

# Development of Electrical and Mechanical Engineering Lesson Using Refrigerator Catalogs and Mana-Pita Sheets

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## 1. Introduction

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan will revise its curriculum guidelines for junior high schools in 2021 and high schools in 2022<sup>1)</sup>. The revision background is based on an awareness that children need to acquire new abilities to live in our drastically changing society, and that MEXT believes high school and junior high school teachers must design more interactive learning style lessons.

The author is a teacher of electrical and mechanical engineering, which is a course provided to student teachers who are seeking certification as a home economics teacher. In keeping with the above-mentioned MEXT directive, she felt it is necessary to design interactive lessons to give student teachers good examples to use when they begin teaching at their future junior high school positions.

In her previous paper<sup>2)</sup>, the author reported on an interactive style lesson in which a hand-made paper box weaving loom was used in an electrical and mechanical engineering class. Some student teachers commented that they hoped to adopt the weaving loom in their future lessons. As their comments suggested, experience-based interactive learning methods can provide student teachers with increased motivation to incorporate such tools into their future lesson plans. In 2019, the author discussed an electrical and mechanical engineering lesson plan that introduced Mana-Pita sheets<sup>3)</sup> and refrigerator catalogs into group learning activities as a new interactive lesson style. Mana-Pita sheets, which are products manufactured by Sakura Color Products Corp.<sup>4)</sup>, have the following features:

1. Transparent wipe-off sheet (310×454 mm)

2. A3-size paper holder (297×420 mm)

3. Portfolio-style

4. Magnet mounting points on the right and left sides

In the active learning style lessons, most studies discussing the use of wipe-off analog tools have focused on lessons using whiteboards and blackboards. For example, Kimura<sup>5)</sup> reported on practical lessons for student teachers using three different sized whiteboards as communication tools in groups of two to four students, as well as discussions between the teacher and students. Watanabe et al.<sup>6, 7)</sup> reported that students could show facts and opinions more clearly and more lucidly indicate relationships between issues when they were allowed to use a whiteboard and sticky notes as visualization tools during in-depth discussions in interactive lessons.

Moreover, Watanabe et al.<sup>8)</sup> described how instructional guides, in this case, a tablet computer increased the quality of discussions in students' group learning. In another study, Imoto et al.<sup>9)</sup> reported advancements in the development of a high school home economics class that used refrigerator catalogs to provide a focus on consumer life and the environment, while Ono et al.<sup>10)</sup> reported enhancements of home economics lessons at a junior high school by concentrating on refrigerators in terms of expenses (electricity costs and purchase price) as well as product eco-friendliness. In their papers, both Imoto and Ono stated that their lessons led students to display increased environmental consciousness when selecting products. In still another study, Fukui<sup>11)</sup> measured the power consumption of a refrigerator and other home electrical appliances to create a home economics lesson plan aimed at teaching the benefits of conserving energy.

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With the above studies in mind, and based on the fact that refrigerators are familiar home electrical appliances have been shown to provide useful tools for teaching environmental awareness, this study reports on a lesson development centered on the use of Mana-Pita sheets (which are more readily available than whiteboards in most classrooms) and refrigerator catalogs, and verifies their effectiveness as teaching tools.

## 2. Lesson Plan Outline

In this 15-lesson electrical and mechanical engineering plan, each lesson of which is 90 minutes long, the instructor typically conducted each class as follows:

1. Inform students of the day's topic (energy saving, eco-friendly products).
2. Instruct each group to place their refrigerator catalogs on their desks. (In the previous week's lesson, each group was tasked with preparing a catalog for this week's lesson by visiting electric appliance stores or using the Internet. However, if any group forgot to bring a catalog, they could use a spare prepared by the teacher.)
3. Ask each group to survey what kinds of features have been adopted in refrigerators shown in the catalog.
4. Ask each group to prepare their presentation document on a Mana-Pita sheet.
5. Ask each group to present their results to the class.
6. Solicit comments on the presentation.
7. Repeat steps 5–6 until all groups have finished their presentations.

## 3. Results and Discussion

Students were instructed beforehand to write clearly and boldly and to keep their hands and sleeves away from the writing on the Mana-Pita sheet to prevent smearing. Although some practice was required, they eventually grasped the needed technique for writing clearly on the sheet. The groups were asked to describe their refrigerator's features concisely, which caused some confusion because they initially felt that they needed to copy every word from the catalog. When some students asked for guidance on the issue, the author advised them to pick out the most critical points, sort them into keywords such as health and economy, and then hold a group discussion to craft appropriate phrases. Figure 1 shows each group's presentation sheet. The following are

some students' remarks on the lesson:

1. A wipe-off sheet is easy to use.
2. It is interesting to write on a Mana-Pita sheet.
3. Group activities are fun.
4. The slips of paper in the holder move too easily when a group turned the sheet vertically during a presentation.
5. Colored pens that are shared with other groups get dull quickly.

Point No. 4 was improved through the use of adhesive tape to hold the slips of paper in place. Point No. 5 was improved by providing each group with a new three-color set of pens. Most students participated actively in the class, and from their behaviors as well as their remarks on the lesson, indicated that they found the lesson using Mana-Pita sheets to be interesting. There were no remarks that suggested that the amount of writing space or preparation time was insufficient for writing their presentation documents.

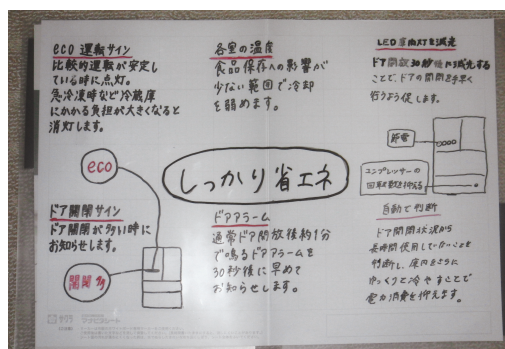
Students were allotted 60 minutes to make presentation documents, and quickly understood the necessity of perusing more than a dozen pages of the catalog within the allotted time, which implies they were sufficiently motivated to participate actively in the lesson. From Points No. 2 and No. 3, we can presume that the size of a Mana-Pita sheet was sufficient to reduce the time pressure students experienced doing group work.

## 4. Conclusions

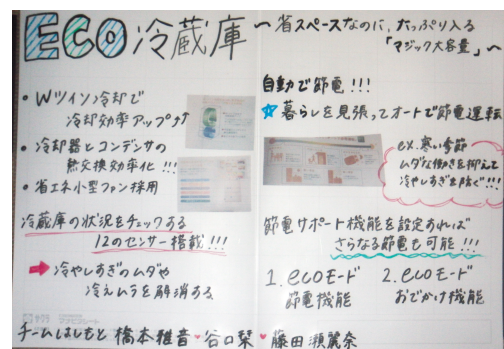
In this study, the author described an electrical and mechanical engineering lesson utilizing Mana-Pita sheets and refrigerator catalogs to give students opportunities to experience group learning as an interactive lesson style. The present study can be summarized in the following two key points:

1. The students demonstrated increased interest in group lessons that involved the use of Mana-Pita sheets.
2. Using several dozen-page-long catalogs in group work, the student groups were motivated to actively discuss how to make their presentation documents within the allotted time.

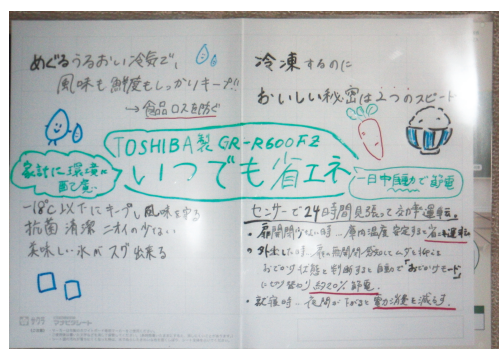
Although the Mana-Pita sheet magnets were not used in this lesson plan, the author intends to make a plan in which the students will be asked to use those magnets to attach their presentation sheets onto the classroom whiteboard for facilitating intergroup comparisons, and to allow comments to be written on other groups' sheets while



(a)



(b)



(c)

**Figure 1:** Presentation sheets of three groups.

(a) The title placed centrally is “Good Energy Saving.”

(b) The title placed at the upper left is “ECO Refrigerator.”

(c) The title placed centrally is “Saving Energy Anytime Automatically: Budget-Pleasing & Eco-Friendly Design.”

engaged in discussions with the whole class.

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〔研究ノート〕

## 冷蔵庫のカタログとマナビタシートを使った家庭電気・機械の授業展開

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### 要 旨

広島女学院大学では中学校、高等学校での家庭科の教員免許取得のための科目の一つに家庭電気・機械を開講している。2021年度から中学校、2022年度からは高等学校で新しい学習指導要領が文部科学省によって改訂され、子供たちがより能動的に学ぶ授業を設計する力が教員には求められることになる。株式会社サクラクレパス製のマナビタシートはホワイトボードと同様、マーカーで書いたり、消したりすることができる。さらにA3 サイズという手軽さがありどの教室でも取り入れることができるという特徴を持っている。また、冷蔵庫は家庭科の授業で省エネや環境に配慮した生活という視点から教材として取り入れられている。本研究では、アクティブラーニングの授業形式としてグループ活動による冷蔵庫のカタログとマナビタシートを使用した授業展開を行い、学生の反応や感想をもとに、これらの教材による授業効果を検証した。その結果、次の2点にまとめることができた。

1. 教員志望学生らはグループ学習でマナビタシートを使った授業に興味を抱いた。
2. 十数ページのカタログを教材でかつ与えられた時間内にプレゼンテーション文書をどのように作るかを活発に議論する動機づけになった。