Research Article

BUILDING THE TEACHING ACTIVITIES STATISTICAL CHARTS IN MATHEMATICS SECONDARY EDUCATION CURRICULUM 2018 FOR JUNIOR HIGH SCHOOL

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ABSTRACT

Statistics and probability have become the main knowledge to be taught in Math general education curriculum 2018. Teachers face many difficulties because they must teach new statistical content for the first time. In the context that one curriculum with many textbooks, teachers must proactively design the teaching content by analyzing the content and the competency required to be developed for learners and referring to domestic and foreign textbooks. Based on teaching statistics at a junior high school, our analysis shows that there is the appearance of charts and the relationship between them by grade level. Moreover, in this research a teaching design process has been developed, applied, and summarized into appropriate teaching contents. Teachers can refer to specific teaching activities in the paper related to the choice of data representation in the statistical charts and contribute to the development of mathematical communication competency. The proposed teaching situations are all practical. These practical contexts are close and consistent with the psychology of junior high schoolers.

Keywords: statistical chart; data representation; mathematical communication competency

1. Problematic

The general education curriculum issued in 2018 aims to develop the competency and quality of learners, especially the ability to solve problems in practice (Ministry of Education and Training, 2018a). With this approach, the mathematics secondary education curriculum (MC) (MC, 2018) requires teaching and learning statistics. In the mathematics secondary education curriculum issued in 2006, statistics were only taught in grades 3, 4, 5, 7 and 10. For the new one issued in 2018, statistics are required to be taught from grade 2 to grade 12. MC 2018 has affirmed that statistics are "a compulsory component of mathematics education in schools, contributing to enhancing the applicability and practical

value of mathematical education" (Ministry of Education and Training, 2018b, p. 8). At the elementary level, students are required to "organize data into bar charts/ pie charts". As for junior high school level, students are required to "select and present data into appropriate tables and charts". According to Bloom taxomomy, this is an application level. Therefore, students have certain knowledge about reading statistical data and know how to apply statistical thinking to represent data. With the absence of textbooks for MC 2018, building a series of teaching activities that meet the requirement is an issue.

2. Teaching statistics in mathematics secondary education curriculum 2018

2.1. General requirements

MC 2018 requires teaching statistics through observation skills, reading charts and data representation from simplicity to complex. The objectives or the content of statistics are presented in hierachy (from simple to advanced level):

At the primary level, the contents of statistics course are simple so that students can solve simple practical problems (Ministry of Education and Training, 2018b, p. 7)

At the secondary school, students know how to collect, classify, perform, analyze, and process statistical data; analyze statistical data through frequency and relative frequency; and identify some simple rules in practice (Ministry of Education and Training, 2018b, p. 8)

At the high school, students can collect, classify, perform, analyze, and process statistical data; use statistical data analysis tools through central trend measurement characteristics and dispersion measurement for non-grouped and grouped data samples; and use statistical rules in practice (Ministry of Education and Training, 2018b, p. 9)

2.2. Requirements for teaching statistical charts

MC 2018 describes the requirements to be met with each grade (from grade 2 to 12) in teaching statistics. Limited to statistical charts, this curriculum assumes that the charts show the correlation between the numbers or quantities, and student need to learn how to read the relevant figures, making comments on data. The charts are presented in MC 2018 from grade 2 to grade 7: picture charts, bar charts, pie charts, line chart, and data table.

Table 1. Charts in MC 2018 from grade 2 to grade 7

Chart	Grade	Relevant requirements
Picture Chart	2	- Collect, classify and tally statistical objects (some basic circumstances). - Read and describe the figures in picture chart. - List some simple comments from the picture chart.
Data table	3	- Recognize how to collect, classify, and record statistics (in some simple situations) according to the given criteria. - Read and describe the data in tabular form. - List some simple comments from the data sheet.
Column chart	4	- Be aware of statistics series. Identify ways to arrange data ranges

		based on the criteria. - Read and describe the data in the form of bar charts; Sort data into bar chart (no drawing required). - Give some simple comments from the bar chart, calculate the average of the data in the bar chart. Familiarize with problem detection, the simple rule is based on observing the data from the bar chart.
Pie Chart	5	- Collect, classify, compare and arrange data according to given criteria. - Read and describe the figures given by pie chart (not required to draw); select the representation (by data series, tables, charts, ...) of statistics. - List some simple comments from the fan chart. Familiarize students, the rule is based on observing the data from the pie chart. - Solve simple problems related to figures obtained from pie chart. Recognize the relationship between statistics and other knowledge in Mathematics and in practice.
Bar chart	6	- Perform data collection, classification, and representation according to the given criteria from various sources such as tables, knowledge in other subjects. Identify the validity of data according to simple criteria. - Be proficient in reading and describing data statistics tables, charts, double bar / bar charts). Select and display data into appropriate tables and charts. - Recognize simple problems or rules, solve simple problems related to data in the form of statistical tables, charts, double-column / bar charts. - Recognize the relationship between statistics and other subjects (History, Geography, ...) 6th grade and in practice (climate, market prices, ...).
Line chart	7	- Implement and explain the collection and classification of data according to given criteria. Explain the rationality of the data according to simple mathematical criteria (such as the rationality, the representation of a conclusion in the interview, ...). - Be proficient in reading and describing data in the form of statistical charts: pie chart, line chart. Select and display data into the appropriate chart. - Identify different types of representations for a data set - Identify simple problems or rules, solve simple problems related to statistics in the form of fan charts (given), straight line charts. - Recognize the relationship between statistics and other subjects (History, Geography...) grade 7 and in practice (environment, medicine, finance...).

In 8th and 9th, students are not required to learn new charts but from existing ones they must perform more complex tasks.

Table 2. Teaching statistical chart in grade 8 and 9 of MC 2018

Content	Grade 8	Grade 9
Collect and organize data	- Select and display data into appropriate tables and charts in the form of statistical tables; picture chart; bar chart / double bar chart, pie chart, line chart. - Compare different types of representations for a data set - Describe how to convert data from one form of representation to another.	- Explain and set data into appropriate tables and charts in the form of statistical tables; picture chart; bar / double bar chart, pie chart (pie chart); Line chart. - Detect and interpret inaccurate data based on simple mathematical relationships between data presented in simple examples. - Explain and implement the way to transfer data from one form of representation to another.
Analyze and process data	- Identify problems or simple rules based on analysis of data collected in the form of: statistics table; picture chart; bar / double bar chart, pie chart; Line chart. - Solve simple problems related to the data collected in the form of: statistics table; picture chart; bar / double bar chart, pie chart; Line chart.	- Determining the frequency and relative frequency of a value. - Set up relative frequency / frequency table, relative frequency / frequency chart, multiplexed frequency / relative frequency table, relative multiplexed frequency chart. - Explain the meaning & role of frequency and relative frequency in practice - Recognize the relationship between statistics and knowledge of other subjects in the 9th grade program and in practice.

In this paper, we only focus on one requirement in grade 8, "*Select and display data into appropriate tables and charts in the form of statistical tables; picture chart; bar chart/double bar chart, pie chart, line chart.*" This level of achievement is described by "*select and display*" data into appropriate charts. It is lighter than "*explain and set*" verbs for grade 9.

3. Mathematical communication competency

MC 2018 requires students to form and develop mathematics competency, including core components: mathematical thinking and reasoning capacity; mathematical modeling competency; the ability to solve the problems; mathematical communication competency; competence in using mathematical tools and means. The mathematical communication competency is shown by listening comprehension, reading comprehension and recording

mathematical information. While the old curriculum only refers to the listening and writing skills, this is a striking difference for MC 2018.

Focusing on mathematical communication ability, MC 2018 describes 4 expression groups for junior high school (Ministry of Education and Training, 2018b, pp. 13-14):

N1: Listening comprehension, reading comprehension and taking notes (summary) with basic mathematical information, focus on writing (speaking or writing). Then, analyze, select, and extract necessary mathematical information from the text (in written or written form).

N2: Performing the presentation, expression, questioning, discussion and debate of mathematical contents, ideas, and solutions in interaction with others (at a relatively complete and accurate level).

N3: Using mathematical language combined with common language to express mathematical contents as well as demonstrating evidence, methods, and results of arguments.

N4: Demonstrating confidence when presenting, expressing, discussing, and explaining mathematical contents in some situations that are not too complicated.

Therefore, the verbs in the requirement of teaching statistics in grades 8 and 9 such as (explain, prove, describe ...) are very suitable for developing mathematical communication competency.

In their work Radford and Demers (2004) introduced a teaching process that promotes student communication in the math classroom. We summarize that process as follows:

Step 1: Teacher presents activities.

Step 2: Students work in groups to discuss the findings and prepare mathematical arguments to explain.

Step 3: Students work in groups talk to each other, research, and explain the results of other groups.

Step 4: Students hold a group meeting to discuss the group's solutions and arguments.

Step 5: Small groups of students prepare answers and explain more about the results of their groups.

Step 6: Teacher holds a general discussion about the achieved results.

This teaching process allows students to interact with each other to compose answers, evaluate solutions of other groups by refuting or refusing, or reflecting on other groups' opinions about their opinions. Therefore, establishing arguments to protect or adjust opinions. As such, the skills students develop through this teaching process are very suitable for the objectives of the MC 2018 in terms of mathematical communication competence.

4.   The activities for teaching about selecting charts

The following is the teaching activities for selecting charts between picture charts, bar charts, and pie chart. This situation helps students establish the relationship of conversion between the three charts and enhance mathematical communication after teaching steps. These activities help to achieve a requirement in teaching statistics at grade 8 according to MC 2018, "Select and display data into appropriate tables and charts in the form of statistical tables; picture chart; bar chart/double column chart, pie chart *[...]*" (Ministry of Education and Training, 2018b, p. 68)

4.1.   Review the charts

Before conducting experiments, teachers need to teach picture charts and remind students of bar charts and pie charts. Because of the experiments that we plan to do in the future, it will be performed on 8th grade, students studying under the current curriculum 2006. Therefore, this activity is necessary because according to our analysis, teaching diagrams in elementary schools is less concentrated.

a) Picture Chart

Picture chart indicates data using images and icons. Each symbol represents a certain number. The two charts below show the amount of ice cream sold during the day. However, in Figure 1, an icon corresponds to an ice cream cone. In Figure 2, an icon corresponds to 3 ice cream sticks.
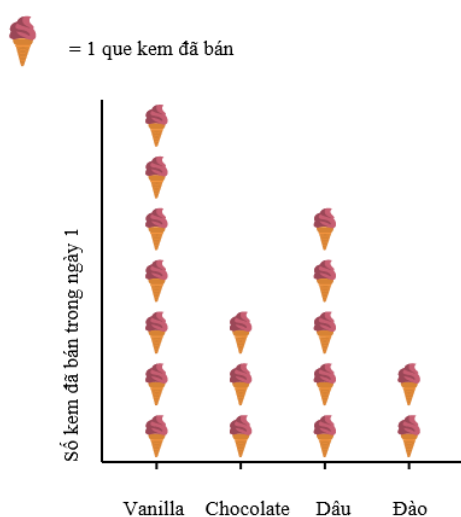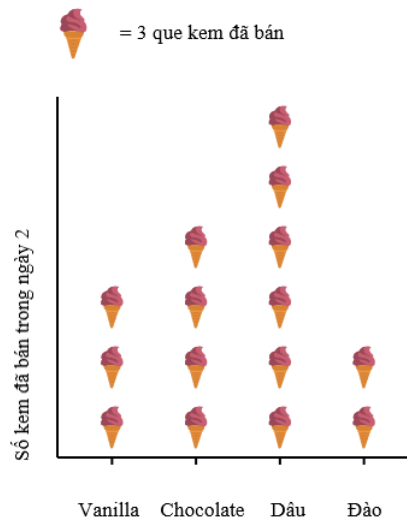

Figure 1

Figure 2

b) Bar chart

In the mathematics curriculum in 2006, the bar chart appeared for the first time in the 4th grade. However, then the bar chart reappeared in grade 7 with the introduction "the chart where straight lines are replaced by letters. Also, sometimes the rectangles are drawn closely together to make comments and comparisons called rectangular charts" (Phan et al., 2011, pp. 13-14).

Hình 2
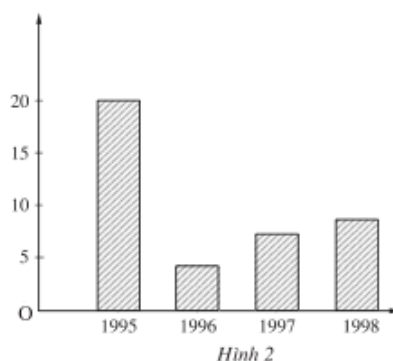
The chart shows the deforestation area of our country destroyed from 1995 to 1998
(vertical unit: thousand ha)

c) *Pie Chart*

The pie chart in the MC 2018 was formerly known as the fan chart. The pie chart appears in grades 5 and 7 of the MC 2006.

A pie chart is a chart that uses slices of a circle to show the relative size of the data. The pie chart is relative, not entirely accurate, but can visualize the ratio of each part to the overall.

Pizza	Pizza
Phở	Phở
Gà rán	Roasted chicken
Hamburger	Hamburger
Cơm tấm	Broken rice
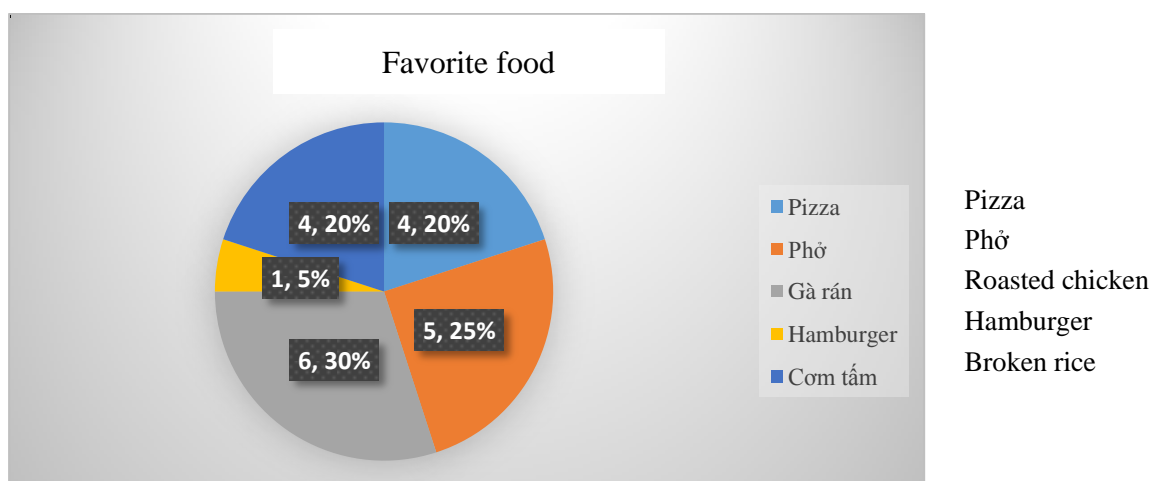
4.2. *Experimental process*

The experiment was conducted based on the procedure suggested by Radford and Demers (2004) taking place in 90 minutes with 6 steps and through 3 problems.

Step 1 (5 minutes): Teacher presents mathematical activities that students will perform. Teachers divide the class into small groups, each group has 3-4 students and hand out the learning cards to students.

Step 2 (20 minutes): Students work in groups and discuss to give answers to the study cards.

Step 3 (15 minutes): Students exchange study cards with each other. Each group will discuss your group's solution.

Step 4 (15 minutes): The two groups exchanging cards will discuss. Then finalize their work.

Step 5 (10 minutes): The groups then return to their seats, complete the presentation of their work on the handout of A4 paper.

Step 6 (25 minutes): Representing groups come up and present their solution. Other groups followed, debated and criticized. Teachers systematize knowledge and end the lesson.

4.2. Problems

Problem 1. *The following is a survey of the favorite sport of class 8A*

Sport	Number of Students
Badminton	18
Basketball	15
Soccer	9
Ping pong	3

Please use the picture chart to represent the favorite sport of class 8A.

Problem 2. *The school expands its survey on favorite sport of grade 8 students and obtains the following data table:*

Sport	Number of Students
Badminton	84
Basketball	75
Soccer	53
Ping pong	32
Swimming	26

1) Draw a picture chart to show data about the favorite sport of grade 8 students.

2) Please choose a chart that you think is more appropriate to represent data about the favorite sport of all grade 8. Explain why the chart you selected is more appropriate?

Problem 3. *The school continues to expand the survey about the favorite sport for students of the whole school and obtains the following table of data*

Sport	Number of Students
Badminton	375
Basketball	269
Soccer	155
Ping pong	50
Swimming	198
Volleyball	66
Athletics	34
Shuttlecock	13

1) With the above data, should you use the picture chart to represent the data? Explain why?

2) Select a chart that you think is more appropriate to represent data about your childhood favorite sport of the whole school. Explain why the chart you chose is more appropriate?

3) The principal wants to know the percentage of the favorite sport of the whole school, please help him draw a pie chart. In your opinion, is this circular fan chart more appropriate than the ones you have drawn? Explain your answer.

4.3. A priori analysis

In practice, the outstanding didactical variable is the data of the three problems. Problem 1, simple data easily represented by a picture chart, namely 1 symbol for 1 unit. Turn to problem 2, the data is more complex than problem 1 but can still be represented by a picture chart, especially using a symbol to represent many units. However, the other possible chart for students is the bar chart. For problem 3, the data are more complex, making it difficult for students to perform by a picture chart. Students have to then choose another chart, and a bar chart is more suitable. The problem also requires students to calculate the ratio and draw a pie chart. Besides, the experimental process helps promote mathematical communication. Students will understand their ideas when presenting their problem-solving methods to other students and teachers. Students learn new mathematical concepts when they explain words, use charts, write, and use mathematical symbols. Discussing and analyzing together will produce optimal strategies, and false options will be revealed and solved. Moreover, students can practice attentive listening skills and think about other students' ideas carefully. They can use everyday languages to link to the math language.

5. Conclusion

MC 2018 does not have any textbooks yet. Moreover, teaching statistics has many new contents. The teaching activities we have developed here in this paper suggest a methodology for teachers' involvement in curriculum development. Teachers will start with the required competency and content to propose teaching activities. In addition, they also need to have appropriate teaching strategies for developing learners' competency. In this paper, we introduced a teaching process that contributes to the development of mathematical communication skills. These activities need to be experimented to evaluate their feasibility in real classes.

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XÂY DỰNG HOẠT ĐỘNG DẠY HỌC BIỂU ĐỒ THỐNG KÊ TRONG CHƯƠNG TRÌNH GIÁO DỤC PHỔ THÔNG MÔN TOÁN 2018 CHO BẬC TRUNG HỌC CƠ SỞ

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TÓM TẮT

Thống kê và xác suất đã trở thành một mạch kiến thức chính cần dạy trong chương trình giáo dục phổ thông môn toán 2018. Giáo viên gặp nhiều khó khăn vì lần đầu tiên phải dạy những nội dung mới về thống kê. Trong bối cảnh một chương trình có nhiều sách giáo khoa, giáo viên phải chủ động thiết kế nội dung dạy học bằng cách phân tích những yêu cầu cần đạt về nội dung và năng lực trong chương trình và tham khảo từ những tài liệu dạy học khác nhau như sách giáo khoa trong nước và ngoài nước. Giới hạn trong việc dạy học thống kê ở bậc trung học cơ sở, phân tích của chúng tôi cho thấy sự xuất hiện của các biểu đồ và mối liên hệ giữa chúng theo từng cấp lớp. Hơn nữa, một quy trình thiết kế dạy học được chúng tôi xây dựng, vận dụng trong nghiên cứu này và đúc kết thành những nội dung dạy học phù hợp. Giáo viên có thể tham khảo những hoạt động dạy học cụ thể trong bài báo liên quan đến việc chọn lựa biểu diễn dữ liệu giữa các biểu đồ thống kê đồng thời góp phần phát triển năng lực giao tiếp toán học. Các tình huống dạy học được đề xuất đều gắn với thực tiễn. Các bối cảnh thực tiễn này gần gũi và phù hợp với tâm lí học sinh bậc trung học cơ sở.

Từ khóa: biểu đồ thống kê; biểu diễn dữ liệu; năng lực giao tiếp toán học