

Proposal of Food Design Methods in the Age of Recipe 3.0

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Abstract

This paper will investigate the integration of artificial intelligence (AI) into the creative process of recipe creation by the average consumer and its potential to improve everyday life through personalized cooking and nutrition science. By engaging food and nutrition students in a practical experiment to generate recipes using a language understanding model (LLM), we will assess the feasibility and user impact of Recipe 3.0, a model that democratizes culinary knowledge and promotes innovative culinary activities. certain limitations, such as the lack of taste experience in AI. Nevertheless, the results demonstrate the important role of AI in assisting with recipe creation and suggest a possibility of creating dishes through a creative process while incorporating essential requirements and considerations.

Keywords: Artificial Intelligence, Education, Recipe 3.0, LLM for cooking, nutritional analysis, democratization of culinary emergence, ChatGPTs

1 Background

Modern technological advancements have revolutionized many aspects of everyday life, most notably advances in artificial intelligence (AI). The challenge, however, is that in many cases these technologies tend to be limited to commercial applications and specialized fields and have yet to be fully exploited for creativity in everyday life. This paper addresses this issue from the perspective of "recipe creation" by ordinary consumers. Cooking is an essential cultural activity in daily life that has a significant impact on individual entertainment, health, and social interaction. Recipes are the body of knowledge that supports this culinary activity, and they vary according to individual environments and preferences. Until now, recipes have often been created by professional chefs, and the creative process has not been very open to the general public. However, with the spread of the Internet, the socialization of recipes as Recipe 2.0 has progressed, allowing home cooks and food lovers to share their own recipes online and engage in a wide range of exchanges. This movement has promoted the democratization of culinary knowledge and encouraged many people to participate in creative culinary activities. This study explores how Recipe 3.0, as proposed by this study, will affect our daily lives in the future. Through this research, we believe we can provide suggestions on how to utilize cutting-edge technologies such as AI in everyday life to enhance the quality of life.

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2 Purpose

The purpose of this study is to identify how AI and human collaboration can work in the fields of culinary and nutritional sciences to facilitate new creations. Specifically, we will focus on the current lack of generalized use of AI technologies, particularly language understanding models (LLMs), and develop practical use case models to improve this situation. Despite modern technological advances, the reality is that many users are not fully utilizing AI. To address this issue, this study proposes models that utilize LLM to generate specific cooking recipes and perform nutritional analysis, and evaluates the impact of these models on actual users. Through this process, we also consider it an objective to examine the balance between the effective use of AI and the role of humans in this process.

3 Precedent Research

In recent years, there has been a growing number of initiatives that integrate technology with cooking and nutrition. For example, smart kitchens use IoT devices for efficient meal preparation and nutritional management, while food tech enables online food delivery and 3D printing of food. Food innovation has focused on the development of new cooking and food production technologies as a way to cut through and enrich the lives of users. However, some aspects of current technology are too much focused on nutrition and health. A dish or meal that satisfies users is not only about numerical nutrition, but also about the appearance, the situation, and the cooking itself, which can be considered entertainment. We believe that efforts to expand the media aspect of the food field will be required in the future.

4 Experimental procedures and subjects

- (1) Purpose of Experiments: To experiment what would happen if food and nutrition majors used LLM to create recipes
- (2) Target: 11 sophomore female junior college students majoring in food and nutrition (8 students responded to the questionnaire)
- (3) Date: April 12 Created a group line, downloaded ChatGPT (OpenAI) Trial cooking and cooking through dialogues; answer questionnaires in Forms.
- (4) Method: Create a recipe while conversing with the AI, make a prototype, take pictures, and answer a questionnaire.
- (5) Usage Environment: GPTs including own knowledge(GPT-4), iOS17. Provide examples of specific content for the conversation:

When creating a recipe with the AI, ask and present specific questions. The following specifics should be used in the conversation to create the recipe as you imagine it.

- 1 That it is a recipe for a snack at a daycare center and that you should answer in Japanese.
- 2 Energy is 100-150 kcal
- 3 Main machines and equipment needed for cooking
- 4 How many servings (easy-to-make portions)
- 5 Image or atmosphere of the recipe

5 Cooking Experiments with AI

There were eight recipes created in this study. In this chapter, we present the flow of developing one product as a case study and the dialogue with GPTs.

TEST USER

I would like to know the amount of lemon cookies.

GPTs

I'll tell you the amount of lemon cookies.

Ingredients: • Butter: 1/2 cup (melted)

- Sugar: 1/2 cup
- Peel of 1 lemon, grated
- Lemon juice: 2 tablespoons
- Flour: 1 cup
- Baking powder: 1/2 teaspoon
- Salt: a pinch

TEST USER

Please tell me the amount in grams.

GPTs

I will tell you the amount of lemon cookies in grams.

- Butter: 113g (equivalent to 1/2 cup) • Sugar: 100g (equivalent to 1/2 cup)
- Lemon peel: grated from 1 lemon (approximately 5 to 10 g of peel from 1 lemon)
- Lemon juice: 2 tablespoons (approx. 30ml) • Flour: 120g (equivalent to 1 cup)

TEST USER

How many pieces will have around 200 calories?

GPTs

The number of lemon cookies you can bake depends on the size and thickness of the cookies, but if you are thinking about a typical size cookie, you should be able to bake about 15 to 20 cookies.

GPTs

Lemon cookies:

- Soften the butter by bringing it to room temperature.
- Beat the butter and sugar until creamy.
- Add lemon zest and lemon juice and mix well.
- Add the flour and mix until the dough comes together.
- Roll the dough, place it on a cookie sheet, and bake in the oven at 180 degrees for about 10-12 minutes.

This candy is easy to make, so it's fun to make with your kids.

Through the above conversation, the actual dish was completed. Below are images of the completed dishes.



Figure1: Image of food designed by test users

6 Results and Evaluation of Experiments

(1) Type of finished dish

Banana mousse, Banana steamed bread, Lemon cookies, Oatmeal cookies, Avocado and banana soymilk juice, Chocolate cupcakes, Banana pancakes, Yogurt parfait with fruit

(2) Time required to prepare the recipe

- Less than 5 minutes 5 persons
- 5-10 minutes 2 persons
- 10-15 minutes 1 person

(3) Difference from thinking of a normal recipe

In the recipe using AI, AI had no experience of eating the food, so the imaginary recipe didn't taste very good. I thought it would still taste better if I made it without using it, thinking it through myself."

I thought it would be better to make it by myself without using AI. Also, I thought it was good because it saved me a lot of time and effort because I could answer questions in a few dozen

seconds, whereas I would have to think of a recipe from scratch and carefully calculate nutritional information.

However, with AI, it takes only a few dozen seconds to answer the question, which is good because it saves time and effort. However, I thought it would be more accurate to calculate the nutritional information using the medcalorie or ingredient list, because it cannot be said that the calorie count is really correct. However, it can come up with a lot of recipes at once, so I think it will be useful for my everyday baking and cooking.

The difference is that the AI can come up with snacks in a few seconds that I could not come up with on my own, and the AI can easily generate recipes by simply inputting the ingredients I want to use. I thought it was efficient and varied to create my own snack recipes based on the AI-generated recipes."

"AI was good at coming up with easy-to-prepare menus. On the other hand, there were some menus that were too simple for me to come up with when I usually come up with my own menu. When we plan our own menus, we consider things like budget, food combinations, seasonality, and so on. However, it seems difficult to make AI consider such things, so I think it is better to have AI think about each item separately, or to add a little more, as in the case of the snacks this time. However, I do not trust it in terms of quantity. When they imagine the finished product, they sometimes wonder if it will not look good or will not turn out as they imagined. Therefore, I thought it would be better to use the AI menu as a reference and improve only the parts that bother me, rather than using it as it is. I also found it more difficult to specify conditions than I expected. I thought it was necessary to think carefully and have the knowledge to specify the conditions because even if I specified the tools, I would get a menu that was different from what I imagined.

"It saved me time because I didn't have to do a lot of research, so I was able to create a menu easily."

"I thought it was very good because it gave us ideas that we had not thought of ourselves."

"Less time to think. I can put in almost everything I want to put in, so I can get closer to my ideal."

(4) Impressions after making it

I followed AI's recipe, but the taste was still uneven. I had my family try it, but they said it was too rich."

I thought it was amazing how quickly they responded to my questions about calories. "I thought it was great that when I decided on the calorie content and asked questions, they immediately responded. I would like to refer to it when I prepare menus in the future. However, I felt that it was not enough to serve them as they were at daycare centers and hospitals, so I thought it was necessary to do nutritional calculations and make prototypes. I made so many cookies that I brought them to school in Tupperware and my friends said they were delicious and ate most of them. I thought it would be difficult at first, but after talking with ChatGPT, I was able to work on it right up until I made the prototypes. I would do it again if I had the chance."

(5) Regarding other cooking themes

I would like to try another theme. 6/8 participants "Creating recipes for changing regular meals "Creating recipes for changing regular meals to senior citizen meals or other meals that suit the target population."

"I would like to have AI create a menu for a month's worth of meals within a month's food budget."

"I would like AI to come up with small bowls of food, garnishes, etc. Also, I thought it would be interesting to see how to specify the budget."

"I was able to create a menu for banana muffins that took children's allergies into consideration. I would like to use it when I can't come up with ideas for children's menu items for special events."

"About special meals"

"About meals for allergy"

The actual survey results are shown below.

Table 1: Questionnaire Items and Results

| ID | recipe name | How long did it take you to complete the recipe while talking to the AI for the first time? | If you wanted to make further changes, did you have a conversation and make changes on a different day or at a different time? | If you answered (1) in 3 that you made changes, how much additional time did it take you to complete it? | If you answered (1) in 3 that you made the change, why did you make the change? | What was the good thing about changing (1) in 3? Or what were the changes you were not satisfied with? Please write down what you liked and what you were satisfied with. | What was the difference between creating recipes without using AI? | Would you like to try a different theme? | If you answered "Yes" to question 8, what kind of things would you like to try? | If you have made a prototype, please write your impressions of it and how you would like to use it. Please also include any reactions you have had from other people. |
|----|-----------------------------------|---|--|--|---|--|--|--|---|---|
| 1 | Banana mousse | 10-15 minutes | 2) Did not change | | | | When it comes to recipes using AI, since AI has never eaten food before, the imaginary recipes didn't taste very good. I thought it would be more delicious to make it by thinking about it myself instead of using it. | no | | I made it according to the AI's recipe, but the taste was still biased. I asked my family members to try it, but they commented that it was too rich. |
| 2 | Banana steamed bread | less than 5 minutes | 2) Did not change | | | | You can instantly create a recipe and the AI will do everything within the scope of your idea, so you can start cooking right away. Also, if you create a recipe without using AI, you have to start from scratch and carefully calculate each nutritional value one by one, but AI can answer in just a few tens of seconds, saving you a lot of time. I thought it was great. | yes | Creation of recipes when changing regular foods to suit elderly people's diet or target audience. | |
| 3 | Lemon cookies | 5-10 minutes | 2) Did not change | | | | If you come up with a recipe without using AI, it would be difficult to calculate the amount for one person and adjust the calories, but with AI, it will give you the amount for one person in a few seconds and come up with a variety of recipes, so it's great. I thought it was easy. However, since it cannot be said that the calorie content is truly accurate, I thought it would be more accurate to calculate the nutritional value using MedCalc or the ingredient list. However, since it can think of many recipes at once, I think it can be useful for everyday snack making and cooking. | no | | I decided on the calorie count and asked him some questions, and he got back to me right away, which I thought was amazing. When I actually made it, it was very easy and delicious. I thought I would like to use this as a reference when preparing my menu. However, since it was not enough to provide it as it is at nursery schools and hospitals, we felt it was necessary to calculate the nutritional value and make a prototype. I made a lot of cookies, so I brought them to school in Tupperware and my friends said they were delicious and ate most of them, which made me happy. AI first, I thought it would be difficult, but after talking with ChatGPT, I was able to start working on it right away, even creating a prototype. I would like to try it again if I have the chance. |
| 4 | Oatmeal cookie | less than 5 minutes | 1) Changed | 3 minutes | It was different from my ideal snack and the amount of ingredients was very rough. | ① What I was satisfied with was that new recipes appeared in a few seconds. ② I was not satisfied with the amount of ingredients being expressed in tablespoons and teaspoons, but I wish they were expressed in grams. | It takes a lot of time to come up with recipes without using AI, and there is a lack of variety, but with AI, you can come up with snacks that you couldn't come up with in a few seconds, and you can easily create recipes by just inputting the ingredients you want to use. I thought it would be efficient and rich in variety to make snack recipes by using AI-generated recipes as a reference and arranging them myself. | yes | I would like the AI to create a menu for one month within the monthly food budget. | |
| 5 | Avocado and banana soy milk juice | less than 5 minutes | 1) Changed | 30 minutes | The work process didn't seem to turn out very well, and the menu ended up looking more like a small bowl than a snack. Also, there were times when I didn't use the designated tools. | ① The good thing is that it was easy to imagine and it seemed easy to make. ② Even if you ask for "amount for 2 people" or "please specify a specific amount," it will display 1 piece instead of g. | AI is good at coming up with menus that are easy to make, but there were some that were so simple that I wouldn't normally think of them when I was thinking of a menu myself. When we make a menu for ourselves, we consider things like budget, food pairings, and seasonality. However, it seems to be difficult to make AI consider such things, so I think it's perfect when you want to have AI think about each item separately, or when you want to add a little more, like when you thought about snacks this time. However, it is not very reliable in terms of quantity. When you imagine the finished product, you may feel that if you use this method, it will look bad or it won't turn out as you imagined. Therefore, rather than using the AI menu as is, I thought it would be better to use it as a reference and improve only the areas of concern. I also found it more difficult to specify the conditions than I expected. Even if you specify a tool, a menu that is different from what you imagined will appear, so I thought it was necessary to think carefully and have the knowledge to specify conditions. | yes | I would like you to think about small dishes and garnishes. I also thought it was interesting how they specified that something could be done within a budget of ○ yen. | The texture was more like eating it with a spoon than juice. I added 200ml of soy milk to each of the two bananas and one avocado for the amount for two people, which made it heavy and difficult to drink, so I thought it would be a good idea to reduce the amount of bananas to one. I also had some friends try it, and they said it tasted even better if they added honey. I was also advised that it would be good to add frozen bananas to make it smoothie-like. Actually, it can be made with either soy milk or milk, but I decided to make it with soy milk so that even those with allergies can eat it. Although the sweetness was modest, it was rich and delicious, and I think it's a very good menu because it fills your stomach. Also, you can make various arrangements from this menu, such as adding yogurt or cereal, so I would like to actually use it when creating menus. |
| 6 | chocolate cupcake | less than 5 minutes | 2) Did not change | | | | Since I didn't have to do a lot of research, I was able to save time and make menus easily. | yes | We were able to generate a menu for banana muffins that takes into account children's allergies. I wanted to use it when I couldn't think of ideas, such as for event meals for children's menus. | |
| 7 | Banana pancakes | less than 5 minutes | 2) Did not change | | | | I thought it was great that they came up with ideas that we had never thought of before. | yes | About the event meal | |
| 8 | Yogurt muffin with fruit | 5-10 minutes | 1) Changed | | I don't know how long it took, but it took me a while to come up with the name of the snack. Well, I thought I'd change it up a little bit. | ① There are more choices of fruit inside. ② It took a long time. | Less time to think. Since you can include almost anything you want, you can get closer to your ideal. | yes | About meals for allergies | I'll try making it next time |
| | | less than 5 minutes | 5 people | Changed 3 people | | | | yes | 6 people | |
| | | 5-10 minutes | 2 people | | | | | no | 2 people | |
| | | 10-15 minutes | 1 person | | | | | | | |

7 Conclusion

The experiment revealed that even under the same conditions, AI-generated recipes varied among students. The recipes that students developed through dialogue with AI, verified for nutritional value using calculation software and prototyped, have the potential to be used as snacks in day-care centers. Additionally, the survey indicated that students who previously created menus from books or the internet found AI, which suggests easy-to-make recipes, appealing. When asked about quantities, AI responded with "approximate amounts," but it was also necessary to request recipes in "weights (g)" depending on the question's phrasing. Respondents expressed doubts about the reliability of these quantities, indicating the need for human verification when creating recipes with AI. This highlights the importance of user proficiency in prompt engineering. The significance of Recipe 3.0 lies in creating new value through the integration of AI and cooking. While it is unlikely that the act of cooking will be entirely replaced by robotics, future applications may see robotics utilized as cooking tools, similar to microwave ovens. Nevertheless, humans will remain central, creating recipes that meet individual needs.

In conclusion, AI-generated recipes, developed in collaboration with students majoring in food and nutrition, are expected to play a significant role in supporting recipe creation through dialogue that aligns with culinary conditions and visions. The experiment showed that the ability of students to create recipes aligning with their vision varied depending on how questions were posed, highlighting the necessity for a learning support system that guides students in specifying conditions through dialogue with AI. Future tasks include a comparative experiment between AI-assisted recipe creation and fully manual recipe creation. This will further elucidate the potential for collaboration between AI and humans in the culinary field.

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