fill the gap between theory and practice and in this process, different teaching and learning models, such as inquiry learning, project-based learning, practical theorizing, problem-based learning, and research-informed clinical practice, are used. According to Weilan, Hudson and Amador (2014) who state that teacher trainers should focus on the theoretical and practical aspects of any practice, pre-service teachers should perform teaching practices with students and teachers since they can understand the complexity of teaching and develop their professional identity understanding in this way. Among the most important facilitating ways to develop professional teaching identity by pre-service teachers with their professional awareness is their getting involved in practices that combine theory and practice. Although its importance has been discussed sufficiently, according to Korthagent et al. (2001), many studies on teacher training have shown that the connection of theory with practice is insufficient. There are various reasons for this in teacher training. Among the most important ones are the facts that the type of information processing used by teacher trainers is either rational or cognitive, and pre-service teachers do not have sufficient concrete problem-solving experiences to apply theories (Hennissen, Beckers & Moerkerke, 2017). In this case, practices that will allow pre-service teachers to have the experiences in question should be included in training programs.

The content of teacher training programs must have a structure that is parallel to what is expected of students and teachers at grade levels at which science will be taught. At these grade levels, the aim of science teachers is to focus on the development of vision towards science, understanding of questioning and researching processes and using these by associating them with the daily life of students, rather than endeavor to obtain intense abstract information that students cannot associate with their theoretical, daily lives. Nevertheless, teachers are expected to use multiple teaching ways and methods that will help students obtain meta-cognitive skills and scientific process skills, in which students are made active, use research-based teaching strategies and consequently make scientific discussions and become aware of what they know, particularly the co-working skills, and also skills such as creativity and logical thinking, instead of providing scientific information through expository teaching. The teacher competencies in question should be provided to students in teacher training programs. In this case, the fact that pre-service science teachers have significant qualities in terms of content and pedagogical knowledge makes it obligatory for them to get the experience that will develop these and ensures parallelism with the new science teaching approach that is expressed as today's reform-based science teaching. To ensure this, instructional lesson designs that combine theory and practice, allow students to experience the importance and way for meaningful learning and support professional development gain importance in science teacher training programs. Method lessons are at the top of the lessons in which these course designs can be applied in the best way both due to their content and structure that consists of two parts, being theory and practice. Therefore, the Instructional Group Activities Design (IGAD) was addressed in this study, and it was aimed to determine the opinions of pre-service teachers on IGA performed in the "Special Teaching Methods I" course.

1.1. Instructional group activities design (IGAD)

The IGAD aims to increase professional development through teaching skills, in which a learner-centered teaching process is adopted, and includes activities in which pre-service teachers work together in ensuring the achievement of targets. The IGAD consists of six

design components in total, being learning targets and outcomes, task features, and the process of linking theory to practice, guidance, group structuring and interaction, and assessment and feedback. Before explaining the design components, it is necessary to state that these components are related, and the aim here is to present the main structure of the design to lead and guide practitioners, and not to restrict the instruction with stages or components. Practitioners (teaching elements) may adapt, change and update design components during practice when it is necessary for students to achieve learning targets.

The learning targets and outcomes component aims to obtain the content achievements of the lesson and develop teaching skills, and achieving the desired learning results of the IGAD is expected as a result. The lesson achievement dimension includes the achievement of different types of information (phenomenal, procedural, etc.). Nevertheless, when the design is regulated in the form of a group study, it also includes the achievement of skills such as taking responsibility, positive solidarity and commitment, and the ability to express one's thoughts. In the achievement of information, it is especially aimed to expand the information specific to a field, make an association with different fields, and make information in a particular field deeper by using materials, etc. Another learning target is the achievement of social skills. Here, it is especially aimed to develop social skills by such means as learning to discuss, respecting the thoughts and opinions of other people, and learning to think critically and give feedback.

The task features component qualifies the tasks given by the teaching staff to students to achieve their learning targets and contains the decisions on the activities that students should carry out. These activities are explained by the teaching staff before the beginning of practices. The activities in question may include tasks at different levels from a simple research study to the development of a project. Nevertheless, regarding the features of the tasks, it should be emphasized that they encourage students to make discussion and exchange opinions about the ideas and experiences, they can be associated with original and daily life, and they are suitable to the levels and common work.

The component of linking theory to practice generally qualifies the practice process in which procedures take place, and includes how the subjects explained in the theoretical lesson are transformed into activity by students during the practice hour, and the operational procedure and application of the activities. In these application activities, cooperating has been considered as the first central concept. Therefore, the dimension of emphasizing good cooperation rules and conditions, structuring the cooperation by teaching students on cooperation skills or the cooperation process, and reflecting these on practices are covered by the component of linking theory to practice. The second central concept is the operational procedure of IGA to be performed in practices. What is meant here is that possible activities include the fact that the subject both requires the content knowledge, i.e. theoretical knowledge, and its practical application/applications. In the process of linking theory to practice, the teaching staff contributes to the stimulation of students' curious attitudes and creating ideas about the content.

The guidance component explains the guidance, coaching, and support provided to students by the teaching staff during the whole design process. This guidance is not the guidance performed only before the beginning of practices, but it includes permanent guidance activities aimed at performing the tasks given each week. The guidance includes the ability to make students face their behaviors or mistakes and supporting their mutual harmony. At the same time, together with verbal guidance, when needed, it also includes bringing together experts and students and hardware guidance such as the ability to use the right search engines on the internet regarding the search for any subject, or providing tools

for any laboratory experiment. The first part of the group structuring and interaction component means the group composition in addition to the group size. Therefore, information such as the number of individuals in a group, homogeneous/heterogeneous structure, and what will be taken into consideration for heterogeneity is included in this component. Moreover, the process of cooperation in which students try to achieve their learning targets, i.e. interaction, is another part of this component. The interaction addressed here is multi-dimensional interaction. This interaction includes interaction between students and their friends in the group, interaction with other group members in the classroom, and interaction/cooperation between students and the instructor. In the group, there are sub-components such as especially sharing the information on the method/subject learned in the theoretical lesson, dividing the tasks and responsibilities, giving feedback on one another's behaviors and supporting providing help to each other. Moreover, the questions of the teaching staff on how they personally contribute to cooperation and collective product to get information about the project are among the features of the group structuring and interaction component.

The assessment and feedback component is about the measurement procedures used for evaluating the access to learning targets and group activities that combine theory and practice. The feedback consists of peer assessment feedback provided by both the teaching staff and classmates. The component of assessment and feedback does not include focusing only on the product, but also on the mutual working process. The main problem of the study was expressed as "What are the opinions of pre-service science teachers on IGA?" The sub-problems related to this problem are as follows: (1) What are the opinions of pre-service science teachers on the effects of IGA on their professional development?, (2) What are the opinions of pre-service science teachers on the fact to which area/areas (e.g. professional development, social development, etc.) IGA contributes most?, (3) What are the opinions of pre-service science teachers on the positive and negative aspects of IGA?, (4) What are the opinions of pre-service science teachers on the effects of IGA on their knowledge?, (5) What are the opinions of pre-service science teachers on the level of difficulty of IGA?, and (6) What are the opinions of pre-service science teachers on the states of having problems during the process of preparing and carrying out practice activities?

2. Method

The research is a qualitative study conducted on pre-service teachers studying in the Science teaching program of a middle-sized university in the Aegean Region of Turkey. According to Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz, and Demirel (2008), some of the most basic features of qualitative studies are direct data collection, making rich descriptions, being process-oriented, the fact that participants reflect their viewpoints, and flexibility in research patterns. It can be said that the study has qualitative features since the data are collected directly, descriptions are made, and it is important to reflect the viewpoints of the participants in this study. This study was conducted in phenomenology design. According to Stamouli and Huggard (2007), in phenomenography research, one can identify how key concepts are understood by the learner. In other words, phenomenology seeks reality in individuals' narratives of their experiences of and feelings about specific phenomena to produce in-depth descriptions of these phenomena (Cilesiz, 2011). In this study, the phenomenography research design was used since it was aimed to determine pre-service teachers' opinions on instructional group activities by using their experiences and to develop a deeper understanding by revealing what they mean for them.

2.1. Participants

The participants of the study consist of 56 pre-service third-grade elementary school teachers studying at the Faculty of Education. The participants in question were purposefully selected among third-grade students since the Special Teaching Methods-I course is taught at this grade level. Moreover, purposeful sampling was used since there was an obligation to reach individuals with experience on the subject to be examined in the study. In conclusion, the selection criteria can be listed as having participated in the IGAD application, having received or receiving the course Special Teaching Methods I, studying in the third grade, and volunteering to participate in the study. 53.6% (n=30) of the pre-service teachers are female, and 46.4% (n=26) are male (Table 1).

Table 1. *Participants' profile*

Gender	f	%
Female	30	53.6
Male	26	46.4
Totally disagree	56	100.0

2.2. Data collection

An opinion form that consists of closed-ended and open-ended questions that aim to determine certain demographic features and opinions of pre-service teachers on IGA was used in the study. Opinion questions are those questions that aim to determine what an individual thinks about a particular subject at a particular time (Balcı, 2007). The questions of the opinion form were created by reviewing the literature and taking the opinions of experts. The components of the IGAD and the determination of the pre-service teachers' general perceptions of IGA were specifically taken into consideration in the preparation of the questions. Therefore, the first one of the questions asked to the pre-service teachers is about the benefits of IGA in terms of professional development. This question is closely related to the "learning targets and outcomes" component of the IGAD; it questions whether the desired learning outcomes are achieved and aims to investigate the opinions of pre-service teachers in terms of ensuring the aim of increasing professional development, which also constitutes the basis of the design. Another question is related to the first one, and it aims to investigate the area/areas to which IGA contributes most. As it is also expressed when explaining the component of learning targets and outcomes, the aim is not perceptional information achievement, but many professional and social outcomes are aimed. In this context, it is aimed to both determine this outcome of IGA and reveal the general perceptions of pre-service teachers with this question mentioned. Based on the fact that the activities carried out may have positive aspects as well as negative ones, the opinions of pre-service teachers on the positive and negative aspects of IGA were asked in the next question. Another design target is to ensure that pre-service teachers can combine their content knowledge and certain application skills. This makes up the "linking theory to practice component" of the IGAD. In this regard, it was thought that IGA would also contribute to the content knowledge of pre-service science teachers. Another question asked to pre-service teachers is related to finding their opinions on the effect of IGA on their content knowledge. Nevertheless, another aspect that should be understood is the difficulty perceptions of pre-service teachers of IGA and whether they have any problem in the process. Therefore, the other two questions asked to pre-service science teachers are related to this, while the first one was arranged as a close-ended question, and the second one was arranged as an open-ended question to understand the reasons. Consequently, it can be said that the questions in the data collection tool were

generally designed to collect in-depth information on the thoughts and assessments of pre-service teachers regarding the effects of IGA.

2.3. Procedures

It can be stated that the IGAD consists of three basic components. These are as follows: (1) Certain main elements to which the Council of Higher Education (2007) that is responsible for raising teachers in Turkey attaches importance regarding teaching training, (2) the application and content structure of the lesson, (3) the program development designs and teacher training policies in the literature. Regarding the first one, the Council of Higher Education says the following about the application of curricula at the faculties of education:

> "…in the implementation of the programs, it is important to start from the experiences first and then achieve the concepts and definitions as a requirement of the constructivist philosophy of new primary school programs. On the other hand, the association of the course subjects with the curricula prepared by the Ministry of Education for the relevant level and enriching them with real-life examples are the other elements to be taken into consideration." (CoHE [YÖK], 2007; p.10)

In the design developed by taking into consideration the elements in question, pre-service teachers were asked to plan and implement their own activities under the guidance of the teaching staff to get the first-hand experience and start from their experiences. Furthermore, the subjects were selected among the 4th, 5th, 6th, 7th and 8th-grade level science subjects in the weeks that fitted the method in order to associate the course subjects with the curricula prepared by the MoNE (Ministry of National Education [MEB]) for the relevant level. In addition to this, pre-service teachers were asked to use cases, materials, posters, scenarios, projects, etc. that would associate science subjects with daily life in accordance with the teaching methods and subjects in the theoretical lesson.

It should be noted that this course, i.e. Special Teaching Methods I, was selected specifically for the implementation and content structure of the lesson, which is the second component. This course is an obligatory course that consists of two hours of theory and two hours of practice. In the course description of the lesson, "science teaching, the main objectives of science teaching, science literacy, concept teaching (misconceptions, mind maps, concept cartoons, V diagrams, etc.), methods and materials used in science teaching, examination of the science and technology curriculum implemented in 4-8th grades (themes, achievements, learning situations, assessment techniques, etc.), examining and assessing course, teacher and student books" take place (CoHE, 2007). In this context, the subjects in the course description of the lesson were taught by the teaching staff (the first author of the study), while the pre-service teachers were asked to apply the activities (in a group work) they prepared within the scope of the task plan of the content taught for that week (e.g. preparing a mind map on different science subjects in the week for mind maps, preparing caricatures in the form of posters and worksheets in the concept cartoons week, etc.).

The program development designs and studies on teacher training in the literature were investigated for the third component that was taken as a basis for the development of the IGAD, and these were used. Although many studies were examined, it can be said that the studies by De Hei, Sjoer, Admiraal and Strijbos (2016) and De Hei, Strijbos, Sjoer and Admiraal (2016) on group learning activities, and especially the studies by Hennissen, Beckers and Moerkerke (2017) aimed at linking theory to practice in teacher training were used, and these studies were accepted as guides.

2.4. Data analysis

The conventional content analysis was used in the analysis of the opinion form questions used to determine the opinions of pre-service teachers on IGA (Hsieh & Shannon, 2005). In the conventional content analysis method, coding categories are derived directly from text data differently from the directed content analysis and summative content analysis. The conventional content analysis was used in this study since the texts containing the answers given by pre-service teachers to the questions related to their opinions on IGA were taken as a basis, and a previously created theory or research finding results were not used as initial codes. Certain stages were created in the study by taking the study by Hsieh & Shannon (2005) as a basis, and the content analysis was performed by applying these stages respectively when performing the analyses. The stages are as follows: (1) performing a general reading of the whole data to see the overall meaning, (2) reading the data word-by-word to get a grasp of the main ideas and concepts (starting to derive the codes), (3) starting to take notes about the text (the researcher creates codes especially by using the words written by the participant). In this process, the researcher codes the remaining interview papers by using the pre-codes created after coding 3-4 interview papers and adds new codes when he/she encounters data that do not fit an existing code), (4) reviewing the data after coding all interview papers and combining certain codes in this process, dividing some of them into sub-categories (the categories are used to organize and group the codes in meaningful clusters), (5) completing the analysis by examining the final codes to turn the results into a hierarchical structure. Performing analyses, coding and creating themes in the study can be explained upon an example as follows: One of the questions asked to the pre-service teachers was 'What do you think about the educational group activities carried out during the period? Assess them in terms of positive and negative aspects.' All student answers to this question were read to see the overall meaning, and then they were reread individually. Notes were taken to create codes for student answers in rereading. One example of the student answers to this question is as follows: 'The activities were good. We had some time-related restrictions. There was not a big problem in the applications. I think a lesson should be like this (Student 1)'. The words 'good activities', 'time restriction' were noted for this answer. After all similar student answers to the question were coded, the appropriate ones were combined. The codes were combined using other similar student answers, and the code 'Good/ perfect/ enjoyable activities' was created. This code was then presented under the 'positive opinions' theme. The 'time restriction' code was placed under the 'negative opinions' theme. A similar application was repeated for all interview questions.

In this study, the analysis results were presented and tabulated as frequency and percentage frequency values. In addition to this, the data analysis was performed by the author of the study twice (at one-month intervals) to increase the reliability of the study, and the consistency between these codings was calculated. The percentage of concordance was examined by comparing the numbers of repeating the codes for each open-ended question (Miles and Huberman, 1994). For both codes, the percentage of concordance was found to be 0.89 as the average of all questions. Furthermore, the process of creating an analytical procedure consisting of 5 stages before the analyses and performing the analyses has a positive effect on the reliability and validity of the study. The examples of the student answers were given in the study together with the content analysis results. The real names of the students were not used when giving these examples, and the students were coded as "Student 1", "Student 2", …. instead of this.

3. Findings

One of the main objectives of the IGAD is to increase professional development as mentioned before. Therefore, the determination of the views of pre-service teachers on the subject was found to be important as a priority. In this context, it was primarily aimed to take the opinions of pre-service science teachers who had IGA experience on the effects of these activities on their professional development. The statement that makes up one of the closed-ended questions asked to pre-service teachers in line with this target is as follows: "I believe that these practice activities we carry out in the Special Teaching methods-I course are beneficial in terms of professional development." The opinions of pre-service science teachers on this proposition are presented in Table 2.

Table 2. *Opinions of pre-service science teachers on the benefit of IGA in terms of professional development*

Codes	n*	%
Totally agree	45	80.3
Agree	10	17.9
Partially agree	1	1.8
Neither agree nor disagree	0	0.0
Disagree	0	0.0
Partially disagree	0	0.0
Totally disagree	0	0.0

n: refers to the number of pre-service teachers. In the study, all numbers shown with the letter "n" express the number of individuals.

As can be understood from Table 2, it can be observed that almost all of the pre-service science teachers who participated in IGA found the activities in these practices beneficial in terms of their professional development. 98.2% (n=55) of the pre-service teachers in total answered this question as "totally agree" and "agree." There was no pre-service teacher that answered it negatively.

Another question asked to the pre-service teachers is as follows: "To which area/areas (e.g. professional development, social development, etc.) do you think the educational group activities you have performed throughout the period will contribute most?" The opinions of the pre-service science teachers on the area/areas to which IGA contributes most are presented in Table 3.

Table 3. *The opinions of pre-service science teachers on the area/areas to which IGA contributes most*

Codes	f*	%**	Examples of Student Opinions
To the area of professional development	50	56.3	It contributed mostly to my professional development. Apart from that, it was nice to create a product with the group. I learned to respect the thoughts. I could express my opinions better when talking about the things that I don't like (Student 14).
To the area of social development	14	15.8	
To the development of content knowledge	5	5.6	
To the development of the ability to make criticism/critical thinking	5	5.6	
To the field of personal development	3	3.5	It contributed to my professional development, social development, and mostly self-development because you cannot get to know yourself before taking a responsibility; you may only learn what you can do, your rights and wrongs when you are given a responsibility (Student 26).
To the psychomotor development area	2	2.2	
To the development of the self-assessment skill	2	2.2	
To the field of creativity	2	2.2	
To the development of the self-expression skill	2	2.2	
To the development of interpersonal communication	2	2.2	The most important thing is professional development, which is followed by personal development and social development (Student 6).
To the development of the skill of taking responsibility	2	2.2	

f*: It is the frequency of the opinions stated by the pre-service science teachers. In other words, each student may have given more than one opinion on the question. Therefore, the sum of the frequencies in question means the frequency of opportunities and not the number of students in the study. This also applies to tables no. 3, 4 and 6 in the study.

%**: The frequency percentage of the opinions stated by the pre-service science teachers. This also applies to tables no. 3, 4 and 6 in the study.

As can be seen from Table 3, the participants of the study made an evaluation that IGA has positive effects on different fields and stated that it contributes to these fields. According to the pre-service teachers, the biggest contribution is made to the professional development area (at a frequency of 56.3%, f=50) and social development area (at a frequency of 15.8%, f=14). Furthermore, pre-service science teachers believe that IGA contributes especially to the content knowledge development and critical thinking skills.

Furthermore, the opinions of the pre-service science teachers that were not included in the table since their answers to this question in the opinion form were repeated only once are as follows: "To the field of self-development," "To the field of self-confidence development," "To the development of the skill of being programmed," "To the field of participating in group works," "To the development of laboratory skills."

Another question asked to the pre-service teachers is "What do you think about the educational group activities carried out during the period? Assess them in terms of positive and negative aspects." The opinions of the pre-service science teachers on this question are presented in Table 4.

Table 4. *Opinions of pre-service science teachers on the positive and negative aspects of IGA*

Theme/ Category	Codes	f	%	Examples of Student Opinions
Positive opinions	Effective/meaningful learning	8	10.1	The activities were good. We had some time-related restrictions. There was not a big problem in the applications. I think a lesson should be like this (Student 1). Practice activities are necessary for learning the subject. They contributed to me a lot in professional terms, in terms of creativity. However, I think it would be better if this lesson was in second grade. To me, third grade is just a year for homework, and we made a great effort to complete the lessons, projects, and homework we have. Although taking such an extensive course in the most intense year and having time restrictions have made us exhausted in terms of completing the practices, one of the reasons for my becoming successful in this course and learning the lesson is certainly practice studies (Student 15). To me, the activities were definitely perfect. They affected me positively because performing such activities was what I wanted for my development at the end of the fifth period. I got this chance with this lesson. I did it gladly. I can say that it made me love my field even more (Student 5).
	Ensuring permanence/permanent learning	7	8.9	
	Good/perfect/enjoyable activities	7	8.9	
	Contribution to content knowledge/love	7	8.9	
	The development of critical skills	5	6.3	
	Ensuring the transfer of what is learned in theory to practice	5	6.3	
	Contribution to professional development	4	5.1	
	The development of creativity	4	5.1	
	Gaining experience	4	5.1	
	Developing imagination	3	3.8	
	Ensuring learning by doing/applying	3	3.8	
	Ensuring the exchange of ideas	3	3.8	
	Ensuring the mastering of the subject	3	3.8	
	Good group works	3	3.8	
	Learning from peers	2	2.5	
	Learning associated with everyday life	2	2.5	
	Contribution to social skills	2	2.5	
Negative opinions	Time restriction	3	3.8	
	The difficulty in preparing a report/doing practice each week	2	2.5	
	Experiencing a difference of opinion with group students	2	2.5	

As can be seen from Table 4, while pre-service science teachers expressed many (at a frequency of 91.1%, f=72) positive opinions on the educational group activities they performed during the period, they expressed very little (at a frequency of 8.9%, f=7) negative opinions. As for the positive opinions of the pre-service teachers, it is understood that they emphasized especially effective learning and expressed an opinion that IGA ensures permanence in learning and contributes to content knowledge. Some (at a frequency of 8.9%,

f=7) of the study participants referred especially to the structure of the activities in positive opinions and defined the activities in question as good, perfect, and enjoyable. Another aspect that is emphasized in positive opinions is skill achievements. The skills that are specifically emphasized by pre-service teachers are critical thinking (at a frequency of 6.3%, f=5), creativity (at a frequency of 5.1%, f=4), and imagination (at a frequency of 3.8%, f=3). As for the negative opinions of the pre-service science teachers on IGA, the most remarkable opinion is the time constraint (at a frequency of 3.8%, f=3), this is followed by the difficulty in preparing a report or doing practice each week, and a difference of opinion with the friends in the group.

Moreover, the answers given by the pre-service teachers to this question in the form categorized as a "positive opinion" but not included in the table since they were repeated only once are as follows: "Contribution to research skills," "Learning how to develop suggestions of solution to the problem," "Gaining cognitive skills," "Learning to respect group members," "Learning to be open to new ideas," and "Ensuring self-recognition." As can also be understood from the answers given, these pre-service teachers also made positive assessments of IGA. Again, an answer to this question that was categorized as a "negative opinion" but that was not included in the table since it was repeated only once is as follows: "Being criticized much by the friends in the classroom."

One of the open-ended questions asked to the pre-service teachers is "Do you think that the practice activities in this course affect your content knowledge? Why?/How?"

48 (85.8%) individuals in total answered the first part of this question positively with the answers "Yes, it affected positively (n=36)" and "I believe that it affected positively (n=12)". 7.1% of the pre-service science teachers gave the following answers by adding certainty to their positive assessments: "It definitely affected me positively (n=2)" and "It definitely affected, positively (n=2)". At the same time, 7.1% of the pre-service teachers in the study gave answers that can be regarded as negative: "It affected me partially positively (n=2)", "It affected me in a way (n=1)", and "No, I don't think so (n=1)".

The opinions of the pre-service science teachers regarding the second part of this question, i.e. the questions "Why?/How?" in terms of the effects of IGA on their content knowledge are presented in Table 5.

Table 5. *Opinions of pre-service science teachers regarding the effects of IGA on their content knowledge*

Theme/ Category	Codes	f	%	Examples of Student Opinions
Curriculum knowledge	Since I am knowledgeable about the subjects specific to my field	12	15.0	Yes, I think that it affects my content knowledge positively. When doing some works (e.g. a V diagram), I have realized that I have misconceptions. In the learning circle, I have learned to integrate the information in the science lesson into life (Student 25).
	Since I review the subjects in the field when preparing an activity	5	6.3	
	Since I am knowledgeable about the subject content of the course books	5	6.3	
	Since I am knowledgeable about the achievements and learning areas specific to my field	5	6.3	
Research/ scientific activity knowledge	Since the practices are based on our content knowledge	12	15.0	I think that it affects my content knowledge positively because the practices were carried out based on our content knowledge. It enabled us to add new information to our content knowledge (Student 1).
	Since I learn through practices	8	10.0	
	Since it requires us to do research related to the field	5	6.3	
Student knowledge	Since it provides permanence to my knowledge	6	7.5	It affected our content knowledge positively because all of our practices were related to the course books in our field (Student 40).
	Since I work on the deficiencies I realize in the practice	3	3.7	
	Since it enables me to realize my misconceptions	3	3.7	
	Since it eliminates/corrects my misconceptions	3	3.7	
	Since it reinforces/develops my knowledge	2	2.5	
Knowledge of teaching methods	Since I am knowledgeable about the methods specific to my field	5	6.3	It positively affected our content knowledge. We recalled a lot of missing information when preparing our projects. We learned the subjects of the 5th, 6th, 7th, and 8th grades and tried to prepare suitable activities for them (Student 43).
	Since the examples of methods specific to the field given in the course stuck in our minds	2	2.5	
Knowledge of measurement and evaluation	Since I have learned alternative assessment methods	2	2.5	It positively developed our creativity and hand skills rather than our content knowledge (Student 11- who said no).
	Since I make a self-peer assessment	2	2.5	

As can be understood from Table 5, pre-service science teachers revealed that IGA has important effects on their content knowledge in different ways. Certain themes were achieved by examining the codes of the answers given by the pre-service teachers to this question. The theme with the most repeated opinions among these is the theme of "curriculum knowledge." The most repeated code under this theme was expressed as "Since I am knowledgeable about the subjects specific to my field" at a frequency of 15% (f=12). Furthermore, it is observed in this theme that pre-service teachers said that IGA affects their content knowledge through their becoming knowledgeable about the subjects in their field, the content of the course books, and achievements and learning areas when preparing the activities. In the research/scientific activity knowledge theme, pre-service teachers especially emphasized that the practices should be based on content knowledge that they learn in this way and they should conduct research when doing this. The pre-service teachers that took part in the study gave student knowledge examples with such answers as ensuring the permanence of the knowledge (f=6) and becoming aware of misconceptions (f=3) and correcting them (f=3). Apart from this, the most repeated answer by the pre-service science teachers in the theme of teaching methods is to be knowledgeable about the methods specific to the field (f=5). The theme that makes up the opinions of the pre-service teachers regarding the question of the contribution to the content knowledge apart from this is the measurement and evaluation knowledge theme. As can be understood from this theme, some pre-service teachers reported knowledge about self-peer assessments (f=2) in IGA and the alternative measurement evaluation and assessment methods used in the practices (f=2) and associated this with the content knowledge.

Moreover, the answers given by the pre-service teachers to the "why/how?" part of this question in the opinion form but not included in the table since they were repeated only once are as follows: "Since it concretizes abstract information," "Since it enables me to associate the subjects with daily life," "Since the unique examples given in the lesson reinforce our knowledge," "Since I develop my knowledge with creative ideas," "Since it shows the applicability of the information," "Since it makes me understand the value of information," and "Since my self-confidence increases."

Another closed-ended question asked to the pre-service science teachers is as follows: "State your opinion about the level of difficulty of these practice activities we have performed in the special teaching methods course." The opinions of the pre-service science teachers regarding the level of difficulty of IGA in relation to this question are presented in Table 6.

Table 6. *Opinions of pre-service science teachers on the level of difficulty of IGA*

Codes	n	%
Very easy	1	1.8
Easy	16	28.6
Hard	37	66.1
Very hard	2	3.5

As can be seen from Table 6, more than half of the pre-service science teachers (66.1%) qualified IGA as "difficult." Contrary to this, 28.6% of the pre-service teachers reported that these activities performed in the Special Teaching Methods-I course are easy.

Another subject that is tried to be determined is whether pre-service science teachers have any problem during the process of preparing and performing practice activities. Another

question asked to the pre-service teachers in this context is as follows: "Did you have any problem during the process of preparing and performing practice activities? If "Yes," what?"

42 (75%) of the pre-service science teachers answered the first part of the question as "yes," and 14 (25%) answered it as "no." The opinions of the pre-service science teachers on the "What?" part of the question, regarding what kind of problem or problems are experienced during the preparation and realization part of IGA, which is the second part, i.e. continuation of the question, are as shown in Table 7.

Table 7. *Opinions of pre-service science teachers on the situation of having problems during the preparation and realization process of IGA*

Theme/ Category	Codes	f	%	Examples of Student Opinions
Group-based problems	The failure of group members to meet regularly	9	14.6	Finding new things was difficult. We were asked to do a lot of research. Sometimes problems were experienced in terms of gathering all group members (Student 17).
	Group problem (without any explanation)	8	13.0	
	The failure of group members to perform their duties	6	9.7	
	The problems of sharing tasks among group members	3	4.8	
	The implementation of the ideas of dominant individuals in the group	3	4.8	Yes, we had some problems. These are problems generally caused by our group members. We also had "time" problems. There were restraints at a time when we had homework in other lessons (Student 28).
	Intra-group differences of opinion	2	3.2	
	Intra-group clashes/conflicts	2	3.2	
	Communication problems with group members	2	3.2	
Time-based problems	Time restraints	15	24.3	
	The difficulty of doing research/homework every week	2	3.2	
	The long duration of preparing an activity	2	3.2	Yes. Sometimes the duration was felt restricted. Sometimes, I had difficulty in finding creative and unique practices (Student 54).
Activity/practice-based problems	Difficulty in creating unique products	3	4.8	
	The difficulty in finding materials/tools	3	4.8	
	Difficulty in finding original/creative ideas	2	3.2	

Upon examining the opinions of pre-service science teachers on the situation of having problems during the process of preparation and realization of IGA, it is observed that most of them (75%) have certain problems. When these problems are grouped, it is observed that they are mainly gathered under three categories. These categories are "group-based problems" that

include certain problems brought about by working together with the group, "time-based problems" regarding the pre-service teachers' obligation to spend important time, and "activity/practice-based problems" that include certain problems related to the structure of activities or practices. Upon examining group-based problems, it is observed that problems related to the failure of group members to meet regularly (14.6%) and problems related to the failure of group members to fulfill their responsibilities (9.7%) are at the top of the list of most important problems. 24.3% of the pre-service science teachers have time-related problems in their IGA. Moreover, some pre-service teachers (4.8%) stated that the stage of preparing activities is very long. At the same time, some pre-service teachers (12.8%, f=8) said that they experienced activity and practice-based problems and explained this by associating especially with having problems during the process of creating products, having problems in finding tools, and having difficulty in finding creative ideas.

4. Discussion and conclusions

Since the classroom environment in Turkey requires much more than theoretical knowledge can give, it is observed that even pre-service teachers with adequate methods and content knowledge experience difficulty in putting their knowledge into practice (Şen, 2009). Therefore, it is quite important for pre-service teachers to carry out educational activities that will allow them to put their theoretical knowledge into practice, develop their content knowledge and create their own ways of learning-teaching-thinking. In this context, an educational group activity was designed in the present study, and it was aimed to evaluate its results in the context of their opinions.

It is quite an important result that almost all of the pre-service teachers have reported an opinion that IGA is beneficial in terms of professional development. This situation that can be presented as a proof showing the power of design can be interpreted as the fact that small-group studies based on experience and active learning can be used especially in method lessons. Furthermore, considering the assessments of the pre-service science teachers regarding to which area IGA contributes most, more than half of them (at a frequency of 56.3%, f=50) stated that this contribution is made to their professional development. This result is important in two aspects. Firstly, it is necessary to note that one of the objectives of the development of educational group activities in which pre-service teachers participate is to contribute to increasing the teaching skills of pre-service teachers. In this case, it can be said that the IGAD developed for the study is effective, and its aim of development was achieved to a large extent when the results obtained from the opinions of the pre-service teachers are interpreted. Secondly, it can be said that the belief of the pre-service teachers that IGA increases their professional development most will also increase their level of professional awareness/consciousness (here, awareness/consciousness was used with the meaning of "the belief and awareness of any teacher of the way of how and by which means to teach in the classroom environment regarding their field"). This is very important in many aspects. Especially when the close relationship between professional awareness and future educational practices and professional identity development is taken into consideration, it can be stated that the experiences gained will provide them ease in their professional lives and act as a catalyst in their practice-based activities. According to Weiland, Hudson, and Amador (2014), studies show that the professional awareness/consciousness skill can be learned early and the teaching experience has the potential to support development further together with the constant professional development. The study by Ucar and Sanalan (2011) shows that the understanding of pre-service teachers regarding high-quality science teaching is created by teacher's training programs. Therefore, it can be expressed that it is necessary to ensure that pre-service teachers gain experiences with similar educational designs in science teacher training programs, whereby increasing their professional awareness and developing their

understanding of science teaching. The second most repeated opinion of pre-service teachers regarding the area to which IGA contributes most is the social development area. This can be associated with the working of pre-service teachers in small groups in IGA. Furthermore, as it is clearly specified in the "learning targets and outcomes" component of the IGAD, another learning target of the design is the achievement of social skills. This component aims to develop social skills through such means as learning to make discussions, respecting each other's thoughts and opinions, critical thinking, and giving feedback. In this case, it can be said that the opinions of pre-service teachers that IGA contributes to the field of social development with important achievements brought about by group work are shaped, and consequently, it is revealed that another target of the design is expected.

According to the pre-service teachers, the most positive aspect of IGA is that it ensures effective/meaningful learning. This result is quite significant because effective/meaningful learning is a pre-condition for the realization of conceptual understanding in science teaching. The findings of the study by Avraamidou (2013) have shown that the meaningful learning-teaching experiences obtained by pre-service teachers in their courses at the university show that they perceive them as critical in shaping their science teaching tendencies. According to the author, these experiences are especially affected by inquiry-based studies, contemporary theoretical discussions, open-air field studies, good-humored classroom environment and its features, and teachers. These findings support making and using teacher training lesson designs that aim to support pre-service science teachers in including them in meaningful learning experiences. Furthermore, according to Wilson and Kittleson (2012) who stated that it is hard to plan meaningful science learning, one of the most significant aims of science teacher training programs is related to meaningful science learning/perceiving science. In this case, the fact that the pre-service teachers expressed their opinion that IGA ensures meaningful learning at this frequency can be interpreted as the fact that it also serves the objectives of science teacher training programs.

Another most repeated opinion by pre-service science teachers on the positive aspects of IGA is that it ensures meaningful learning. Furthermore, the pre-service teachers associated one of the reasons for the contribution to their content knowledge in the question that asks them to make an assessment on the effects of IGA on their content knowledge with ensuring the permanence of their knowledge. In this case, one of the most important effects of IGA according to the pre-service science teachers that took part in the study is its contribution to meaningful learning. According to Özgür and Tosun (2012), ensuring permanent learning in students is one of the main targets of higher education just as in all curricula, and now learning has turned into a phenomenon that must last lifelong. In this case, it can be said that the positive opinions of pre-service teachers are very important, and they contribute to the realization of one of the main targets of higher education. Some of the participants that took part in the study defined the activities in question as good, perfect and enjoyable especially by referring to the structure of the activities in their positive opinions. Furthermore, more than half of the same participant group qualified these activities as "hard." This contradiction can be explained by individual differences of thought such as the level of participation into the activities in question, attitudes towards IGA practices, or the thought that the time spent in these practices is too much. Indeed, when the opinions of the pre-service teachers on the negative aspects of IGA were examined, time constraint and the difficulty in doing practice/preparing a report each week were expressed. According to de Saint Léger and Mullan (2014), the time spent on the tasks in group works and the workload are factors that should not be disregarded. The time factor may constitute a pedagogical obstacle for students that do not spend or wish to spend the time necessary to "discuss and apply" with group members. In this case, solutions, such as changing, increasing or making flexible the time

given to pre-service teachers according to the difficulty of the task in educational practices in which the workload is high, such as IGA, can be offered. Therefore, it may be a better option to make the time flexible in activity weeks with the high workload (such as project-based learning practice when pre-service teachers develop a project in this week) rather than performing a different activity each week necessarily. Thus, the time spent on the task will be correlated with the general weighting of the task (workload).

In science teaching, the subject content knowledge includes the substantive knowledge and syntactic knowledge about science knowledge, and extensive knowledge of how it is used for understanding the scientific practices of a discipline and developing scientific knowledge (Arias and Davis, 2017). In this context, while it can be said to what extent the content knowledge is important for performing the educational practices related to this field, on the contrary, the open relationship between IGA and content knowledge can be easily observed based on the fact that content knowledge is formed by understanding the scientific practices related to science. Therefore, one of the questions asked to pre-service science teachers on IGA is related to its effect on content knowledge. 93% of the pre-service science teachers believe that IGA affects their content knowledge positively and increases their content knowledge in different ways. Similarly, in the study carried out by Hennissen, Beckers and Moerkerke (2017) on the basis of a three-stage theory for the purpose of linking theory to practice in teacher training, the conceptual knowledge of pre-service teachers that makes up their content knowledge increased after the practices. Wilson and Kittleson (2012) stating that teacher trainers should encourage pre-service science teachers to get the science lessons that will help them build a solid content basis indicate that the insufficiency of their science content knowledge may lead them to use educational approaches that lack conceptual depth in classes they will teach in the future. As can also be understood from here, the applicability of the desired practical education approaches is closely related to the subject area knowledge. In this context, the opinions of pre-service science teachers regarding the effects of the activities applied on their content knowledge are of great importance.

Science teachers are expected to be knowledgeable about student learning, teaching strategies, the curriculum and evaluation, and most importantly, they are expected to arrange these components so that they ensure the meaningful learning of students (Aydın et al., 2013). The opinions of pre-service science teachers on why and how IGA affects their content knowledge are gathered exactly in the components expressed by Aydın et al. (2013). The themes of the opinions collected are curriculum knowledge, research/scientific activity knowledge, education methods knowledge, and measurement and evaluation knowledge. It can be said that the sum of these themes also makes up the content of pedagogical content knowledge. In the curriculum knowledge theme, pre-service teachers are of the opinion that their content knowledge increased thanks to their being knowledgeable about the subjects specific to their field, being knowledgeable about the content of the course books and being knowledgeable about the achievements and learning areas specific to their field. While they showed being knowledgeable about the methods specific to their field in the teaching methods knowledge theme as the reason, they showed learning the alternative assessment methods and making a self-peer assessment as the reason under the theme of measurement and evaluation knowledge. Considering all these results, it can be said that the pre-service science teachers had the opportunity to develop pedagogy with the content knowledge related to science through IGA and they had field experience in relation to this.

In the last twenty years, an increase occurred in the use of group learning activities in many professional programs and disciplines of universities. Nevertheless, the transition from individual learning activities to group learning activities has not been easy both for students and teaching staff (Wosnitza & Volet, 2013). Group work is to ensure that students produce

more complex level studies than they complete individually. In this process, peers learn from one another, they realize the gaps in their learning, express their knowledge and skills in relation with those of other people, and consequently, this is a privileged opportunity for them (de Saint Léger & Mullan, 2014). However, it is inevitable that problems are encountered in group studies. In this study, the pre-service science teachers stated that they experienced certain problems related to the failure of group members to regularly meet in IGA practices and the failure of group members to fulfill their responsibilities. The fact that some of the group members did not participate in the studies effectively may have led other group members to have problems by disappointing them. In a similar way, a series of negative problems regarding the past experiences of the pre-service teachers in relation to group works in subjects such as group management, communication, distribution of work, group dynamics, targets and the level of contribution of other group members to the study were reported in the study carried out by Volet and Mansfields (2006). In the studies carried out by the authors, the extent to which the personal targets of students are fulfilled also comes out as a factor that leads to the development of their current attitudes towards group studies. In this case, creating positive attitudes towards group studies can be regarded as an option by means of learning the expectations of pre-service teachers at the beginning of such educational designs that include intensive group studies and conducting discussions that will support creating their personal targets in relation to the lesson. Furthermore, it can be stated that taking the wishes of students into consideration rather than the efforts of ensuring heterogeneity in the process of creating groups may reduce such problems. On the other hand, it will be more accurate to bring solutions to group problems instead of giving up group studies in such educational practices. From the perspective of social constructivism, students learn better through interaction with one another in the group. According to Zedda, Bernardelli, and Maran (2017), who indicate that group studies increase both cognitive and social skills of students, the design of programs that include group studies will enable pre-service teachers to increase the efficiency of education and learn the professional skills that they can transfer to their students. In this context, it can be expressed that arranging practices such as active learning-based IGAD that incorporates the elements of reform-based science teaching and has the features of supporting professional development in the form of group studies by developing precautions that will solve the group problems will be both in compliance with today's learning theories and help pre-service teachers in gaining the desired teaching skills.

In teacher training, it is necessary to discuss any kind of professional development program, and even those with the most positive effects. Since the educational needs of students, the interaction between the expectations of education systems and their effects will be different, it is necessary to do research, try, discuss and think about professional development programs (Avalos, 2011). For this reason, although pre-service science teachers have quite important achievements according to the opinions of pre-service science teachers, IGAD should be applied at different universities and to different pre-service teachers, and the results should be discussed. Apart from this, it is important to apply the designs in question in practical lessons apart from special teaching methods and assess their results. According to one of the suggestions in the multi-dimensional study by Yücel-Toy (2015) in which the researcher performed the thematic analysis of pre-service teacher training studies in Turkey, studies on what the education process of special teaching lessons should be and how the structure of the lesson can be designed are also needed. In this context, discussing what to do to increase the effectiveness of IGA practices in the special teaching methods course or the thoughts and perceptions of students from which other dimensions may be investigated can be suggested. Furthermore, the outputs of the IGAD applied in the study were not compared with the outputs of the classroom environment in which no such application was made. In

this context, the outputs of IGA can be evaluated by comparing its results both qualitatively and quantitatively with an experimental and control group study in future studies.

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