TRANSFORMING MEDIA ITEMS INTO CLASSROOM TASKS IN THE CONTEXT OF A STUDY GROUP

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Interpretation of statistical information which is included in media extracts is considered as a critical aspect of statistical literacy. In the context of a study group, seven secondary teachers were given a media item and were asked to analyze it and transform it into a classroom task. In this paper we focus on the process of this transformation and we explore factors that frame the integration of media in the teaching of statistics. Results show that among the main aspects that affect the transformation process are: teachers' familiarity with the context in media reports, difficulties in defining learning goals and teachers' low self-confidence regarding classroom management issues.

INTRODUCTION

Interpreting statistical results is one of the main aims for statistics education. Among the learning experiences is to investigate ways in which statistical information is presented in the media and other sources, and identify sources of deception in misleading graphs and accompanying statements (NCTM, 2000). Gal (2013) underlines that while we think about mathematics education, we should be thinking about the outcomes and products of the mathematics education being provided to learners, not only from an internal but also from an external point of view and that educators, psychologists, sociologists, economists, etc. should also view mathematics education and its societal role from a lifelong or lifespan perspective.

Although statistical literacy is treated as a key educational goal, reform efforts in statistics education do not elaborate much on the importance of using media sources. Moreover, despite a few studies that focus on teachers interpretations of media (e.g. Monteiro & Ainley, 2007), there is very little research on how media can be integrated in the teaching of statistics.

Our aim in this study is to investigate factors that affect the integration of media in mathematics classrooms. Particularly we study:

1. How do teachers transform media extracts into a classroom task?
2. Which are the factors that frame this transformation?

THEORETICAL BACKGROUND

Statistical literacy education involves (a) direct exposure of learners to principles and "worry questions" (Gal, 2002) that need to be applied when evaluating real-world statistical communications, coupled with (b) the use of selected examples for "misleading" graphs," flawed" statistical reports, or "problematic" probabilistic claims in various media channels (e.g., Best 2001). However, in a survey of more than 240 instructors of introductory statistics (Garfield, 2000) less than 25% said they "frequently used "discussions of statistics in the media, and roughly half indicated they never ask students to critique news articles in classroom assessments. It seems that many instructors' teaching of statistics is neither oriented towards statistical literacy nor assess media extracts for teaching purposes.

Several studies have investigated aspects of the statistical literacy in interpreting graphs in media contexts. Watson (1997) suggests a three-tiered framework for statistical literacy based on media information including (a) a basic understanding of probabilistic and statistical terminology, (b) an understanding of probabilistic and statistical language and concepts when they are embedded in the context of wider social discussion, and (c) a questioning attitude where more sophisticated concepts are used to contradict claims made without proper statistical foundation. Although reading and interpreting graphs in media texts have become a central issue in developing the dispositions subsumed under statistical literacy (Gal et.al., 1997), it constitutes a quite complex and challenging domain for mathematics teachers. Monteiro and Ainley (2007) investigated 218 student teachers and explored elements and processes involved in the

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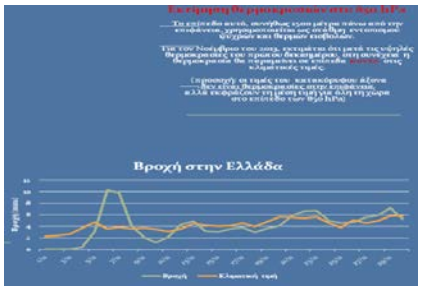
interpretation of graphs in media. In their study they noted that, in order for participants to make their interpretations, they mobilized not only their statistical knowledge but also other form of knowledge, their experience about the context and their feelings, and they suggest *critical sense* as an important element which can help to mobilize and balance a range of factors presented in the interpretation of graphs process.

Our aim through this study is to get insight on how secondary mathematics teachers transform media extracts into classroom tasks. Rowland and his team (Rowland et.al., 2009) set the *transformation* as one of the four categories in the *knowledge quartet* of mathematics teaching. Here, we use the term transformation in accordance to Rowland's definition, as the ability of teachers to transfer what they know in a way that can be appropriate and accessible to students. The way teachers transform mathematical tasks for their classroom determines students' opportunities to engage meaningfully in mathematics and promote their conceptual understanding as well (Chapman, 2013). Stein & Lane (1996) define two phases in the transformation process: (a) the set up phase, where teachers modify instructional materials to classroom task and (b) the implementation phase, where the task is transferred in the classroom. As far as the set up phase is concerned, three main factors that influence the transformation process of mathematical tasks, are identified in their work: teachers' goals, teachers' subject matter knowledge and teachers' knowledge of students. In this paper, we aim to explore how these factors are specified within the media context and also identify other factors that seem to influence the process of transformation in this case.

METHOD

This paper presents part of an ongoing qualitative study that aims to support teachers to integrate statistics in their teaching of mathematics. For this part of the study the focus is on the use of media in the teaching of statistics. Seven secondary mathematics teachers and two researchers participate voluntarily in a study group (Arbaugh, 2003) engaging in three main actions: (a) analyzing and transforming a given media task, (b) reading research papers related to the use of media in the teaching and learning of statistics and (c) designing and using a media task in the classroom and reflecting on their teaching. In this paper we focus on the first action of the study exploring teachers' understandings regarding given media tasks and the transformation process into tasks for their classroom. All the authors of the paper participated in this phase of the study.



Your teacher is in charge of the excursion to the Acropolis Museum. He wants to avoid a rainy day for the excursion so he downloaded from a website the diagram you can see.

a) Which days in November seem not to be appropriate for the excursion?
b) Is the information given from the graphs sufficient for deciding the excursion day?
c) What other information you could search to make your judgment?

Figure 1. The weather task

The teachers who participate have a degree in mathematics or applied mathematics and they all have done postgraduate studies in mathematics education. Akis, Dinos and Marcos are practicing teachers with a mathematics teaching experience of 8, 10 and 18 years respectively and with little teaching experience in statistics. Moreover, Marcos and Dinos have a personal interest in statistics while Akis' involvement with statistical content is limited to his university experience. The other four participants, namely Lia, Cloe, Sofi and Ria, are novice teachers with no teaching experience and no particular familiarity with the statistical content.

Concerning the first action, a media task based on a weather forecast item (see Fig. 1) was given to the teachers. In the figure there are two rainfall curves. The one curve represents a timeline of mean values of rainfall in the month under discussion, as measured in Greece the last 30 years, and the other curve represents a forecast for the rainfall in Greece the same month. Teachers were

asked: (a) to analyze individually the task in terms of its mathematical and pedagogical characteristics and (b) to report on their analysis and discuss about the potential use of this media task in the classroom, in the following groups' meeting. The meeting was audio and video recorded.

Our data sources were the written responses of the teachers and the transcriptions from the video and audio recordings of the meeting. For the analysis of the meetings' data we worked on the principles of grounded theory. On a first level of the data analysis we tried to detect the main themes that emerged in the study group's discussions, next, we searched for different views or attitudes related to each theme and the rationale behind them. Shifts in participants' views throughout the discussion were also considered in our analysis. The written responses were used as additional source to explore participants' initial views.

RESULTS

From the analysis of the data three main themes seem to emerge in groups' discussion regarding the transformation process of the weather task. These themes are presented and further analyzed below.

Debating About the Appropriateness of the Context

The ability to interpret the context of the media and the importance attached to this seem to play a crucial role in teachers' judgment of whether to use it or not. The fact that the given task was based on a diagram with meteorological information created a lively debate among the teachers through which two main views emerged: the one that *questions the appropriateness of the context* and the one that *recognizes the usefulness of the context*.

The first view was supported by Marcos, Lia and Akis who rejected the context as inappropriate and provided various reasons to support their view. Marcos argued that "*This context has many unknown elements for the students. Even for me, as a teacher, this context is difficult to interpret so I can't go far or deeper by using it*". However, Marcos showed a high level of interpretive skills and his questions and points were purely statistical, for example: what exactly do we calculate by the mentioned measures, what is the relationship between the parameters that are related to the weather, or how (with which model) the prediction has been calculated, the unfamiliarity with the meteorological context seem to be determinant for doubting the usefulness of a task like the weather task in the teaching of statistics. For Lia: "*this task is an interesting one but not for the mathematics classroom*". Throughout the discussion, Lia's view was restricted to a first-level reading of the diagram and she appreciated the task only for its usefulness to motivate students, stating: "*I would prefer to use this context in other lessons than mathematics or statistics, in Physics maybe*". Lastly, Akis mentioned that: "*I wouldn't use it. Since I don't know much about meteorology, this graph says nothing to me*". Throughout the discussion Akis was trying to interpret the information in the graph and, in many instances, he was trying either to make specific parts of the graph clear or to confirm that his observations were correct. In the end of the discussion Akis showed a shift from his initially negative to a more positive stance towards the task arguing that: "*it would be interesting to test such a task in the classroom and to see how it works*".

The fact that the weather task was based on an authentic media item, seemed to act positively in teachers' attitude towards it. Dinos, although admitting unfamiliarity with the context, could focus on specific parts of the graph and expressed a willingness to use it. The others, although having a positive attitude, could not provide explicit evidence as to why they would use it and how. Particularly, Sofi and Ria characterized the task as "nice" but couldn't concentrate on any particular aspect, and Chloe seemed to appreciate the general context as something that students could be interested in, but she suggested to refine the graph in a more simple form. The extract below shows Chloe's difficulty to understand the difference between media and real context:

Chloe: If I were to make a general discussion with the students I would give it to them as it is, but if I wanted to teach specific concepts I would try to find a simpler diagram or I could change it in this respect.

Dinos: But if you change the original in a convenient way then you don't have a media context but just a context from everyday life.

Sofi: He is right, this is the way diagrams appear in meteorology.

Chloe: But I can't understand the difference between this and what we call real context. Is it that this is something that happens the time we speak?
Dinos: There is a big difference.
Chloe: Please, explain to me.
Dinos: We can make problems with a realistic context every time we want, but in this case you are the one who judge the mathematics behind and you can control it. But, if you take something original from the media, then things get quite different, this is difficult, you have no control here.

Defining Learning Goals

The definition of learning goals seemed to be a challenging task for the teachers. Three main attitudes were revealed from teachers' discussion: (a) defining specific learning goals (b) defining general goals without focusing in particular concepts or ideas and (c) not defining learning goals.

Dinos was the only who defined learning goals from the start. He was able to focus on specific parts and linked to specific statistical ideas such as the meaning of mean value in making a decision. As he mentioned in the beginning of the discussion: "*One learning goal that I can see is to help students understand that we can't trust the mean value of the country to make an estimation for a city"* and he suggested that: *"I would give them a diagram for the rainfall prediction in a Greek city so that they would compare the two diagrams"*. Moreover, the discussion seemed to help Dinos go deeper, find more links to statistical ideas and define new learning goals: "*It would be also interesting to find the confidence intervals of this weather prediction and help students to use them as a tool to make estimations. What is the probability to fall out?*".

Three of the teachers could not define specific learning goals and their discussion of this issue was of a general form. In this case, teachers seemed to recognize some statistical ideas in an initial level but couldn't actually focus on statistical concepts, expressing a difficulty to define specific learning goals. Their responses to the researchers' and their colleagues' questions were rather general and they avoid to justify their opinion in a specific way. This seems to stem from their difficulty to interpret the information in the given graph and link it to the statistical content. For example Sofi mentioned that "*If I were a student I couldn't see any statistical ideas behind. There have to be some questions to guide students in order see the connection between diagram's information and statistics"*. When the researcher asked her to give some specific examples of questions she said *"no, I can't think anything specific"*. Similarly, Ria mentioned that there are many statistical ideas to be discussed but when the researcher asked her to be more precise and name these statistical ideas Ria respond "*Mainly how to read a diagram, mainly this, because there are a lot to say*", but she said nothing more. The difficulties in interpreting the diagram and in recognizing specific statistical ideas resulted in a further difficulty to define specific learning goals for their students. However, the interaction among teachers throughout the discussion seemed to help the teachers to focus on specific statistical concepts and until the end of the meeting Sofi and Chloe talked about the meaning of mean value and the role of the outliers in long-term measurements while Ria referred to the issue of trust between the timeline and the prediction line.

The other three teachers didn't define explicitly learning goals. Our initial hypothesis was that making links with statistical ideas could lead to a formulation of specific learning goals, but the case of Marcos refuted it. Although Marcos could interpret in depth the statistical information of the diagram and he recognized many statistical ideas that lied behind, he remained consistent with his initial decision: "*I wouldn't use it in my classroom*". In our request for transforming the given task, he preferred to give other examples instead (using different contexts such us the number of car accidents in a national road). Marcos' unwillingness to transform the task seems to stem from his need to use a more familiar context that helps him make the statistical ideas transparent to the students. Unlike Marcos, Lia couldn't see link the weather graph to statistics. According to her, there is no need of statistical knowledge to make a judgment in this task: "*Simply looking at the diagram you can see which days won't be rainy, so you will choose these*". When she was asked about potential learning goals she said: "*I am not sure if I would use it in the classroom of mathematics, I can't really find a specific mathematical goal*". Last, for Akis, the unfamiliarity with the context on the one hand, and the form of representation used on the weather task on the other, seemed to cause him a difficulty identifying specific learning goals. As he stated: "*you need*

to have access in the data set, to ask students to make calculations, if I were to transform it I would give students a data table".

Linking the Media Context to Learning and Teaching

The groups' discussion revealed two main issues regarding the use of media in the teaching of statistics: the classroom management and the mathematics curriculum. According to the first, teachers seemed to be insecure to manage their classroom and expressed their concern that in such tasks it is very difficult to keep the control of the discussion in the classroom.

Akis: This is not an easy task in mathematics generally. You may start with some initial goals and go to a completely different direction. You can lose the control and then… nothing.

Dinos: This is one of the main problems in using media, that the context can disorientate students and most of the didactic time will be wasted in talking about the one and the other.

Moreover, teachers' lack of previous experience in using media in their teaching seemed to be rather crucial too. Most teachers reveal low confidence in using media.

Dinos: To use something original from the media, unchanged, I don't know, I think I couldn't. I don't know how it works in the classroom. I know that it is something that it is not tested.

Marcos: I don't think that it is difficult but we definitely not have the experience to do it. There are no examples to see.

Akis: It's not easy. You can't support such a task, or design one if you are not talented. You need to have talent to do so.

Marcos: Moreover, since it is an open problem in which there isn't a one and only answer, sometimes there is the risk that the way you respond to students is incorrect, I mean statistically.

Nevertheless, the collaboration among teachers seemed to have a positive impact on teachers' self-confidence about using media items in their teaching. Dinos' response is indicative of this impact:

Dinos: What I keep in mind is the whole discussion we had … Because, if you take an original problem from the media…It is difficult. I mean even if I worked with the weather task for many hours on my own, some of the issues discussed here couldn't be easy for me to think.

Researcher: So, do you believe that the interaction helps?

Dinos: I think it's absolutely necessary. In that way you can be more prepared for the classroom.

Furthermore, the structure of the curriculum and the general goals of mathematics education were also dominant in the discussion. Marcos and Akis talked about time limitations. Dinos argued that the point is not just to implement the task but also to connect it with the previous and the subsequent goals, he mentioned characteristically "*Ok, let's say that I give my students such a task and I raise some statistical issues, and what is next? The point is that you need to do something the next day, the day after. What is it? Do you just open an issue?*". This kind of tasks is not supported by the Greek curriculum and this is an extra barrier when a teacher wants to integrate media in their teaching. Moreover, teachers show a need to see in the curriculum some examples that have already been tested in the classroom, something that they would know how it works.

DISCUSSION

The transformation of a media item to a classroom task seems to be a quite demanding process for mathematics teachers. As seen in the results of this study, only one teacher actually set specific learning goals for the task and suggested specific modifications for using it in his classroom. In most cases, difficulties with the context of the media item, as well as content knowledge limitations seem to hinder teachers from embedding such a task in their teaching of statistics. Moreover, all the teachers expressed low confidence in implementing a media task in their classroom.

Regarding the factors that influence the process of this transformation, we will start with those stated by Stein & Lane (1996). First, teachers' subject matter knowledge seems to play a crucial role in teachers' understandings of media graphs as well as in their ability to interpret the statistical information and recognize main statistical ideas. Particularly for the media context, apart from the subject matter knowledge, the knowledge of the context related to the media item seems to be an additive factor. As mentioned in Monteiro & Ainley's (2007) work, teachers can interpret more aspects and recognize more statistical ideas in a media graph when the context is familiar to

them. The unfamiliarity with the meteorological context seems to function as a barrier in the transformation process, the case of Marcos, who is familiar to the statistical content, is indicative of the context effect. Second, defining specific learning goals seem to constitute a major challenge in the process of transformation regarding media extracts. Teachers seem to have great difficulties in defining concrete learning goals. These difficulties stem from limitations of teachers' content and context knowledge. The third factor is teachers' knowledge of students. As seen in Garfield's study (Garfield, 2000) very few teachers have previous experience of using media items in their classroom; in our case none. This fact constitutes an additive constraint in using media context in the teaching of statistics. The difficulty to predict students' reactions, coupled with the fact that teachers are supposed to act in the moment, result in a feeling of insecurity regarding classroom' control or learning goals' achievement. In our study we identified two more factors that seem to frame the process of transformation: the curriculum and the collaboration among teachers. Teachers seem to need specific examples of tasks based on media items and integrate these tasks within wider learning goals, so that they will be able to know what, why and how. Moreover, the collaboration among teachers seem to have a positive impact in helping them familiarizing with the context of media items, defining specific learning goals and increasing their confidence regarding the management of the classroom reality. Dinos's case constitutes an indicative example of how content knowledge together with teachers' collaboration can result in a positive stance towards using media items in the teaching of statistics.

This phase of the study gave us insight to the process of transformation of media items into classroom tasks. In the next phases of the study, where the teachers will design tasks based on media items and implement them in their classroom, we aim to go deeper in this process and investigate more aspects of the transformation, such as giving clear explanations, making use of interactive teaching, using questioning effectively to assess and develop students' understanding (Rowland et.al., 2009), within the media context.

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