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The Views of Prospective Teachers on The Science Spot Preparation Process*

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Abstract

Interdisciplinary science education is important for 21th century education. Design-based learning is recommended for science education, for technology and engineering integration. However, teachers' design-based science practices are insufficient. In this study, prospective teachers have developed science spot (public spot about scientific issues) that enables media integration into science education. The purpose of this study was to determine the views of prospective teachers about science spot preparation processes. The sample of this study executed as action research consisted of a total of 106 prospective teachers. As data collection tools a survey form and semi-structured interviews were used. The data were analyzed by content. The results showed that prospective teachers reported their positive views on the science spot preparation process and viewed themselves as competent and eager to develop and use science spots in science education. However, they had some concerns about implementation with the students in their classes.

Introduction

In the recent century, scientific ve technological studies increased very rapidly. Today's science is driven by increasingly complex problems and propelled by increasingly powerful technology (Foster, 2002). As a result of this situation, real life problems, their solutions, accordingly the expectations of individuals and society have changed. Individuals and especially professionals confronted with complex problems and need to challenge this problem with skills that named

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21th century skills such as problem solving, analytical thinking, creative thinking, innovative thinking, computational thinking, collbaration (Dede, 2010). The other result of this situation, disciplines are becoming less important, because the spread of various global challenges, like climate change, genetic ills and sub-disciplines like behavioral economics and evolutionary psychology emerged (Thrift, 2013). Countries and societies, that want to be in the forefront of scientific and technological progress, need professionals who have these qualities. Hayward (2016) stated that 21st-century workers require skills that many graduates do not acquire through formal education and students needs more experiences that provide in-depth knowledge of the STEM disciplines and apply to problem solving.

Primarily, educational studies are increased on to train individuals/students to become capable of dealing with such complex issues in both scientific and professional environments (Jacobson & Wilensky 2006; Roehler, Fear & Herrmann, 1998; Spelt, Biemans, Tobi, Luning & Mulder, 2009). In the National Science Education Standards reports of NRC (2005, 2011), it is emphasized that the education of individuals should include knowledge, skills, attitudes to solve real-world problems and the ability to keep up with the modern age. As a reflection of this case, research has been conducted related to the integration of different disciplines that are emphasized in the Technology, Engineering and Mathematics Education (STEM) approach that aims to raise the level of individuals in solving both regional and global problems concerning society as a whole (Çorlu, Capraro & Capraro, 2014; English & King, 2015; Lacey & Wright, 2009). Therefore, as a matter of fact, interdisciplinarity can help to address today's complex issues since it is believed that a cross-disciplinary approach facilitates a comprehensive understanding and increased interest in interdisciplinary education over the years and still continues increasingly. In interdisciplinary education aim to develop some skills for instance, the ability to change perspectives, to synthesize knowledge of different disciplines, and to cope with complexity (Spelt, et. al., 2009). The interdisciplinary education approach is clarified as the integration of technology, engineering (for STEM education) or others disciplines into science and mathematics curricula, which in effect removes the clear-cut boundaries in educational disciplines and creates an interdisciplinary learning environment via concept integration or content integration (Ramaley, 2007; Bybee, 2010; NGSS, 2013). It will provide individuals with sophisticated thinking about events, thus individuals will probe the understanding of science contents/concepts. Also, it will accelerate the solving of social problems (environment, energy, food, health etc.) (Labov, Reid & Yamamoto, 2010).

Despite the presence of science and mathematics as the focus of the STEM approach, in order for science education to reach its preliminary objectives, it is a requirement for science education to include a diversification of disciplines (Çorlu, et. al., 2014; Moore, Stohlmann, Wang, Tank & Roehrig, 2014, p.3). In the STEM education approach practices geared towards integration of disciplines, design-based educational approaches have been suggested in the integration of different disciplines to science education (Wendell 2008). Implementing design activities in science education facilitates learning of science concepts via design and reflects the acquired science concept that was better internalized through discussion onto varied situations or contexts (Cunningham & Hester 2007). In the STEM education approach practices geared towards integration of disciplines, design-based educational approaches have been suggested in the integration of such as engineering and technology disciplines to science education (Wendell 2008). Implementing design activities in science education facilitates learning of science concepts via design and reflects the acquired science concept that was better internalized through discussion onto varied situations or contexts (Cunningham & Hester 2007). In relevant literature a number of studies suggest design-based science activities that foster students' interactive engagement in the course and knowledge structuring by integrating multiple disciplines to designprocess.

Design based science activities inclued design process (ITEA, 2007). In relevant literature a number of studies suggest design-based science activities that foster students' interactive engagement in the course and knowledge structuring by integrating multiple disciplines to design proces (Aydın & Karslı-Baydere, 2019; Hacıoğlu, 2017; Karslı-Baydere, Hacıoğlu & Kocaman, 2019). One of them interaction desing process in contructivist education approach that have four main phases: planning, designing, testing, and sharing (Harel, 1991; Kaffai, 2005).

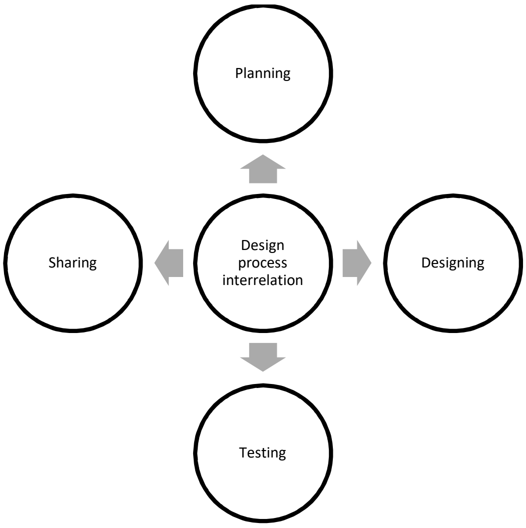

Figure 1. Constructionist design process (adapted from Harel, 1991; Kaffai, 2005)

One of the implementations related to the integration of different disciplines is the integration of technology in science education. In the Science Education Curriculum (SEC) in our country the integration of technology into the teaching process is emphasized. This emphasis is underlined as "developing awareness related to how science, society and technology affect each other"; "encourage how to appreciate contributions on developing science and technology, solving of social problems and understanding of the relationship with the natural environment" in the SEC's aims (MNE, 2013). Integration of technology into science education is used to form the Media Design Process (MDP) (Karahan & Canbazoğlu-Bilici, 2014, p. 95). The MDP enables teaching by utilizing technological tools and designing media products (Liu, 2003). The media design-based science education process consists of multi-media design activities directed to the target as real-life problem solving when students learn basic science concepts. One of the MDP's products is public service announcements (Karahan, Canbazoğlu-Bilici & Ünal, 2015). In this study, the term "science spots" is a product of integration of the MDP on science education. While learners are preparing science spots based on the MDP they will get information by inquiring (Newstetter, 2000), improve life skills such as creative thinking, reflective thinking and decision making (Lambert & McCombs, 1998; Bates, 2000) and positive attitudes on the interaction of science and other disciplines (Karahan & Roehrig, 2014). Moreover, they will be aware of science-technology-society and environmental issues. Also, they will take the opportunity to associate science concepts with daily life and so they will learn meaningful information (Gilbert, 2006). For these reasons, teachers who apply science spots have very important roles. In this context, it is important that teachers have experience about the adoption and implementation of science spots in their pre-service education because practical studies are accepted as effective activities for the acquisition of new knowledge and skills (Kocabaş, Durukafa & Gürses, 2000).

In the literature, it is also an acknowledged fact that prospective teachers are in need of guidance to implement the professional methods and techniques applicable to innovative learning approaches (Lemlech, 1995). Parallel to that, a range of studies validated the fact that teachers face challenges in the application of the professional and content knowledge they gained during undergraduate education (Yeşilyurt & Karakuş, 2011; Başkan, 2001). However, it is not known whether prospective teachers have any experience about the integration of MDP in science education or their views on it. It is believed that to know the views of prospective teachers on the science spot preparing process will shed light on future research that will promote the usage and adoption of science spots. The literature shows that research is limited about the integration of the MDP in science education so there is a need for research to set out the views of prospective teachers in detail.

The Purpose of this study

In the present study, by detecting prospective teachers' views on the use of science spot implementations as an outcome of integrating MDP in science education in learning environments an interdisciplinary approach that integrates multiple disciplines in learning environments has been adopted. It is thus our belief that the present research will contribute to the adoption of science spot implementations and increase its implementation fields in addition to shedding light on future research on the same subject. Based on these insights it is thus the purpose of this study to determine the views of prospective science and primary school teachers engaged in science spot presentation on MDP; science spot preparation processes; using the spots in science education and their suggestions for future implementers. In line with this main objective, the questions listed below have been posed:

- What are the views of prospective science and primary school teachers on the science spot preparation process?
- What are the views of prospective science and primary school teachers on the self-benefits they gained during the science spot preparation process?
- What are the views of prospective science and primary school teachers on the use of science spots in their professional life (in teaching)?
- What are the suggestions of prospective science and primary school teachers for the researchers and colleagues who will develop/implement science spots in the future?

Method

The methodology of this study was action research. Action research is a process used to attentively and systematically collect data and examine participants' educational practices such as the learning process and teaching method practices (Mills, 2007). In our study, implementation/mutual cooperation/discussion-focused action research has been utilized. In this type of action research, the researcher and implementers convene and cooperatively detect encountered problems in the implementation process alongside the liable factors and potential ways to solve the problems (Yıldırım & Şimşek 2008, p. 296). The use of action research in this study holds significance for the purposes of revising and processing the next action plan on the basis of detected or observed results in each stage. Additionally, this study provided an opportunity for prospective teachers to gain experience in the integration of media disciplines and science education in their respective fields. The research spanned one semester and consisted of the stages listed below:

1. Identification of the problems and research questions. In this stage, research questions applicable to the main objectives of the study were structured.

2. Action Research Planning. In this stage, the action research plan was devised to span one semester period (14 weeks). Researchers made their preparation about action in the first three weeks, guided prospective teachers in the second eight weeks for the preparation of science spots and collected/analyzed data and evaluated findings in the last three weeks.

3. Action Research Implementation. The research implementation process continued by following the stages of informing prospective teachers on MDP. That was followed by science spot preparation and presentations by prospective teachers. The stages were completed in the eight weeks as listed below:

Week I. Before the onset of the implementation process prospective teachers were questioned about whether they possessed any experience in the media-design process, its integration in science education and preparing public service announcements. It was then identified that none of the prospective teachers possessed the relevant experience. Next, prospective teachers received one course (50 min.) prepared by the second researcher to introduce the MDP utilized. MDP based on the constructivist learning approach consists of four stages: planning, designing, testing, and presenting (Harel, 1991; Kaffai, 2005).

Furthermore, public service announcement models developed by Karahan and Canbazoğlu-Bilici (2014) and public service announcement samples shared in the social media were presented to the prospective teachers. Prospective teachers were given an activity development form involving MDP. They were requested to follow the MDP in order to finalize science spots. The points to adhere to during the process of science spot preparation within the scope of this research were highlighted:

1. Preparing maximum one-minute science spots to provide brief information,
2. Collecting reliable data without excessive use of scientific information,
3. Avoiding using copyrighted visuals without permission,
4. Using reliable web sites with .edu, .gov, .org etc extensions.

Moreover, it was recommended that prospective science teachers could use computer animation software such as go animate, movuzi, animoto and pawtoon programs for preparing animation and photostage and iMovie, Adobe premiere, Final cut pro, movie maker, and easy video maker for video arrangements.

The moment they started preparing science spots, prospective teachers were encouraged to consult researchers, notify the researchers about the process and receive feedback from researchers throughout the process. In addition, prospective teachers were informed that they would be assisted in materials or tools and equipment to be used in the science spot preparation process.

Prospective teachers were asked to develop their science spots in the following eight weeks on the foundation of real-world problems/topics and acquisition/s specified in the Curriculum of Elementary Education Institutions (Primary Schools and Middle Schools) Science Course (3, 4, 5, 6, 7 and 8th grades). Prospective teachers were advised to be attentive in preparing their science spots to include the acquisitions related to the topic they chose.

Week II. In the planning stage of the MDP they completed their work schedule according to the topic they chose, including acquisition, target group, topic-related content information, the message they aimed to communicate via science spots, their scenarios, B plans and task allocation among group members up to the presentation stage.

Weeks III-V. During the design stage of the MDP, prospective teachers asked researchers' opinions as to whether the topics they chose were suitable for science spot preparation. Prospective teachers, on the basis of received feedback, started to execute their work schedule and spots. At this stage no limitation was put on prospective teachers about consultation hours and guidance was provided face-to-face or online. Prospective teachers in need were given technological tools/equipment aid and supported in their use. Prospective teachers were prepared for the shooting of science spots and on collecting technological tools/equipment and determining players and their roles, costumes and locations for shooting. They then shot their videos and prepared their animations or slideshows. They arranged their science spots using design programs.

Weeks VI-VII. In the testing and redesign stage of MDP, prospective teachers as a group initially re-watched their science spots and noted the points to revise. They asked assistance from researchers about the points to revise. Subsequent to conducting the required changes, the plans of science spots were put into final form.

Week VIII. In the presentation stage of the MDP, prospective teachers presented their science spots and shared the issues they paid heed to as well as their experiences with the other groups. They answered the other group members’ questions.

4. Data collection and analysis. At the end of implementation, in order to identify prospective teachers' views on the use of MDP in science education and science spot preparation, a survey form with open-ended questions alongside a semi-structured interview form were used. Obtained data were qualitatively analyzed and explained in detail.

5. Assessment and reflection. At the end of implementation, prospective teachers' views, suggestions and expectations about the implementation process were identified.

Participants. Participants in this study consisted of a total of 115 prospective teachers; 46 third grade prospective science teachers (PSTs) from the department of science teacher training and 69 third grade Prospective Primary School Teachers (PPSTs) from the department of primary school teacher training in a state university. Prospective teachers, having volunteered to participate in the research, were asked to form groups of a minimum of three and a maximum of six members. In composing their groups, they were advised to select group members with whom they could work in accord and to include at least one member with sufficient knowledge and skills in the use of technological tools/equipment. Group information of prospective teachers is displayed in Table 1.

Table 1
Group information of prospective teachers

Prospective teachers \ Number of group members	3	4	5	6	Group number	Total number of members
PSTs group number	1	4	3	2	10	46
PPSTs group number	1	5	8	1	15	69
Total group number	2	9	11	3	25	115

In this research survey forms containing open-ended questions were fully completed by 38 PSTs and 68 PPSTs. Research data were gathered from the answers given by 38 PSTs and 68 PPSTs to open-ended questions in the survey form.

Research Instruments and Procedures

As data collection tools a survey form with open-ended questions related to the science spot preparation process and a semi-structured interview form were used.

Questions in the survey and semi-structured interview forms were listed under three headings; experiences faced in the science spot preparation process applicable to MDP and the self-benefits prospective teachers gained by partaking in the process, dispositions of prospective teachers to using MDP in their professional teaching life and suggestions for future developers of science spots. The validity of the survey and semi-structured interview forms were authenticated by the views of three experts.

Completion of the survey forms took around 35-45 minutes among volunteering PSTs and PPSTs research-process participants. Semi-structured interviews were conducted by the first author of this research as focus group interviews. To determine focus group members, a voluntarily prospective teacher was selected from each of 25 groups and interviews were conducted in three sessions (10 PSTs, seven PPSTs and eight PPSTs). Because it was hard to execute focus group interviews with a sum of 25 groups, they were separated into three focus groups. Each session of focus group interviews lasted around 1-1,5 hours.

Data Analysis

Data collected from the survey form and focus group interviews were analyzed by content (Strauss & Corbin 1990, p. 62). Data were initially coded with (1) Open coding (Strauss & Corbin 1990). Next (2) for the same headings or topic-related codes a joint code, identical or related codes were collected under the same heading thus the themes were created (Yin, 1989). To ensure the reliability of research data (3), data were analyzed alternately by three different researchers. Next, the agreed and disagreed points among three researchers [Agreement-Disagreement]: [Agreement+ disagreement] *100 were computed via formula. Reliability values were measured as 0,91 for survey data and 0,87 for focus group interview data.

Since PSTs (N=38) and PPSTs (N=68) numbers were not even, the percentage of the frequency of statement of each code was calculated in order to compare the data.

In this research, to ensure the validity of results (4), we attempted to explain the theme formation process that structured data analysis process extensively. Also, for each code, direct quotations from the participants' statements in the survey and focus group interviews were shared (Merriam, 1988).

Results

Findings obtained from the views of PSTs and PPSTs on science spot preparation in line with the MDP are presented in parallel with sub problems.

Findings obtained from prospective teachers' views on the science spot preparation process

In this part the views of PSTs and PPSTs on science spot preparation are shared. Findings related to this sub problem are individually tabulated in line with the MDP.
In the survey and interview form of science spot developer prospective teachers, the findings related to their views on science spot planning process are shown in Table 2.

Table 2
The findings related to prospective teachers' views on the science spot planning process

Theme	Codes	Survey %		Interview %		Theme	Codes	Survey %		Interview %	
		PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)			PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)
Preparation-Planning	Delay	-	4,4	-	-	Scenario setting	Procuring right material	7,9	1,5	20	-
	Unawareness of the process	2,6	2,9	-	-		Consultant support	2,6	-	-	13,3
	Task allocation	7,9	-	-	-		Role distribution	7,9	1,5	20	-
	Population	7,9	-	40	13,3		Location choice	15,7	1,5	10	20
	Knowledge acquisition about spot shooting	7,9	-	-	13,3		Scientific information	-	-	10	20
	Failure to decide	5,3	25	-	-		Disagreement	-	-	10	-
Topic choice	Different opinions	5,3	16	10	26,6		Original product development	-	-	-	6,6
	Change of topic	2,6	5,8	-	-	Measures and B Plan	Task shift	-	-	20	6,6
	Adapting the topic to the spot	39	1,5	30	33,3		Asking for permission	-	-	10	6,6
	Topic-acquisition	-	13,2	40	33,3		Location change	-	-	20	26,6
	Acquisition-Science spot	-	13,2	-	-		Topic change	-	-	-	20
	Topic-related information	10,5	1,5	-	-		Lack of B plan	-	-	60	13,3
	Target group	5,3	-	20	66,6	Preparing work schedule	Setting a joint time	7,9	-	10	13,3
	Real world problem	-	-	-	40		Lack of a work schedule	5,3	-	10	6,6
	Pre-experience	-	-	-	26,6						

Table 2 indicates that as regards the science spot planning process, prospective teachers stated their views on the themes of “preparation-planning”, “topic choice”, “scenario setting”, “B plan”, and “preparing work schedule”. The highest frequency of theme was selected as “topic choice” in the code “adapting the topic to the spot” among prospective teachers. In the survey related to this code, PSTs shared a view at a 39% ratio as ("Since we chose a wide-scope topic, it was hard to constrain the topic to adapt to the spot (PST18)”). PPSTs shared a view at a 1,5% ratio as (“We had difficulty in identifying the kind of video to shoot for a particular topic (PPST16)”). In focus-group interviews PSTs shared a view at a 30% ratio as (“We had difficulty in connecting the spot with science concepts (PST10)”), PPST shared a view at a 33,3% ratio as (“We initially chose GDO’s dangers as the topic but then we constrained it as dangers for human health (PPST9)”). The least frequency of view was in the “delay” code of the “preparation and plan making” theme. In the survey related to this code PPSTs shared a view at only a 4,4% ratio as (“Because we started planning a little late, we could not work on it in detail (PPST16)”). In focus group interviews no view was shared on this code. Table 2 The findings related to prospective teachers' views on the science spot planning process.

In the survey and interview form of prospective teachers developing science spot the findings that demonstrate their views on science spot designing process are seen in Table 3.

Table 3
Findings that demonstrate prospective teachers’ views on the science spot designing process

Theme	Codes	Survey %		Interview %		Theme	Codes	Survey %		Interview %	
		PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)			PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)
Pre-Spot Preparation	Generating different opinions	7,9	1,5	-	-	Spot Shooting Process	Video shooting	5,3	1,5	-	-
	Location of video shooting	15,78	7,3	-	-		Location problem	5,3	2,9	-	-
Spot arrangement	Sound scheme	-	1,5	-	13,3		Spot content	10,5	7,3	-	-
	Timing	2,6	2,9	-	20		Disagreement	7,9	-	-	-
	Missing technical knowledge and skills	10,5	-	90	26,6		Role play	10,5	17,6	20	33,3
Spot development	Group work	-	-	-	6,6		Peer support	2,6	-	-	20

Table 3 shows that as regards the science spot designing process prospective teachers stated their views on the themes of “pre-spot preparation”, “spot arrangement”, “spot-development process” and “spot-shooting process”. The highest frequency of theme was selected as “spot arrangement” in the code “missing technical knowledge and skills” among prospective teachers. In the survey related to this code, PSTs shared a view at a 10,5 % ratio as (“We were going to create the video content on the computer but we did not know how to use computer programs (PST9)”) whilst PPSTs shared no view on this code. In focus group interviews PSTs shared a view at a 90% ratio as (“We had difficulty in procuring the programs to use for video shooting and arrangement. Because the language of the programs we received from our consultant was English it took some time to understand the program and start working (PST2.”), PPSTs shared a view at a 26,6% ratio as (“We were not competent in video arrangement (PPST10). The least frequency of theme was selected by prospective teachers in the “group

work" code of "the spot development process". In focus group interviews PPSTs shared a view at a 6,6% ratio ("Since we worked as a group we faced no difficulty (PPST11.").
In the survey and interview form of prospective teachers developing science spots, the findings that demonstrate their views on science spot testing and development process are as seen in Table 4.

Table 4
Findings that demonstrate prospective teachers' views on the science spot testing and development process

Theme	Codes	Survey %		Interview %		Theme	Codes	Survey %		Interview %	
		PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)			PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)
Role play	Message-gesture mimic synchrony	10,5	-	20	-	Spot content	Scientific content	21,05	4,4	30	-
	Failure to concentrate	7,9	-	40	13,3		Slogan	13,15	13,2	-	-
Technical issues	Disliking	-	4,4	-	-		Scenario change	-	2,9	-	-
	Sound scheme	7,9	8,8	50	13,3		Timing	-	4,4	20	26,6
	Video runs	15,8	7,3	10	-		Effectiveness	2,6	1,5	-	-
	Visual arrangement	7,9	2,9	10	6,6		Adherence to the plan	10,5	-	-	-
	Montage	2,6	2,9	20	6,6		Not needed	2,6	5,8	-	-
	Timing	-	1,5	-	-	Consultant support	Misleading message	-	2,9	10	-
	Model spot	5,3	-	-	-		Content	2,6	-	-	13,3
Instant testing	Synchronous shot and modification	-	-	10	-	Cooperation	Disagreement	7,9	5,8	-	-
							Peer	2,6	-	-	6,6

Table 4 indicates that as regards the science spot testing and development process, prospective teachers stated the challenges they faced on the themes of "role play", "technical issues", "spot content", "instant testing", "consultant support", and "cooperation". The highest frequency of theme was selected as "technical issues" in the code "sound scheme" among prospective teachers. In the survey related to this code, PSTs shared a view at a 7,9% ratio as ("There was a synchronization problem between image and off-voice. We tried to correct this problem (PST27)"). PPSTs shared a view at an 8,8% ratio as ("We had difficulty in adding background music (PPST11)"). In focus group interviews PSTs shared a view at a 50% ratio as ("Sometimes we found that off-voice was higher than the sounds on the video (PST2)") whilst PPSTs shared a view at a 13,3% ratio as ("We added background music to make our science spot more appealing (PPST50"). The least frequency of theme was selected as "spot content" in the code "scenario change" among prospective teachers. PPSTs shared a view at only a 2,9% ratio in the survey as ("We changed the scenario we had prepared and shot another one (PPST12)").
In the survey and interview form of prospective teachers developing science spots, the findings that demonstrate their views on the science spot presentation process are as seen in Table 5:

Table 5
Findings that demonstrate prospective teachers' views on the science spot presentation process

Theme	Codes	Survey %		Interview %		Theme	Codes	Survey %		Interview %	
		PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)			PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)
Experienced problems	Insufficient time	5,3	-	10		Lack of problems	No problem	42,10	51,5	70	-
	Technical issues	-	14,7	-	6,6		Plan	-	2,9	-	53,33
	Presentation content	15,78	10,29	-	6,6		Rubric	13,15	-	-	6,6
	Effective presentation	7,9	4,4	-	-		Group work	-	1,5	-	-
	Indifference of viewers	-	-	10	-						
	Concerns to be liked	-	2,9	-	6,6						
	Agitation	10,5	1,5	10	20						
	Lack of preparation	2,6	2,9		-						

Table 5 shows that as regards problems experienced by prospective teachers at the science spot presentation stage, prospective teachers stated the challenges they faced on the themes of "experienced problems" and "lack of problems". The highest frequency of theme was selected as "lack of problems" in the code "no problem" among prospective teachers. In the survey related to this code, PSTs shared a view at a 42,1% ratio as ("No problems (S37)".) whilst PPSTs shared a view at a 51,5% ratio. In focus group interviews PSTs shared a view at a 70% ratio as ("We did not face any problem in presentation (PST1)") but PPSTs shared no views on this code. The least frequency of theme was selected as "lack of problems" in the code "group work" among prospective teachers. PPSTs shared a view at only a 1,5% ratio in the survey as ("During the presentation we all acted as a group and presented our work (PPST9)").

Findings on the views of prospective teachers on the self-benefits they gained during the science spot preparation process. In the survey and interview form the findings on the views of prospective teachers on the self-benefits they gained in the science- spot preparation process is as seen in Table 6.

Table 6
Findings on the views of prospective teachers on the self-benefits they gained in the science spot preparation process

Theme	Codes	Survey %		Interview %		Theme	Codes	Survey %		Interview %	
		PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)			PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)
Skill acquisition	Interpersonal communication	5,3	4,4	30	16,6	Attitude-value formation	Responsibility	5,3	-	-	-
	Creative thinking	7,9	2,9	20	-		Viewpoint	15,8	10,2	-	-
	Critical thinking	2,6	-	-	-		Sensitive citizen	5,3	1,5	20	-
	Technical skill	7,9	4,4	10	13,3		Personal development	-	-	30	-
	Group work	15,8	8,8	-	6,6		Sensitivity	39,5	4,4	-	-
	Planned work	10,5	-	-	-		Achievement feeling	7,9	14,7	-	13,3
	Experience acquisition	15,8	22,05	-	13,3		Self-confidence	10,5	7,3	-	-
	Monitoring	-	-	20	-		Happiness	-	-	-	13,3
	Implementation	-	-	-	6,6		Science attitude	-	-	-	6,6
Knowledge acquisition	Knowledge awareness	52,6	29,4	70	53,3	Knowledge acquisition	Learning through teaching	2,6	-	10	-
	Accessing correct scientific knowledge	21,05	14,7	70	26,6		Learning through research	15,8	2,9	-	-
	Acquisition	-	4,4	-	-		Learning through fun	10,5	7,3	-	6,6
	Connecting daily issues with science	-	1,5	-	-		Different teaching methods	-	11,76	-	20

Table 6 indicates that as self-benefits gained by prospective teachers in the science spot preparation stage, prospective teachers stated the benefits they gained on the themes of "skill acquisition", "attitude-value formation" and "knowledge acquisition". The highest frequency of theme was selected as "knowledge acquisition" in the code "knowledge awareness" among prospective teachers. In the survey related to this code, PSTs shared a view at a 52,6% ratio as ("No problems (PST 37)") whilst PPSTs shared a view at a 51,5% ratio as ("I discovered that my knowledge on obesity was actually false (PPST13)") whilst PPSTs shared a view at a 29,4 % ratio as ("I gained awareness on the high significance of seating order (PPST44)"). In focus group interviews PSTs shared a view at a 70% ratio as ("During the science spot preparation process we gained awareness of scientific knowledge (PST10)") whilst PPSTs shared a view at a 53,3% ratio as ("Via experts' views we reached scientific knowledge and gained awareness (PPST4)"). The least frequency of theme was selected as "knowledge acquisition" in the code "connecting daily issues with science" among prospective teachers. In the survey PPSTs shared a view at only a 1,5% ratio as ("We discovered how to utilize daily issues in a science spot (PPST35))").

Findings on the views of prospective teachers about how to use MDP /science spots in their future professional lives

In the survey and interview form of prospective teachers developing science spots, the findings that demonstrate their views on how to use MDP /science spots in their future professional lives are as illustrated in Table 7.

Table 7
Findings that demonstrate prospective teachers' views on how to use MDP /science spots in their future professional lives

Theme	Codes	Survey %		Interview %		Theme	Codes	Survey %		Interview %	
		PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)			PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)
Disposition toward using science spots											
Skill acquisition	Inquiry skill	7,9	2,9	10	6,6	Teaching	Performance task	-	1,5	-	-
	Creativity	5,3	4,4	-	-		Different learning approach	36,8	13,2	10	20
	Communication	-	1,5	10	6,6		Asking students to watch ready spots	10,5	17,6	-	20
	Group work	21,05	4,4	10	13,3		Attention grabbing	2,6	19,11	10	13,3
Knowledge acquisition	Knowledge learning	26,31	10,29	30	6,6	Creating awareness/ Attitude-value formation	Connecting with daily life	2,6	1,5	-	-
	Learning through discovering	-	-	10	-		Awareness gain	28,9	7,3	-	-
	Learning by doing and experiencing	-	-	50	33,3		Science attitude	5,3	-	-	-
	Learning through fun	15,8	10,29	20	26,6		Self-confidence acquisition	13,15	4,4	10	-
	Permanent learning	13,15	16,17	50	20		Creating a product	-	2,9	10	6,6
	Learning in a short-time	5,3	5,8	-	13,3						
Concerns about using science spots											
Student	Student level	15,8	26,47	10	20	Material	Material selection	-	-	10	-

Table 7 displays that as regards the science spot testing and development process, prospective teachers stated the challenges they faced on the themes of “role play”, “technical issues”, “spot content”, “instant testing”, “consultant support”, and “cooperation”. The highest frequency of theme was selected as “technical issues” in the code “sound scheme” among prospective teachers. In the survey related to this code, PSTs shared a view at a 7,9% ratio as (“There was a synchronization problem between image and off-voice. We tried to correct this problem (PST27)”), PPSTs shared a view at an 8,8% ratio as (“We had difficulty in adding background music (PPST11)”). In focus group interviews PSTs shared a view at a 50% ratio as (“Sometimes we found that off-voice was higher than the sounds on the video (PST2)”) whilst PPSTs shared a view at a 13,3% ratio as (“We added background music to make our science spot more appealing (PPST5)”).

The least frequency of theme was selected as “spot content” in the code “scenario change” among prospective teachers. PPSTs shared a view at only a 2,9% ratio in the survey as (“We changed the scenario we had prepared and shot another one (PPST12)”).

Findings related to the suggestions of prospective teachers for the researchers and colleagues who will develop/implement science spots in the future

In the survey and interview form of prospective teachers developing science spots at the end of the relevant MDP, the findings that demonstrate their suggestions for science developers/implementers in the future (prospective teachers, in-service teachers, researchers etc.) are as displayed in Table 8.

Table 8
Findings that demonstrate prospective teachers' suggestions for the researchers and colleagues developing/implementing science spots in the future

Suggestions to developers						Suggestions to implementers					
Theme	Codes	Survey %		Interview %		Theme	Codes	Survey %		Interview %	
		PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)			PST (N=38)	PPST (N=68)	PST (N=10)	PPST (N=15)
Process Planning	Preparing work schedule	-	13,2	10	-	Student aspect	Voluntary based	2,6	10,3	-	-
	Asking for permission	5,3	3,0	-	13,3		Student level and skills	5,3	4,4	-	-
	Topic choice	42,1	41,17	70	40		Should be done by students	2,6	-	-	-
	Knowledge acquisition /Researching	42,1	8,8	30	-		Children should not prepare	2,6	2,9	-	-
	Message identification	2,6	-	-	-	Consultancy process	Technical informing	23,68	10,3	30	20
	Acquisition identification	5,3	11,76	-	6,6		Feedback giving	2,6	1,5	-	-
	Task allocation	7,9	2,9	-	-		Motivation	2,6	11,8	-	-
	Planned work	18,42	11,76	30	40		Material procurement	10,5	-	-	-
	Target group choice	18,42	2,9	-	26,6		Assessment Group forming	-	1,5	20	-
	Watching sample spot	-	4,4	-	-	Making Students prepare spot	Extended time	10,5	4,4	-	-
	Scenario setting	10,5	1,5	-	-		Topic choice	13,15	5,8	-	-
	Consulting to experts	5,3	1,5	-	-		Fun spot preparation	7,9	4,4	-	-
	B plan	-	-	30	-	Common use	Adopting as a teaching approach	10,5	23,52	-	-
Spot Shooting/ Designing	Shooting location diversification	21,05	2,9	20	-						
	Sound scheme	7,9	10,29	20	20						
	Image quality	10,5	7,3	-	-						
	Diversifying the visuals	13,15	2,9	10	-						
	Professional shot	10,5	14,7	-	6,6						
	Learning montage programs	7,9	4,4	-	-						
	Active role taking	2,6	2,9	10	-						
	Spot length	5,3	-	-	-						

Table 8 manifests that for the researchers and colleagues who will develop science spots in the future, prospective teachers provided suggestions on the themes of “process planning” and “spot shot/designing” and for the researchers and colleagues who will implement science prospective teachers provided suggestions on the themes of “student”, “consultancy process”, “making students prepare spots” and “common use”. The highest frequency of theme was selected as “process planning” in the code “topic choice (fun, social, current, society related, instructive, interesting)” among prospective teachers. In the survey related to this code, PSTs shared a view at the ratio of 42,1 % as (“I would choose topics that best reflected real world situations (PST10)") whilst PPSTs shared a view in the ratio of 41,17% as ("I would choose society related problems (PPST4)"). In focus group interviews PSTs shared a view in a ratio of 70% as ("Social topics that match students' levels should be given further place (PST10)") while PPSTs shared a view at a ratio of 40% as ("I would be attentive to choose a current topic and try to solve current problems (PPST1)"). The least frequency of theme was selected as "spot shooting process" in the code "message identification" among prospective teachers. In the survey PSTs shared a view at only a 2,6% ratio as ("To be more effective they should make a good message identification (PST5)").

The highest frequency of suggestions offered by prospective teachers to researchers and colleagues who will implement science spots in the future belonged to the theme of "consultancy process" and the code "informing (technical info)". In the survey related to this code, PSTs shared a view at a ratio of 23,68 % as ("It can be taught integrated into computer-aided education or in the process information on video arrangement could be given (PST26)") while PPSTs shared a view at a ratio of 10,3% as ("Before asking them to prepare a spot a sample spot can be watched (PPST32)"). In focus group interviews PSTs shared a view at a ratio of 30% as ("For the students who will develop spots, a longer and more detailed explanation can be given on MDP (PST6)") while PPSTs shared a view at a ratio of 20% as ("Before science spot preparation students would be more motivated if they watched sample science spots prepared by their peers (PPST5)"). The least frequency of theme was selected as "consultancy process" in the code "assessment"" among prospective teachers. In the survey, PPSTs shared a view at only a 1,5% ratio as ("It could be used for assessment purpose as well (PPST43)").

Discussion and Conclusion

At the end of our research prospective teachers reflected on their experiences related to the science spot preparation process based on MDP. In such experiences they mostly shared the challenges faced during the process. It is noticeable, however, that during the process they frequently shared their views on the issues they paid heed to and the situations they enjoyed. Put another way, prospective teachers shared their experiences related to the process in both positive and negative statements.

In the research prospective teachers were informed about the science spot preparation process, they were also provided with public service announcements models prepared by Karahan and Canbazoğlu-Bilici (2014), they were supplied with a sample science spot preparation form and asked to watch public service announcement samples. Nonetheless, irrespective of all the aforementioned attempts prospective teachers shared their view that in the process of science spot preparation they faced challenges in group work. The reason why prospective teachers faced such challenges may be attributed to their underdeveloped skills in working as a group. In the planning process, prospective teachers experienced problems in setting a joint time, identification of spot content and preparing a work schedule. The issues stated by prospective teachers necessitate cooperative work. It was detected that PPSTs who failed to work in cooperation and set a joint time considered themselves incompetent in science spot preparation. Be that as it may, although prospective teachers shared their challenges in the role distribution while setting scenarios during the planning process, they still managed to accomplish the requirements of group work and upon identifying the skills of their team members they aptly distributed the roles. Prospective teachers who managed to work collaboratively in the group shared their view that the overall process was a success. In parallel with this finding it can be argued that during this research prospective teachers improved their group-work skills. In addition, prospective teachers clarified the reasons for their dispositions to use science spot by focusing on the importance of group work in the learning process, thus they suggested researchers and colleagues and potential users of science spots form groups by adhering to the personal differences of students. Prospective teachers stated that thanks to "group work" they experienced no difficulties in either the spot-development process or the science spot presentation process. All these findings point to the fact that in the preparation process, group work/cooperation matters greatly. As manifested in our research, prospective teachers gained awareness of the vitality of group work during this process. As regards prospective teachers' views on the self-benefits they gained from science spots, they shared that their group-work skills improved, which also echoes the related conclusion.

In the science spot planning process, prospective teachers shared the fact that they faced challenges such as agreement in the same opinion, adapting the topic to the spot and connecting among topic-acquisition, topic-information and acquisition-science spots while choosing topics. As regards adapting the topic to science spots, PSTs stated that they faced difficulty while PPSTs said that they faced hardship only in identifying the connection between acquisitions-science spots. The cause leading prospective teachers to experience difficulties in adapting science spots to the topic could be that they were asked to generate different opinions and attempted to prepare a unique science spot not replicating the public service announcements they had watched. By the same token, this case supported the idea that prospective teachers have original product development views.

As regards prospective teachers' views on the science spot designing process, they expressed that they generated different opinions related to designing the science spot. As prospective teachers underlined, the self-benefits they gained during the science spot preparation process in generating different opinions correspondingly boosted the creative and critical thinking skills of the individuals. In the current study, prospective teachers also emphasized the importance of generating opinions during the science spot preparation process. To explain the reasons behind their disposition towards using science spots in the future, prospective teachers noted that generating different opinions during the science spot preparation process stimulated creativity. Previous studies also indicated that design-based science activities improve the creative thinking of students (Doppelt, 2009). Although some prospective teachers expressed the view that generating different opinions on the topic of science spots is important for creativity, some of them evaluated this case as a challenge. They have difficulty in decision making in determining a science spots' topic from different opinions. However, prospective teachers could decide on science spot topics. In this case it is interpreted that the science spot preparing process improves learner's decision-making skills. Previous studies also indicated that design-based science activities improve the decision-making skills of students (Yanpar, Koray, Parmaksız & Arslan, 2006) and also prospective teachers (Bozkurt, 2014). Another reason explaining the challenge prospective teachers experienced in topic selection might be related to their insufficient content knowledge. On the other hand, as regards the self-benefits prospective teachers gained during the science spot preparation process, they shared their views in knowledge awareness and accessing correct scientific knowledge and complementing their missing content knowledge. While explaining the reason behind their dispositions to use science spots in the future prospective teachers stated that this process aided them in accessing correct knowledge (Karahan & Roehring, 2015). As regards the science spot preparation process, prospective teachers underlined the relevance of content knowledge and during the planning stage of the process they emphasized in their suggestions the significance of preparing science spots by attaining detailed information on the relevant field.

Another reason that prospective teachers focused on topic choices was that the content should be selected from socio-scientific and real-world problems. As regards the self-benefits they gained during this process, prospective teachers emphasized in their dispositions to make students prepare science spots that their colleagues and researchers should connect current issues with science in their science spots. Constructivist and context-based learning theories also support the idea that science topics should be presented by establishing a connection with everyday life.

PPSTs have more difficulty than PSTs in choosing topics according to target groups. This might be explained by the fact that the PPSTs target group has a lower cognitive level (age group) than the student group of PSTs. On the other hand, as regards using science spots in the future, both PSTs and PPSTs have concerns on the aspect that students' age level might not be appropriate to ask them to prepare science spots and they could fail to simplify science spots applicable to students' age levels. Irrespective of that, a number of studies conducted within the scope of the European Union and Turkey evidence that parallel to the increase in grades there is a counter fall in students' interests and attitudes towards Science, Mathematics, Engineering and Technology (Çavaş, 2012). Hence for the purpose of keeping students' interest vibrant, it is critically important to instill positive attitudes in young students about interdisciplinary integration in science education, developing their knowledge, skills and approaches related to such disciplines and considering varied disciplines in their career choices (Roehrig, Moore, Wang & Park, 2012; Platz, 2007). Aside from that, Bybee (2013) also underpins that there is a requirement that the interdisciplinary integrated teaching methods and learning acquisitions be diagnosed and diversified by the researchers. All prospective teachers, especially PPSTs, suggested to researchers and colleagues who would use science spots that unless spots were appropriate to students' levels, they would rather not be prepared by students. On that account there is urgent need to increase the number of studies aiming to eradicate prospective teachers' and in-service teachers' ubiquitous concerns on the use of science spots in education and also pre-service and in-service training should be offered to teachers (Bozkurt, 2014; Hacıoğlu, 2017).

Prospective teachers expressed their worries in procuring appropriate materials in the preparation of science spots in future. Correspondingly they warned their colleagues to pay heed to science spot material choices and procurement. A number of prospective teachers experienced challenges in selecting appropriate locations for the scenario, which might be related to their failure to prepare B plans for their location choice. Absence of B plans or change of topic adversely affected the science spot preparation process. Prospective teachers in their suggestions to potential science spot developers shared the importance of taking measures for permission and forging a B plan, which indicates that prospective teachers are fully aware of the crucial necessity of a B plan for the purposes of the entire process.

Prospective teachers in their views concerning the science spot preparation process frequently emphasized the significance of consultant support. Prospective teachers received consultant support in the appropriateness of acquisition–student level (scenario setting), and identification of misleading message and content arrangement (testing and development). The fact that those prospective teachers having received consultant support were able to better execute the science spot preparation process can be construed from their statements such as: "During the presentation stage I discovered that those who received consultant support were better able to present their work in line with the rubric criteria (S6)." Besides, as regards the consultancy task, prospective teachers suggested to the colleagues and researchers who would use science spots in the future that they pay heed to the matters of "informing", "feedback giving", "motivation", "material procurement", "assessment" and "group forming". This situation might be attributed to the increased awareness of prospective teachers on the position and importance of consultancy in the science spot preparation process. Teachers as consultants play a very important role in the performance of learners designed based activities (Ayar, 2015). So, real learning environments, in which prospective teachers should be given opportunities to provide counseling in designed based activities, should be included in the teacher education process.

Some prospective teachers stated that failure to create a work schedule led to the emergence of certain ambiguities and failures in the process of science spot preparation. Among the sample failures experienced in the science spot designing process are the obligation of spot content change by prospective teachers who failed to develop elaborate plans, which points to the paramount significance of plan making and planning stages in the development of science spots. By the same token the fact that those prospective teachers who adhered to their previous plan in the stages of testing, development and presentation experienced no challenges also supports this conclusion. In addition to that PSTs noted that the science spot preparation process instilled them with planned work skills. It is said that prospective teachers gained awareness on the importance of the planning process within the science spot preparation process.

Prospective teachers stated that they gained technical skills during the science spot preparation process even though they experienced challenges in technical problems during the process. This might be related to the fact that it was the very first-time prospective teachers used a video design program. And they provided their suggestions in line with the technical problems they personally experienced. Learners should have technological knowledge and skills to overcome similar problems in the digital age. Having put their signatures on the kids' culture of the 21st century, information and communication technologies are ubiquitous in almost any house and contrary to adults' children are much more active and able in technology use (Kaffai, 1996). Thus, using MDP in science education encourages students to move away from consumer status and leads them to embrace producer status. This finding underlines the fact that science spot activity that necessitates using MDP in science education will motivate students to use information technology tools to boost their learning levels and create means for students to design the kind of learning environments in which they can express themselves through creative products (Kinder, 1991, p. 2). In this context, it is crucial that prospective teachers have both pedagogical content knowledge and technological-pedagogical content knowledge for students to gain technological skills (Canbazoğlu-Bilici & Baran, 2015). It can also be suggested that in science education, integration of science spot preparation and science education in media disciplines contributes to the technological-pedagogical content knowledge of prospective teachers. In addition, prospective teachers shared their views that this process contributed to their technological knowledge and skills in parallel with Jimoyiannis's (2010) explanations that learning via design can involve practical implementations in order to monitor the development of in-service teachers' technological-pedagogical content knowledge. In line with this conclusion it can be suggested that technological-pedagogical education should be offered to pre-service and in-service teachers in order to guide them to use such knowledge in their courses. Hands-on activities can be distributed in science spot preparation related to MDP.

Implementation of MDP in science education fosters students' knowledge, skills and attitudes toward multiple disciplinary fields and basic fields in particular (Wilson, Iyengar, Pang, et al. 2012; Delpech, 2002). At the end of our research, prospective teachers shared their views that during the science spot preparation process their knowledge, skill, attitude and value formation aspects developed, as emphasized in learning domains of science teaching programs. This finding may be seen as an indication that prospective teachers' dispositions to use science spots in future could have been positively affected. It is worth noticing that prospective teachers' views manifested that they achieved progress in content knowledge and pedagogical content knowledge. This finding might be related to the fact that media design-based science education calls for learning conceptual knowledge via research and inquiry-based learning (Newstetter, 2000; Bates, 2000; Fortus, Dershimeri Krajcik, et al. 2004) and utilization of such knowledge (Lambert & McCombs, 1998). This situation could also be a consequence of the prospective teachers' active engagement in the science spot preparation process. Milgram (2011) reported that in education, videos could be facilitated as a means of learning concepts or acquiring conceptual awareness. He also emphasized that videos in particular could encourage students to better learn how to actively participate in the design process. Echoing this finding, students actively participate in the media design-based science education process (Karahan et al. 2015). Relevant literature studies focusing on design-based science education also pointed to identical findings (Bozkurt, 2014; Ellis & Fouts 2001; Hacıoğlu, 2017; King & Weiseman, 2001; Smith & Karr-Kidwell 2000).

Another attention-grabbing finding is that prospective teachers commented that they gained life skills such as interpersonal communication, creative thinking, and critical thinking. Group work skills were also emphasized. Based on prospective teachers' dispositions toward science-spot preparation, it is feasible to deduce that role play skills are heavily effective in science spot preparation. As regards the self-benefits gained during science spot preparation, prospective teachers stated that their attitude and value formation such as sensitivity, self-confidence, responsibility, and science attitude developed. This finding indicates that good planning of work and organization of groups in coordination correspondingly increased the effectiveness of teaching. As pointed out in relevant literature studies, cooperative group work activities were remarkably effective in improving students' knowledge, skills, as well as attitudes and values (Sivan, Leung, Woon, et al. 2000; Gültekin, 2005). It has been reported in a wide array of studies that design-based activities are remarkably contributive to boosting the kind of characteristics essential in any scientist. These characteristics can be listed as sophisticated thinking skills (Marulcu & Sungur 2012), problem-solving skills (Aslan-Yolcu, 2014), social and communication skills (Karahan et al. 2015), creative thinking (Hacıoğlu, 2017) and decision making skills (Bozkurt 2014), elevated positive attitudes toward the course (Capobianco 2011; Çavaş, Bulut, Holbrook, et al. 2013) and motivation (Bozkurt, 2014; Moore, et al. 2014; Schunn 2009; Harkema, Jadrich & Bruxvoort 2009; Sadler, Coyle & Schwartz, 2000), and being technology literate (Morrison, 2006).

Prospective teachers presented some suggestions about implementing science spots in science education. They suggested that taking into account students' level and voluntariness; students would be required or not be required in any way to prepare science spots. Aside from that, they suggested to their colleagues and researchers who would use science spots to generalize their use. This suggestion could be attributed to the previous views of prospective teachers on their dispositions toward using science spots and self-benefits gained from the science spot preparation process that the process involves, viz. connecting daily issues with science, learning through teaching-researching-fun and different teaching methods (Karahan et al. 2015).

In sum it is reasonable to argue that in our research prospective teachers made sense of the directives in the MDP-based science spot preparation process and gained awareness of the significance of each single activity. The other conclusive argument is that prospective teachers developed a viewpoint in using science spots within science education alongside gaining experience in spot preparation, which can be identified as the major results of the present study.

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