CITIZENS FOOD WASTE PREVENTION BEHAVIOUR CHANGE GRANT

RAF100-304 – University student food waste reduction app pilot

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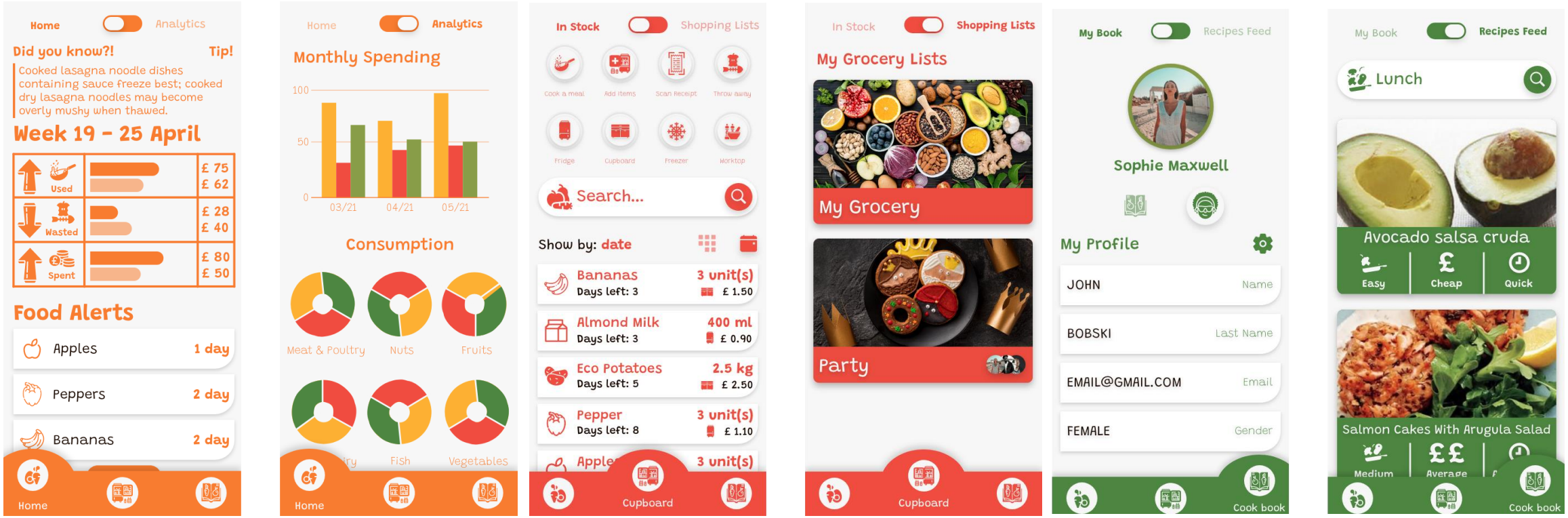
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Centre for Food Policy
Shaping an effective food system

Overall aim of the project

The aim of this scheme is to identify new behaviour change interventions that will encourage citizens to be less wasteful with food.

The aim of this project is to pilot the an app (Gub Gub) to help students eat what they buy on campus and in halls. Also creating information, recipes and content on commonly donated and wasted foods in the halls' community fridges.



Screenshots of the early Gub Gub App, showing different functionality.

Student food waste – a problem

- The average student wastes £300 of edible food a year and halls of residence produce a huge amount of food waste (TUCO, 2019).
- Adults aged 18-34 waste proportionally more food than any other age group (WRAP, 2014).
- Within the student population, 64% of edible food waste is caused by “leftovers” and food passing the expiration date (23% cooking too much, 23% sold in too big quantity, 18% passing expiry), (Acheson, n.d.).

Food waste management apps

Food waste management apps are designed to be food manager software, combined with a versatile shopping and cooking planner that helps citizens avoid food waste by tracking what they have and when it expires. A combination of reminders, nudges and gamification it empowers users to “Eat What You Buy” and reduce household food waste.

Food waste management apps have been shown as being effective methods to reduce citizen food waste. In multiple academic studies, apps have been shown to improve confidence and positive behaviour in users (Farr-Wharton 2015; Lama 2019), and users of the Cozzo food waste management App (part of the REFRESH project) have reported food waste reduction of up to 75% (Ivanova 2019).

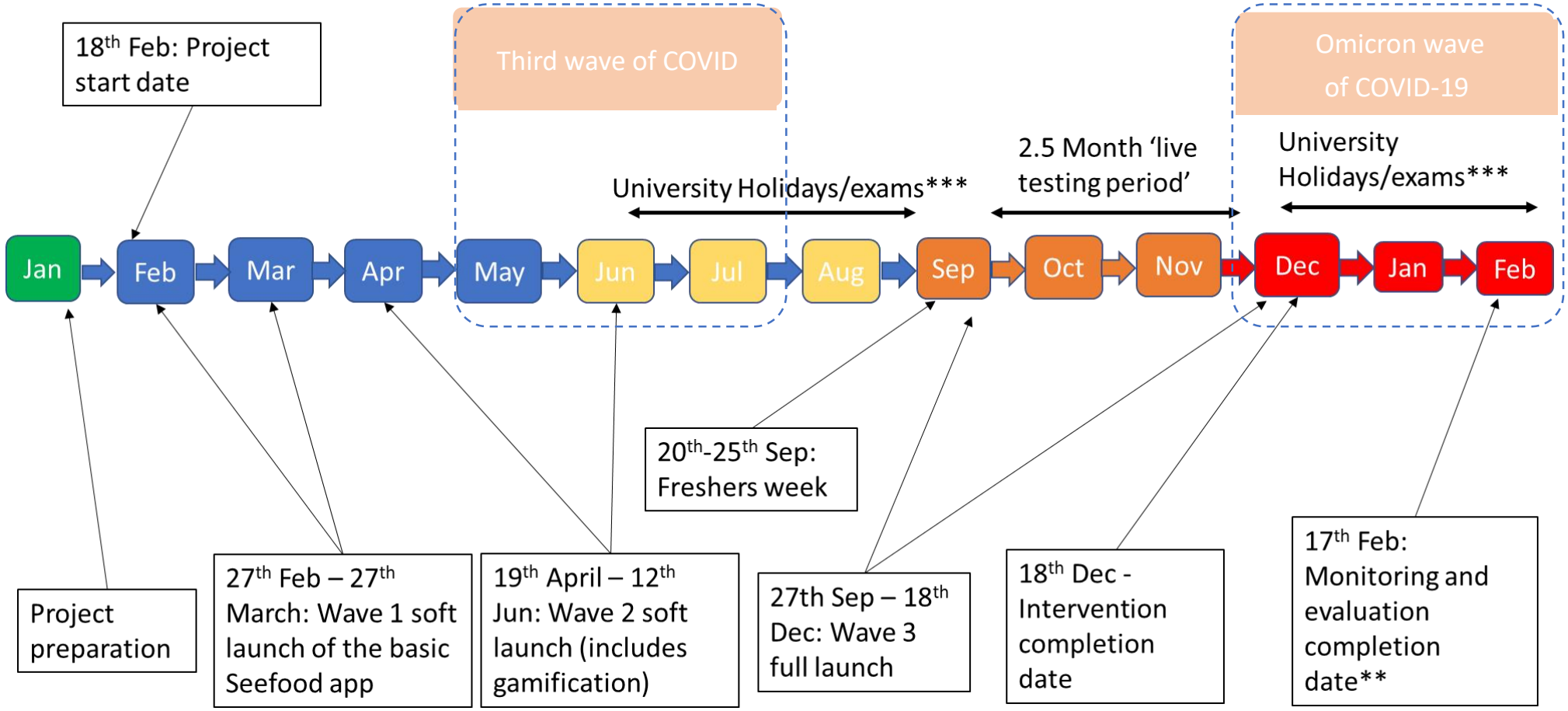
The Gub Gub app provides notifications when food is approaching the expiration date, this prompts students to use the food before it expires. The recipe finding function (which suggests recipes based on a target ingredient) provides students with an accessible and simple way to identify how the food can be used before it reaches the expiry date.

The target audience of this intervention was students at the University of Sheffield n=20,000 students,18-25 year olds, with n=4,000-5,000 in halls of residence.

We targeted students at University of Sheffield halls of residence as the university monitors the weight of food waste from the halls, meaning we can provide an objective measure (in addition to the in-app tracking function) of the success of the intervention in reducing food waste. This can be compared to 5 years of historic food waste data.

Timeline 2021

- The intervention was prepared and deployed over the 2021 year. The third wave of COVID-19 impacted our soft launch period, while the omicron wave of COVID-19 impacted the end of the intervention.



Gamification

Gamification of an app rewards the desired behaviours of reducing food waste and improves user satisfaction and likelihood of habitual long-term use.

Gamification was used to motivate students to show good food management practices and correct app use via a rewarding of points and other features “hats” (e.g. for measuring waste, creating a shopping list, inputting their food into the app, completing food saving challenges).

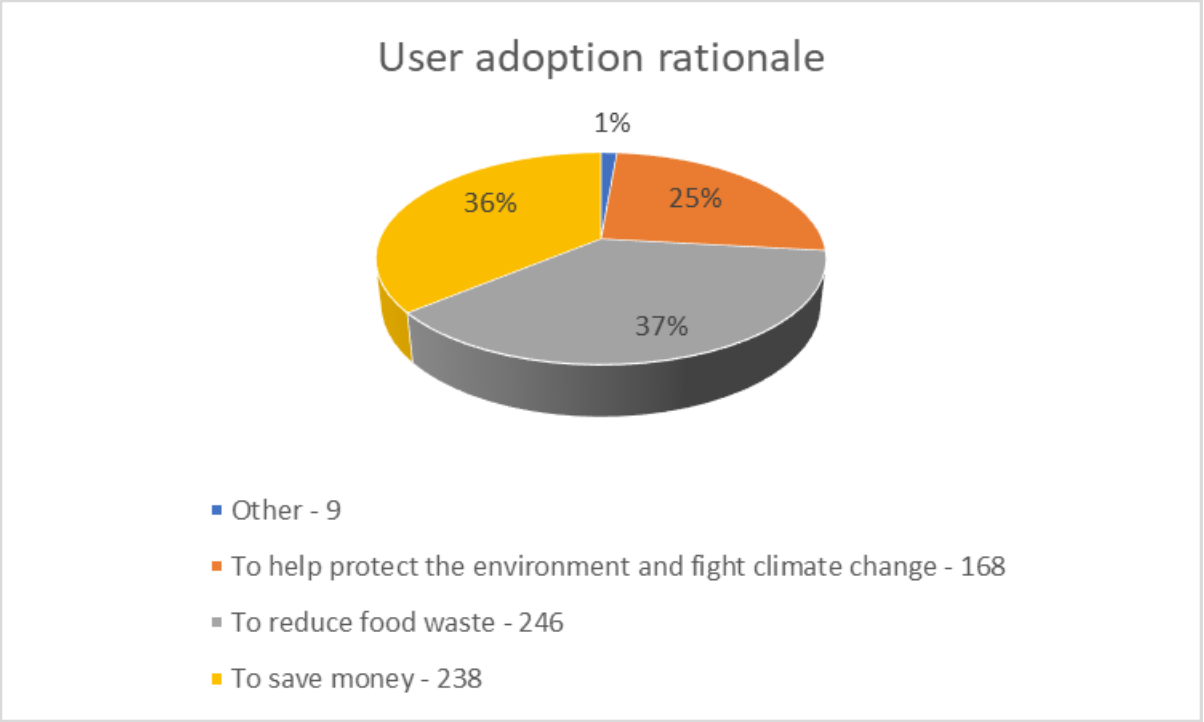
Points can be traded to access other games (a quiz) that indicate the food waste knowledge of the users. If they score all 3 questions correctly, they are given a “variable reward” such as discounts off food and drink vouchers around campus.

User Survey

As users registered they were given the option of taking part in a user survey to gather information on the reasons for adoption, their location of residence, and diet preferences. 661 users filled out this survey. There were 894 unique users of the Gub Gub app, during the intervention period. This survey captured data for ~74% of this total userbase. Post intervention the user base continued to expand to a total of 1398 (measurement taken 1/March/2022).

(Due to Omnicron/Covid impacting on marketing and the lack of automatic update functionality, there were only ~200 to 400 users at any one time on the app.)

Reasons for User Adoption

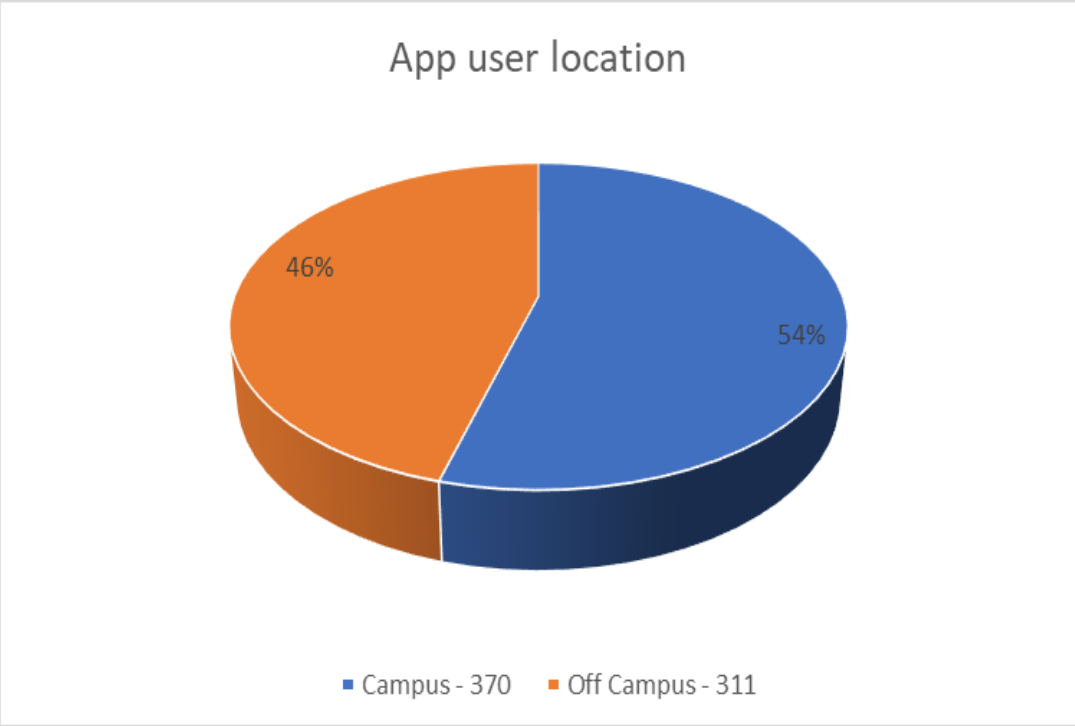


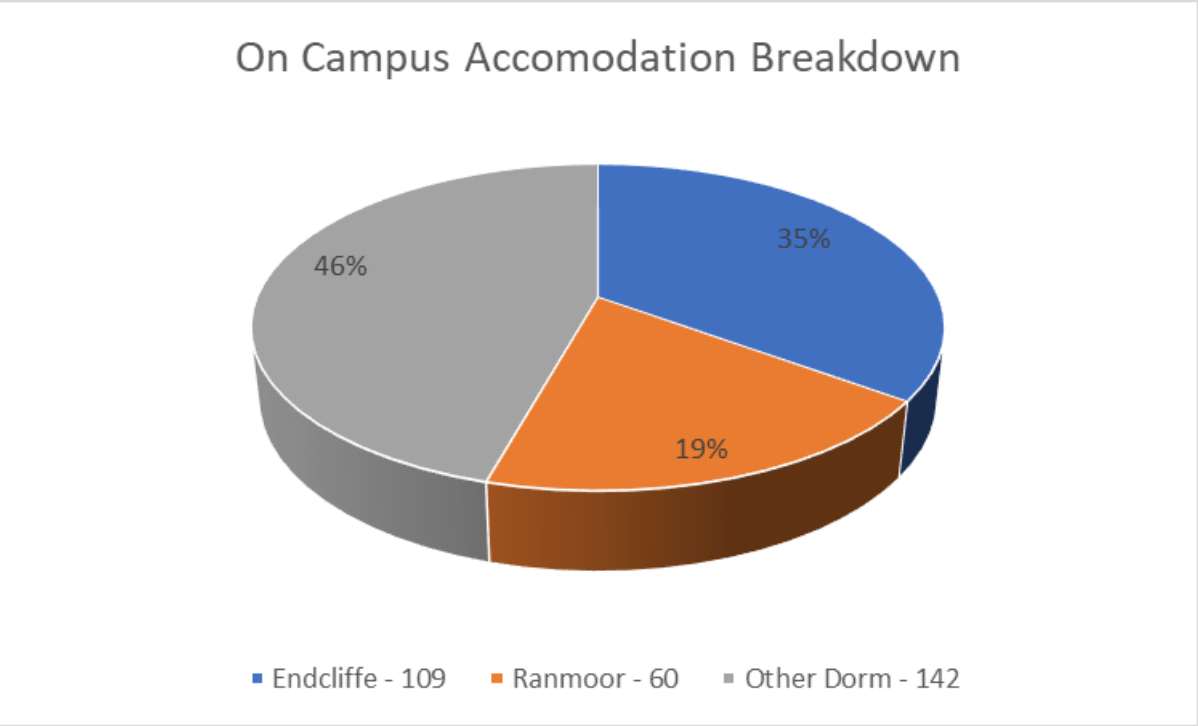
There were 894 unique users of the Gub Gub app, 74% of users (661) completed the on boarding survey which questioned users on their diet, reason for download, location and postcode, establishing the user demographic and rationale.

A total of 5 unique users are identified as Admin or central to the project setup, for data analysis all interactions with Gub Gub by these 5 unique users have been removed from these statistics.

This is ~2.96% of the total University of Sheffield population (Total number of students 2021-22: 30,129)

User location (on or off campus)

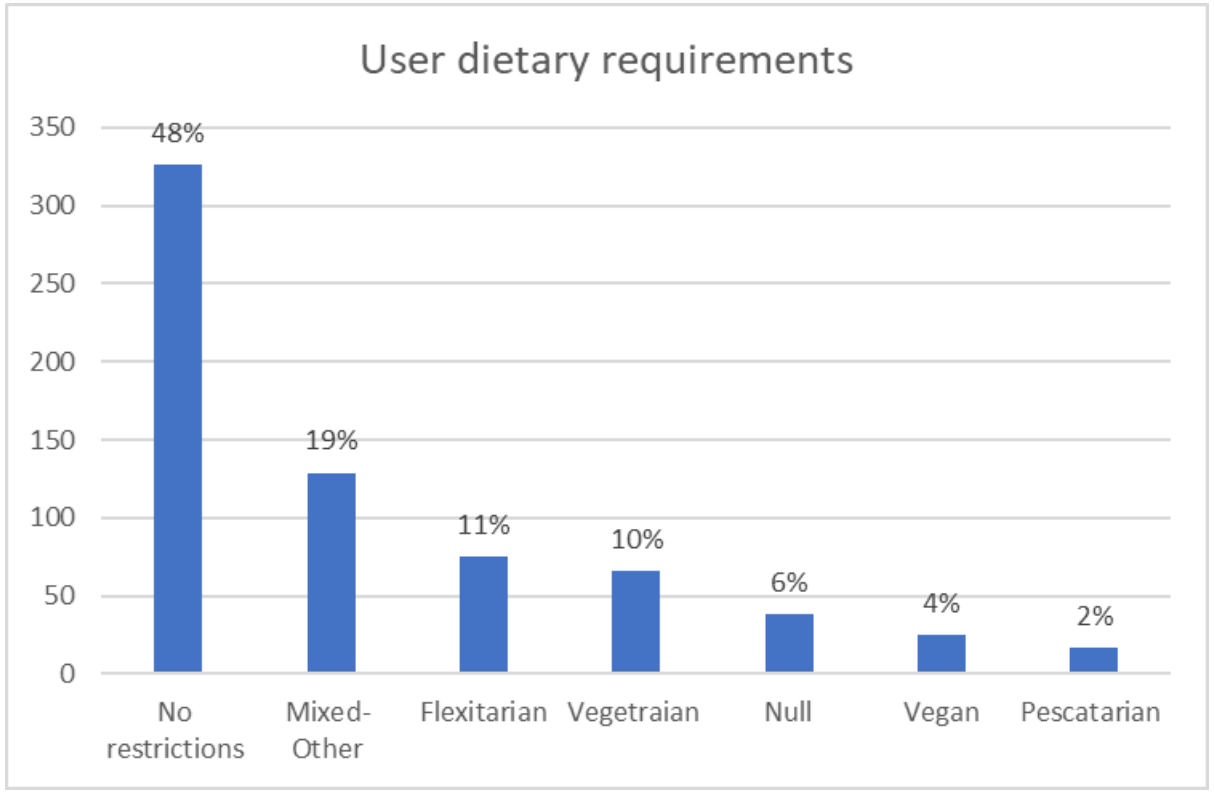




Of the 74% of users who completed the initial demographic survey (n=661), there was a fairly even split between campus and off campus users, with 54% of app users living on campus.

Of the 35 different accommodation blocks (total population 5437) at The University of Sheffield, there were app users living on campus were from the following accommodation: Endcliffe (109) Ranmoor (60) and other dorms (142). This is 6.8% of on-campus population.

User dietary preferences



Of the 74% of app users (661) that completed the initial survey, user dietary preferences. Mixed-other refers to when a user has selected a combination of the dietary categories e.g. no preference, vegetarian and vegan.

The number of students following other dietary patterns is similar to previous research conducted in 2019-2020 at the University of Sheffield (Larner et al 2021)

Marketing timeline and impact data

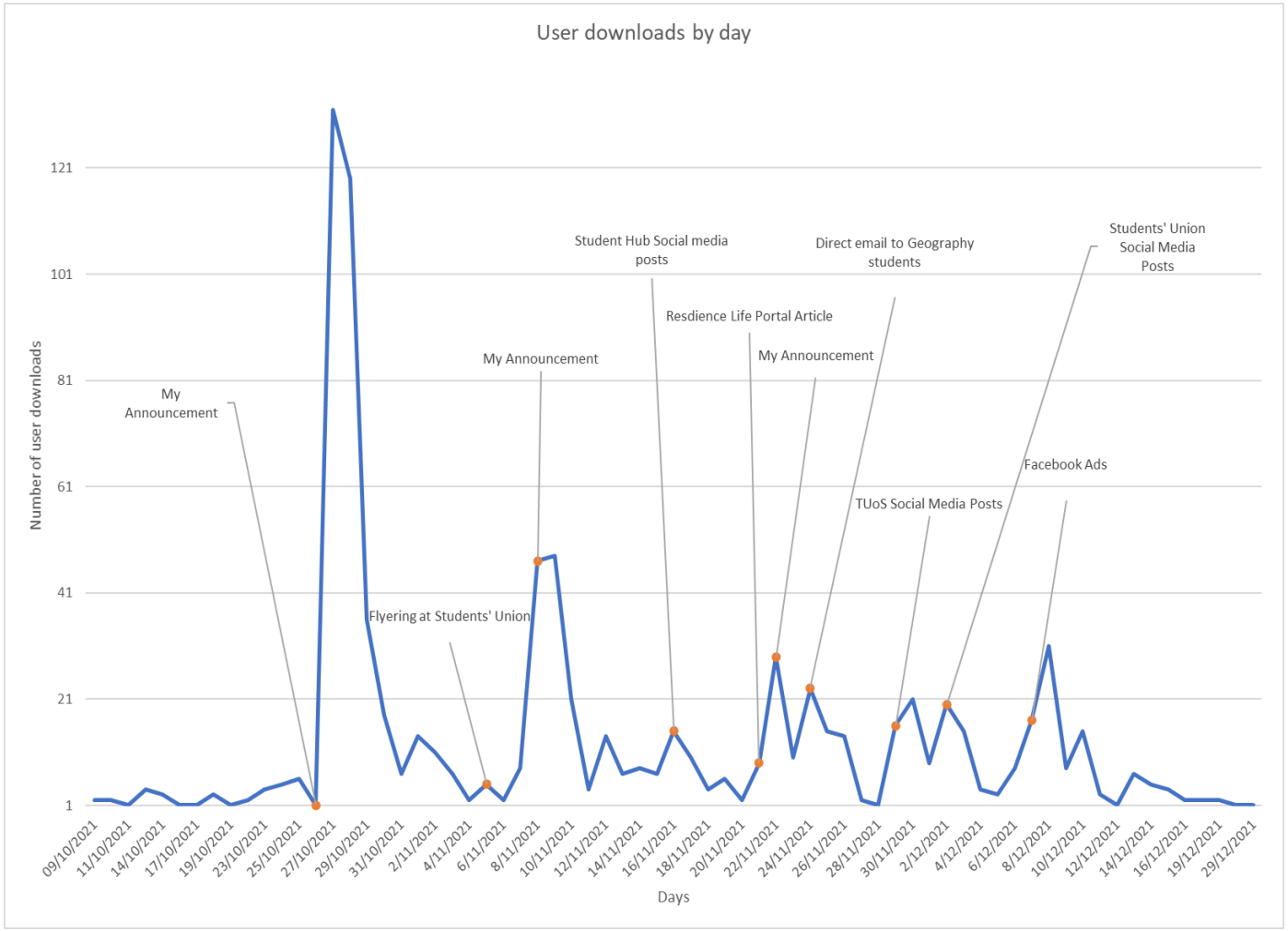
Multiple promotion events occurred over the pilot to promote the app.

The most pronounced increase in user downloads was on the 26th of October when a MyAnnounce email was sent to 23,133 student email addresses, this resulted in 120+ downloads. See the next slide for the download statistics over the intervention.

The correct marketing of the app was found to be of significance to the successful running of this project. The “third” and “omicron” waves of COVID-19 had negative impacts on planned marketing activities throughout the project, dramatically reducing in-person marketing opportunities, and making the team reliant on digital outreach.

Date	What	Recipient count/Followers
19/08/2021	My Announcement: Beta testers needed for new food waste app Gub Gub	4424
18/09/2021	Welcome pack Gub Gub advert	8000 booklets
24/10/2021	Residence Life Portal Article - Gub Gub food management app article	
26/10/2021	My Announcement: Gub Gub Food waste app available to all The University of Sheffield students	23133
28/10/2021	Flyering at the Students Union	200+ flyers handed out
28/10/2021	Forge Press- Student newspaper - Food management app launches at Sheffield	
05/11/2021	My Announcement: New: Gub Gub app rewards at Coffee Revolution. Save food, earn rewards!	5902
05/11/2021	Flyering at the Students Union	2 hours flyering
06/11/2021	Forge Radio interview about Gub Gub	
08/11/2021	My Announcement to staff: Explore the new food waste app	1724
09/11/2021	TUoS SU Social media posts- Instagram stories, Facebook Post, Twitter	Facebook 32,805 followers, Twitter 35.6k, INstagram 14.6k
09/11/2021	Coffee Revolution Facebook post	Facebook 1700 followers
05/11/2021	Residence Life Portal Article - New: Gub Gub app rewards @ Coffee Revolution	
10/11/2021	Geography Department newsletter	
16/11/2021	Student Hub homepage Social media posts - Instagram stories, Facebok stories and Facebook Post	
21/11/2021	Residence Life Portal Article	
22/11/2021	My Announcement: New rewards available at New Leaf and Proper pasty	6k
24/11/2021	Blog post Sustainability Sheffield	
24/11/2021	Direct emails to GEO UG1,2,3,4PGT,PGR email lists	
29/11/2021	Gub Gub shared Uiversity of Sheffield Students Page	6k
02/12/2021	SU Social media accounts	Facebook 32,805 followers, Twitter 35.6k, Instagram 14.6k
06/12/2021	Facebooks Ads	3,8888 Reach, 38 post enaggement, 38 link clicks
07/12/2021	My Announcement:There is still time to get involved with Gub Gub before the end of term!	5916

User downloads over time



This figure shows the user downloads by day, through time, highlighting key marketing events and associated impact.

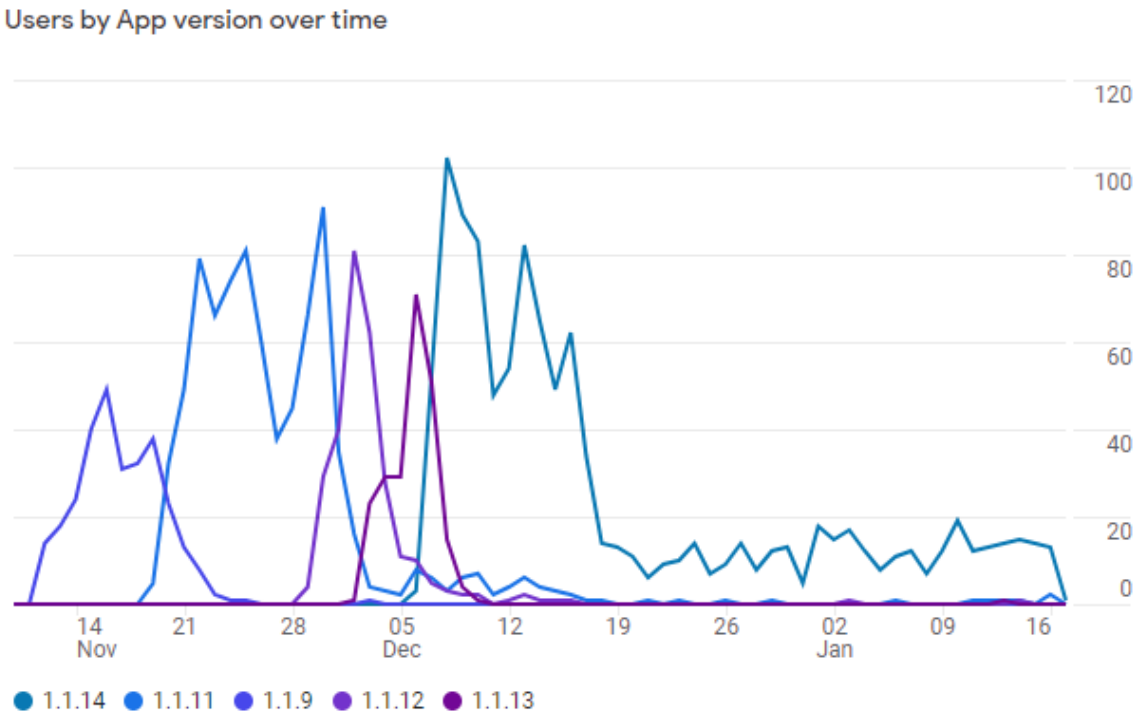
Of the 1229 individual food entries to the Gub Gub app, there were 156 unique user ids, de-duplicated from the user data.

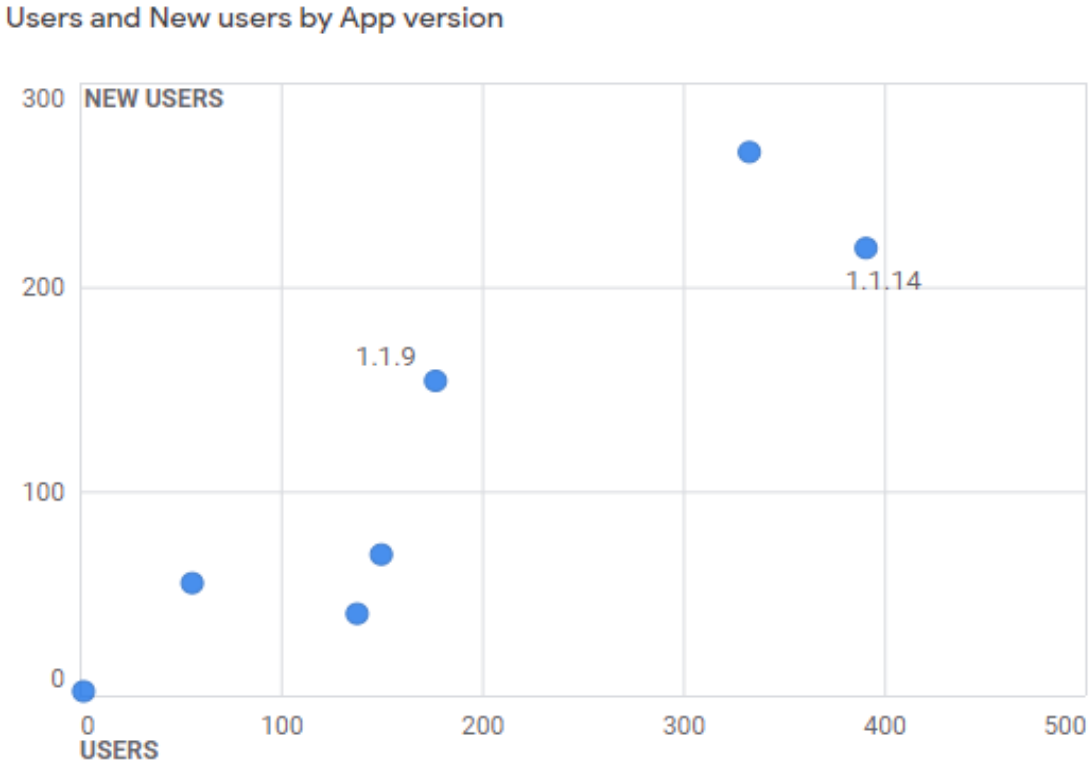
On average each user added 7.8 items of food from 10th October-29th December. Of the 156 unique users, 41 users ‘Used’ the food they inputted at least once.

This highlights that there was a “core” 17% userbase of who input food into the app on a regular basis. Recruitment of these “core” users was spread across the intervention. However due to COVID and end of term, less users were recruited in December.

	Number of user downloads	%
October	348	39%
November	382	43%
December	165	18%
TOTAL USERS	895	

Gub Gub Version releases timeline

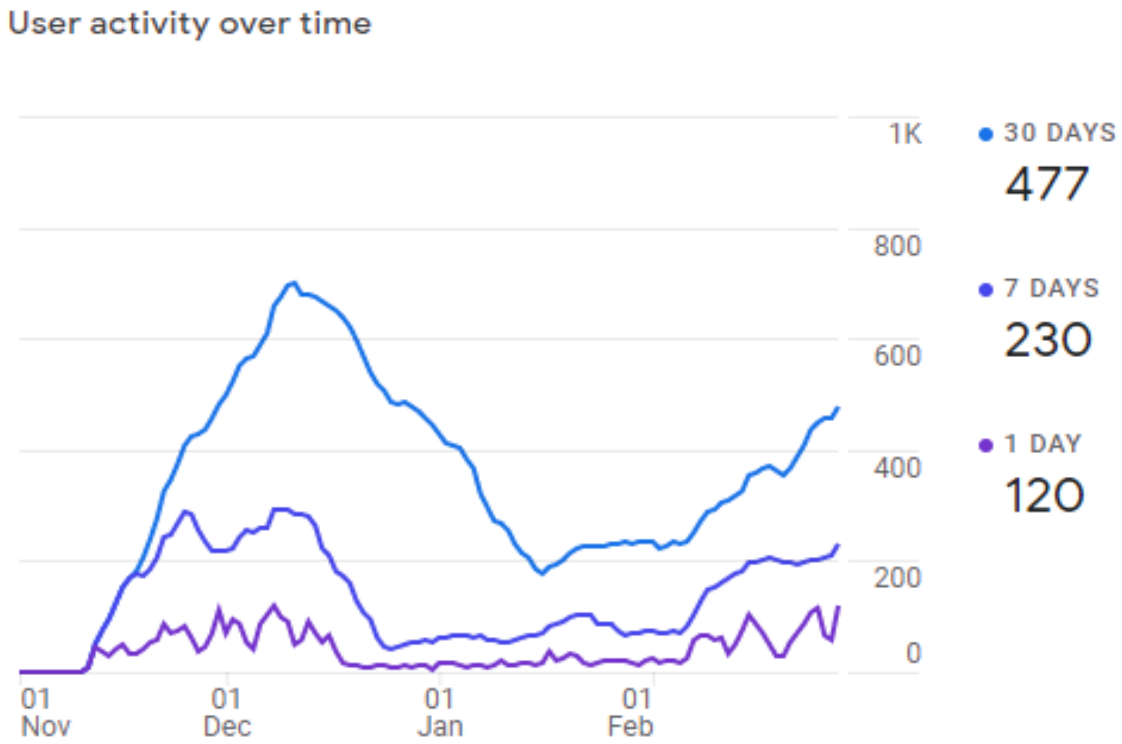




Version control was issue with the Gub Gub app due to not having an automatic update feature. To get new features users had to uninstall and then reinstall the app. Each time this happened some users did not re-install the app.

Version 1.1.14 was the last version of the app, deployed in 6 December 2021 with additional gamification features “New Hat Challenges!” . However due to Omnicron and the lack of automatic update, there were only ~200 new users, for a total user base of 400 users. Some of this user base was very loyal and continued to use this app over the write-up monitoring and evaluation period (Jan-April 2022) (see next slide).

Post intervention User Levels



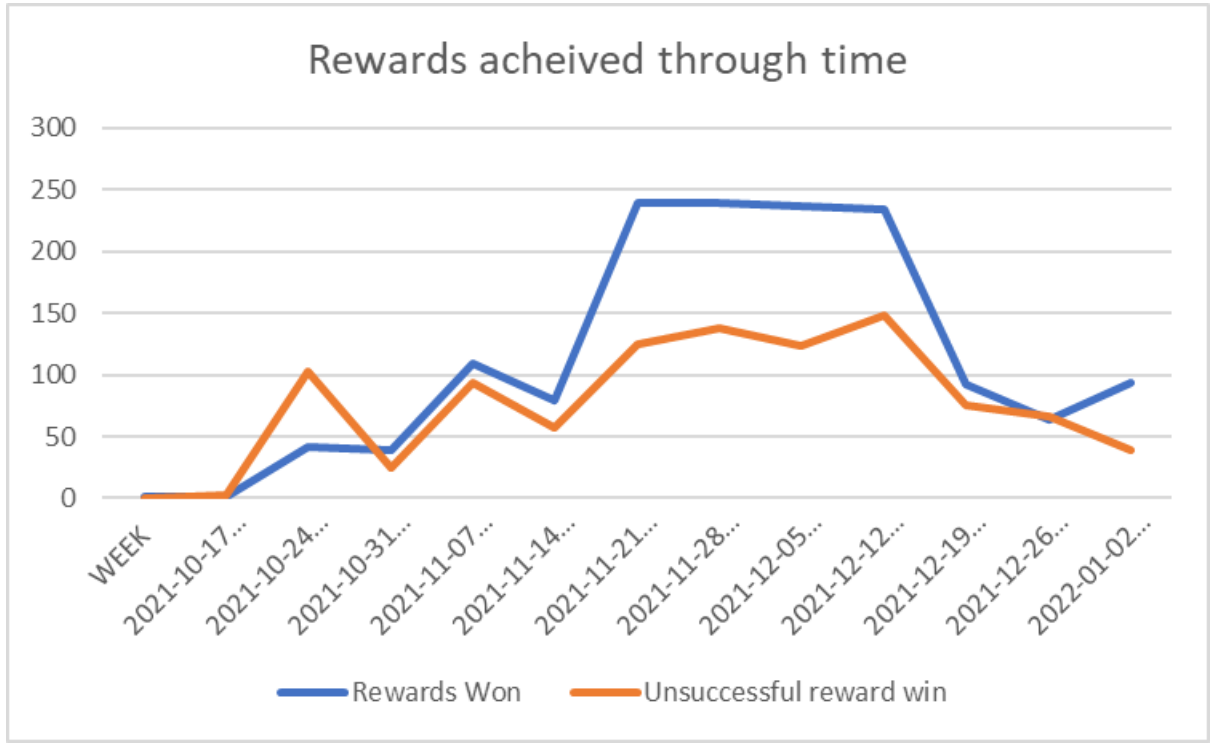
The user base for the app after the intervention was over continued to grow. As of 1/3/2022 the total users is 1398, with ~120 daily active users and ~230 users who engage every 7 days.

This confirms the narrative of a “core” userbase with additional users organically growing the community over time.

Quiz results and user learnings

A quiz “game” was available from the initial launch of Gub Gub beta tester stage in early October 2021.

The introduction of rewards on the app commenced in the first week of November 2021. The quiz comprised 3 food (waste) based questions, completing all questions correctly resulted in a reward. Any incorrect answer resulted in no reward and another opportunity to try the quiz again, with different questions, ‘cost’ the users points. Initially, once the reward was gained, or the quiz unsuccessfully completed, users had to wait a week before attempting the quiz again. Reward availability gained by answering 3 questions correctly ensured randomisation of the prizes and opportunities to gain rewards and allowed administrators control of reward budget.



At a later date 12/11/2021, to help encourage users to continue interacting with the app and ensure the app remained appealing, the quiz was available every 24 hours. The purpose of the quiz was twofold; randomisation as well as encouraging and increasing user understanding of food.

The above shows the proportion of successful and unsuccessful 3 question quiz responses per week, through time. The quiz became available every 24hours on 14/11/2021 which is evident in the sharp rise in questions being answered on the graph.

Rewards claimed

A total of 1023 rewards were gained through the quiz, however only 54% (552) rewards were claimed, leaving 46% (471) rewards unclaimed or expired.

The breakdown of rewards claimed is as follows:

New Leaf = 177 salad wraps at £4.25 each £752.25

Proper Pasty = 53 rolls at £1.70 each £90.10

Traybakes = 118 at £2.10 each £247.50

Filter Coffee = 29 at £1.70 each £49.50

Tea = 17 at £1.70 each £28.90

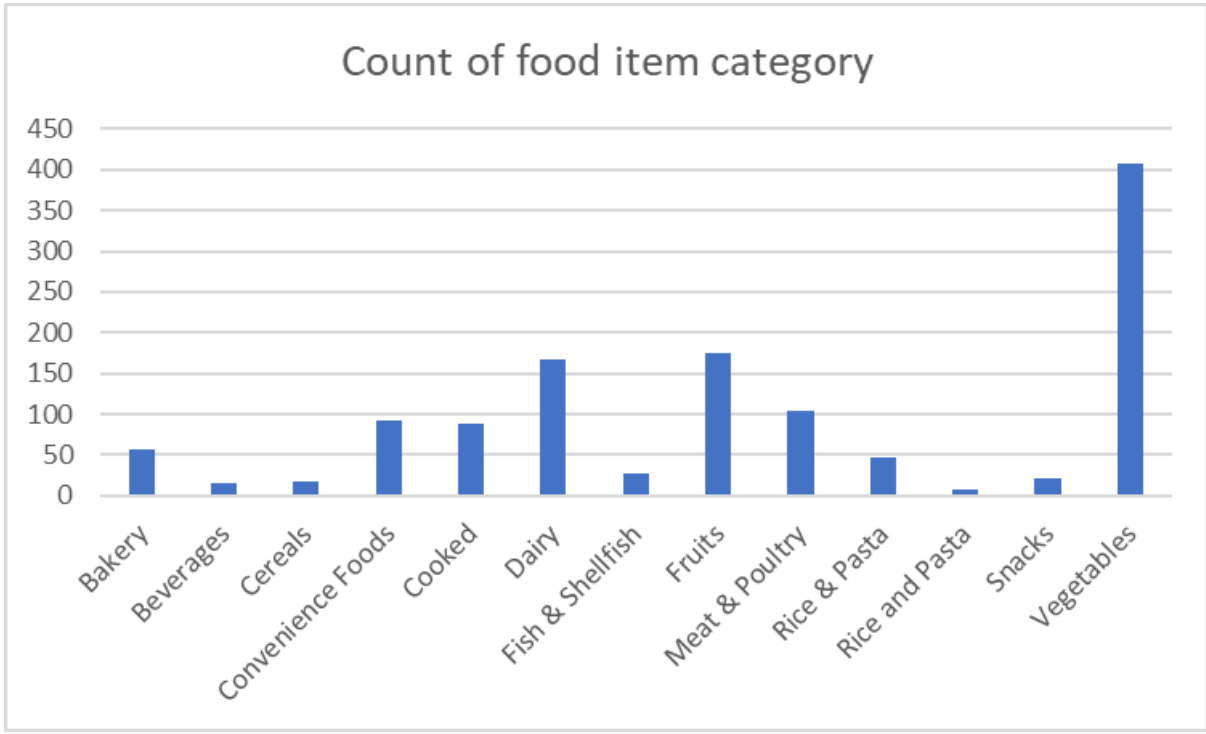
TOTAL = £1168.25 during the intervention period

Due to the high Post intervention User Levels we continued to use the pre-invested funds until the end of the period with £5095 spent by 28th of February 2022. However this additional rewards claim was not included in this analysis

Recipes and Shopping lists

A feature of the App was the ability to create shared recipes and shopping lists. These functions were not as used by the users that much, despite user feedback in pilot phases suggesting this was important, and gamification integrated to promote these features. 43 Recipes were added by the users. 79 shopping lists were created by the users.

Foods added to the app



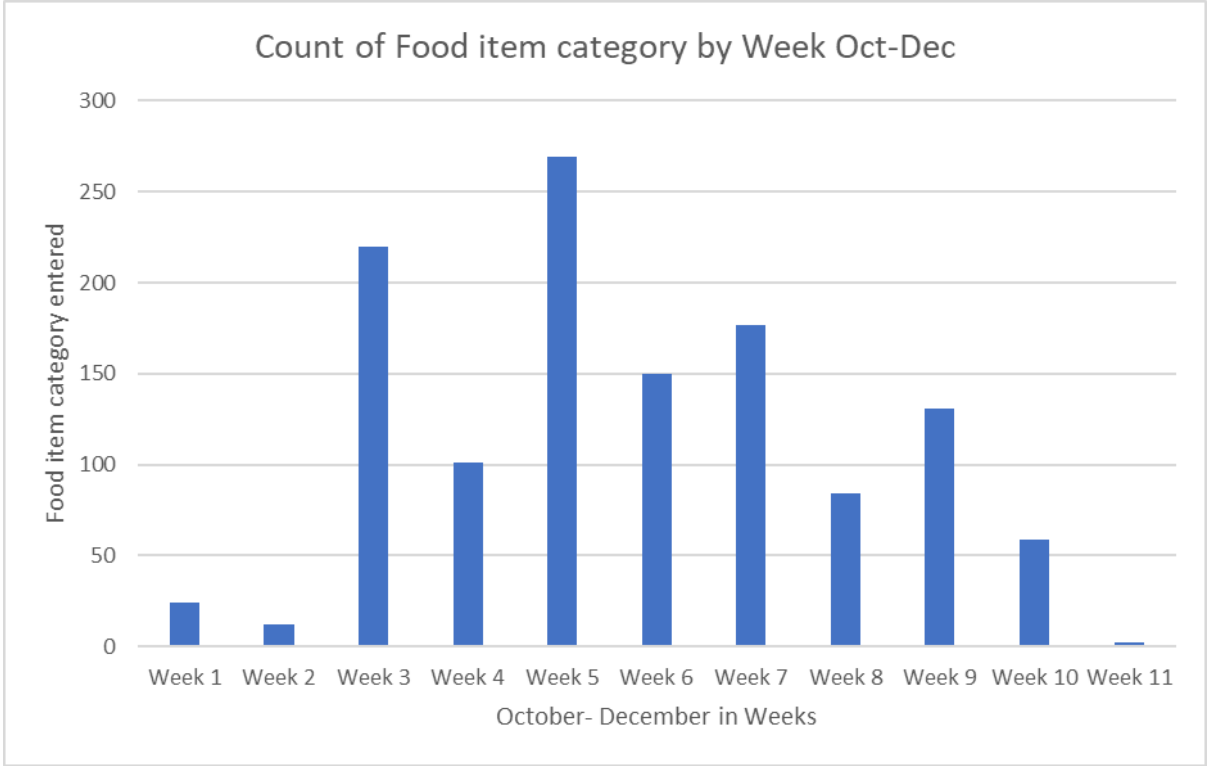
Row Labels	Count of category
Bakery	56
Beverages	15
Cereals	18
Convenience Foods	93
Cooked	88
Dairy	167
Fish & Shellfish	28
Fruits	175
Meat & Poultry	105
Rice & Pasta	48
Rice and Pasta	8
Snacks	21
Vegetables	407
Grand Total	1229

Vegetables, Fruit and Dairy were the most common items added to the App by users. This is the number of times this category was entered not the weight/cost/waste of the items.

Of the 1229 individual food entries to the Gub Gub app, there were 156 unique user ids, de-duplicated from the user data. On average each user added 7.8 items of food from 10th October-29th December. Of the 156 unique users, 41 users ‘Used’ the food they inputted at least once.

It is apparent that many users did not input all their shopping into the app.

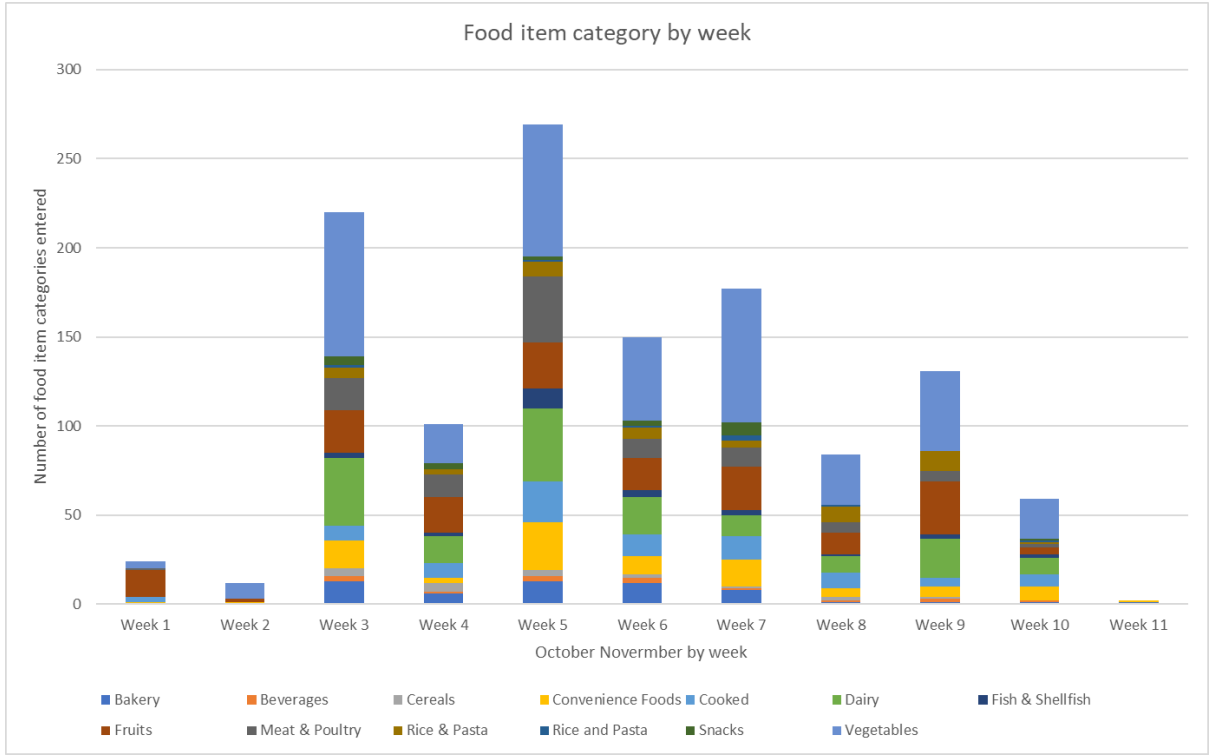
Food input per week



The above graph shows items entered by week, starting Sunday 10th October and ending 22nd December when the last item of food was entered. This is the number of items not the weight/cost/waste of the items.

This corresponds to the growth of userbase over the intervention, and highlights that there was consistent use of the app by a “core” user group – until the end of term and the omicron COVID-19 wave.

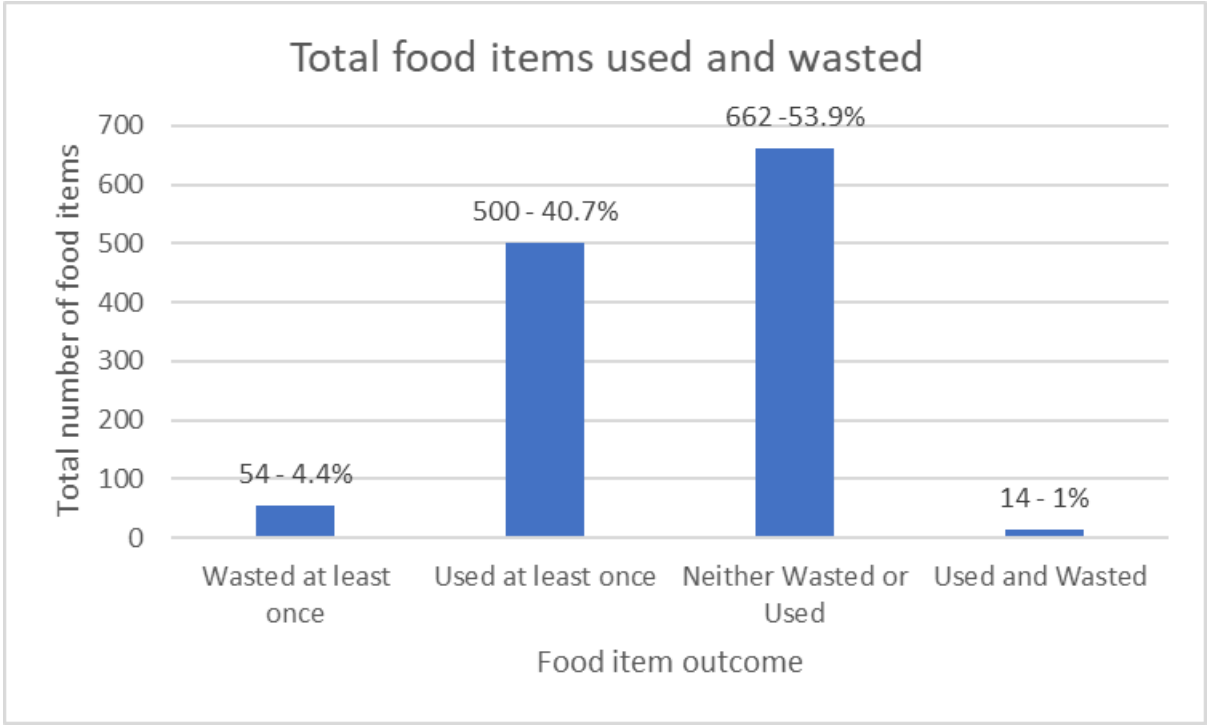
Food item category dated by project week number October-Dec Week 1- 11



The above stack graph shows the entry of food categories through time by week, starting 10th October 2021 until 22nd December, the date of last food category item entered.

This shows that there is a consistent entry into the app of a variety of food categories. The most popular being vegetables, fruit, and dairy. Note this is the number of entries, not the total weight of the food entered.

Use and waste of items



Each item entered could be “used” several time, as well as wasted.

This used and wasted score is equal to 100% of item entered.

14 items (1%) entered were used and wasted to 100%. (414 items were used 99-100%.) 40.7% were used at least once, and 4.4% were wasted at least once. However 53.9% of items entered were not used or wasted at all.

We assume that this not wasted or used foods may have been entered to test the app, but then the user did not return to the app to continue to use the app. This retention and engagement of users is a clear learning from this project.

Multiple uses of an item

Number of updates to 'Used' status	Number of updates to 'Used' category
	1229 items added to Gub Gub
1	514 items used
2	158 items used
3	51 items used
4	18
5	7
6	6
7	3
8	3
9	3
10	2
11	2

Items were engaged with more than once in the app. With some items having more than 5 to 10 interactions. The item with the most interaction in the intervention period was updated 11 times after being entered on 15th December and was last amended on the 21st December.

This level of item engagement is similar to that found in other research (Kandemir et al 2020), with typically foods being purchases and engage with 1-3 times before being totally consumed or disposed of.

The amount of interaction is dependent on the type of food product- e.g. dairy has higher number of uses. However the action of updating the app for every use may have resulted in under reporting.

Monetary data

The first food item added to Gub Gub was on the 10th October 2021, with items still being added in January 2022. For reporting purposes the last day of academic term was the 19th December and the last item added in 2022 was on the 21st of December. Of the 1229 items of food entered into Gub Gub:

414 items were used 99-100%. (This is due to the slider interface possibly making 100% use/waste difficult)

£ Total Inputted into Gub Gub = £878.70 (664 items were inputted with a monetary value)

£ Total Used in Gub Gub = £353.12 (316 items were used with a monetary value)

£ Total Wasted in Gub Gub = £35.93 (41 items were wasted with monetary value)

£ Total unaccounted for = £489.65 (661 items were unaccounted for, neither used nor wasted)

Not all food items entered into Gub Gub were given a cash value, of those that were the total was:

£ Total of unused and unwasted food inputted £441.17

561 items were entered into Gub Gub without a £0 value, of those items

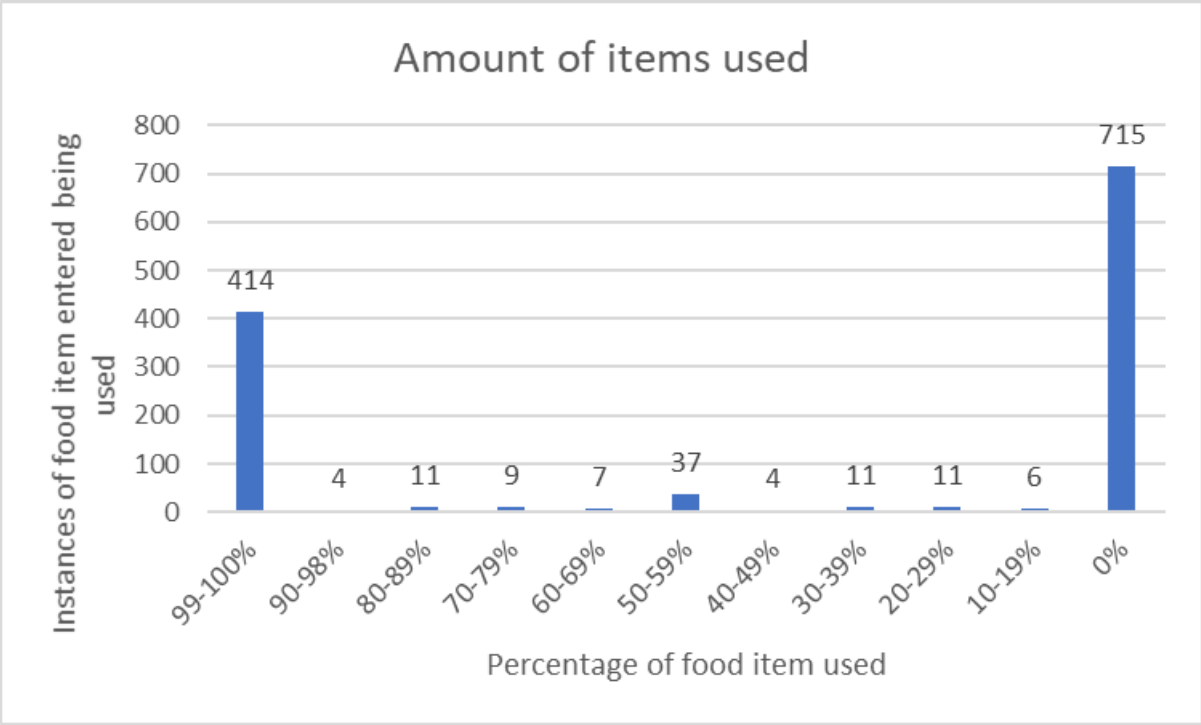
195 items were used

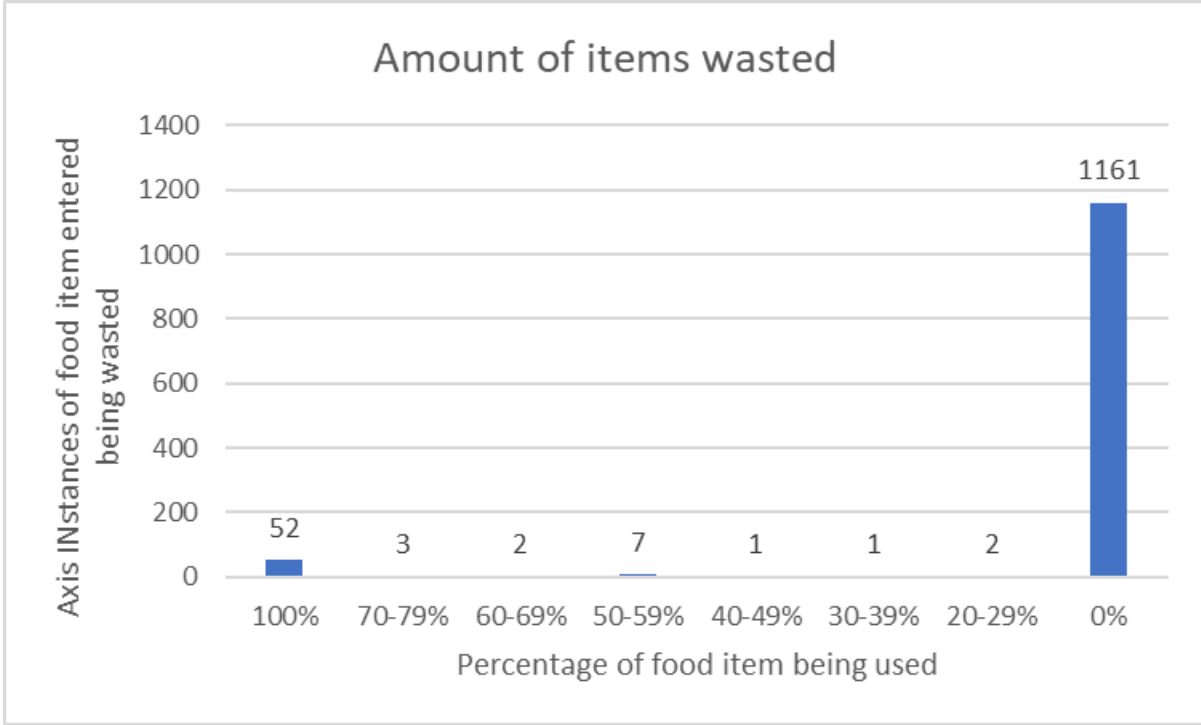
22 items were wasted

344 items were neither used nor wasted

Anomalies in costing were created through the receipt scanner incorrectly entering product information. For total inputted food items costing £3300, £690 and £500 were removed. There could be further anomalies within the data, but if so on a much smaller scale of error.

Amount used vs wasted

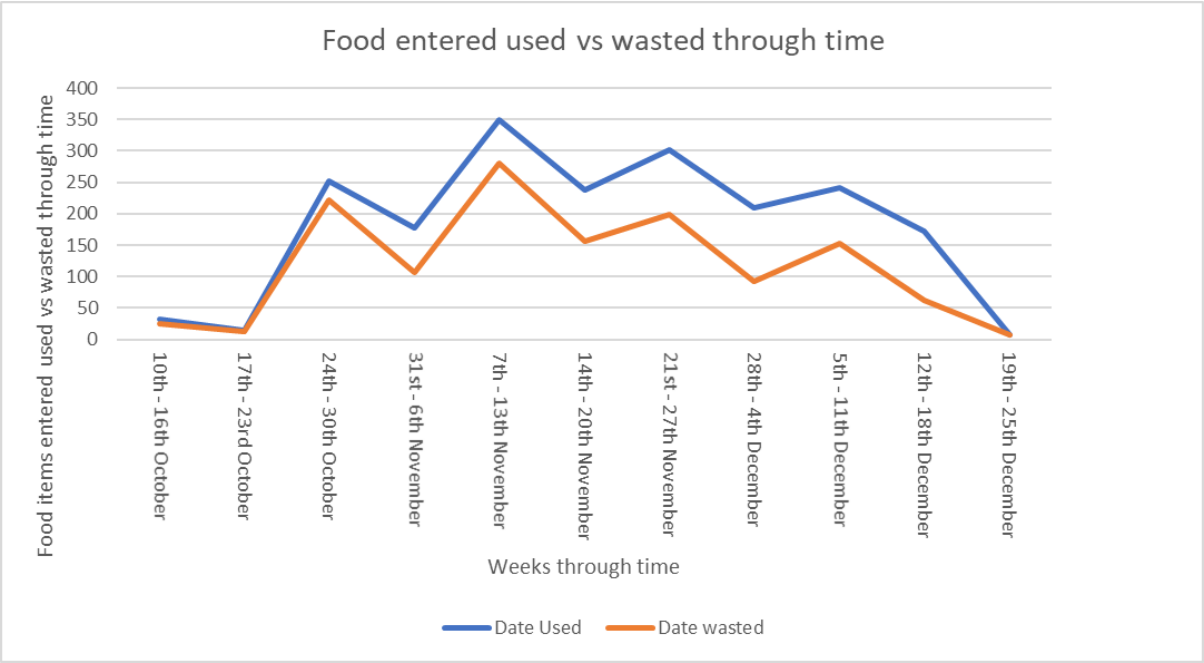




Feedback on this functionality highlights that there was confusion over the design/use of a slider to enter this food. As some users have thought that they fully used or wasted an item but only reported 99% use.

This highlights the large amount of overall food use within the app, and less waste reporting. This could be possible under reporting of waste due to the explicit aim of the app being food waste reduction.

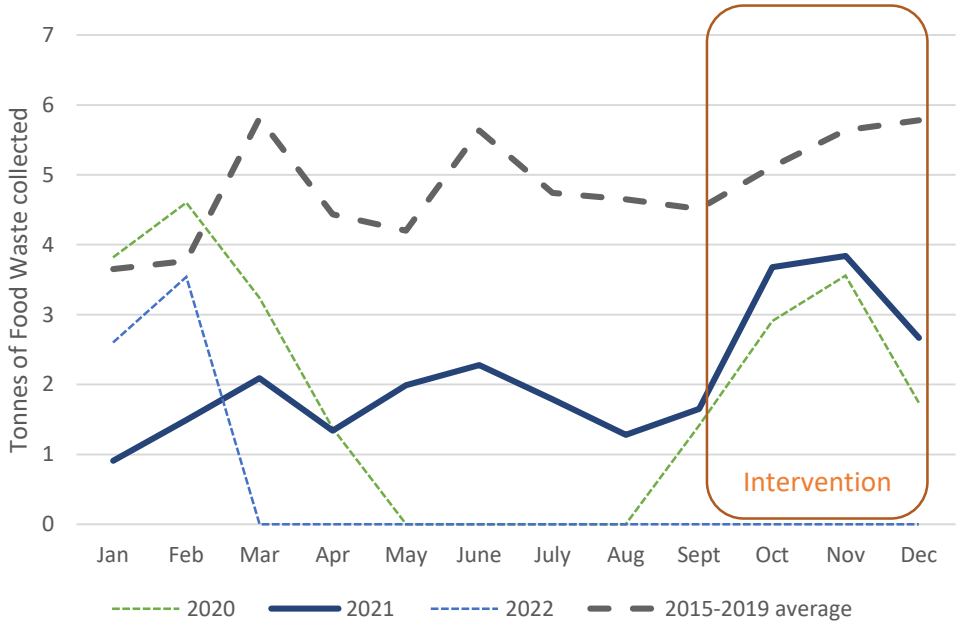
Date used vs date wasted

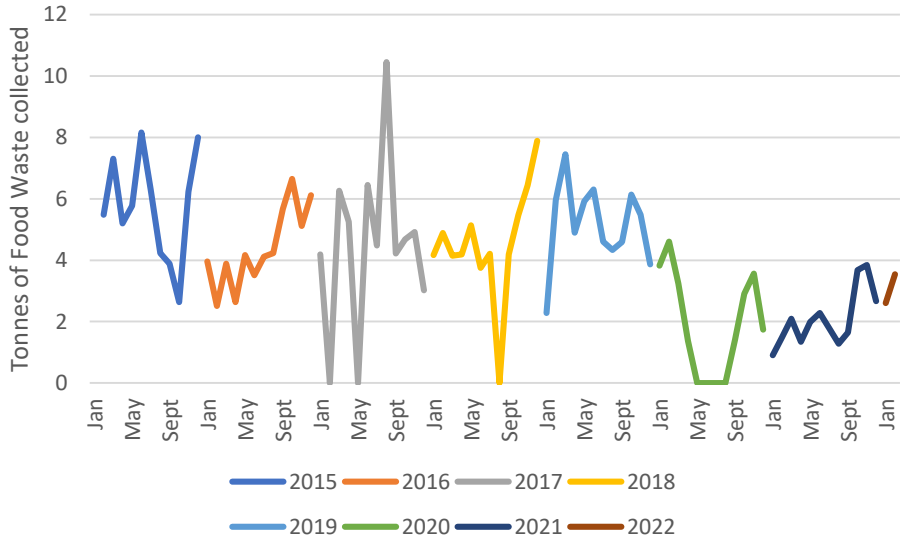


The figure shows that there was consistent weekly activity (above ~150 use events) from 24th of October to 18th of December).

Use and waste of foods were linked to food input into the app. More items were used as the pilot went on (with the user base expanding). Less food was proportionally wasted as the intervention went on.

Food waste in halls of residence





In the intervention, monthly food waste collected from the halls of residence (average 2.96 tonnes/month) was below Monthly Average Weight 2015-2019 food waste (4.8 tonnes/month). (see figure left)

However, this is not a reliable evidence of food waste reduction due to app introduction due to differences in student numbers and post COVID recovery, as well as only 7.4% of on campus population using the app.

Food waste collection from the halls of residence

2020 - 38.27 tonnes **2021 (Intervention)** - 32.83 Tonnes **2022** - 16.27 (tonnes to Feb-March)

The figure (left) shows an increase of the food waste collection from the halls of residence in 2021 compared to 2020 during the intervention period, this could be due to increase student numbers.

The figure (right) shows a high level of monthly variation in the 2015-2022 food waste collection from the halls of residence. The September-October “freshers” spike is less sever in 2021 than in previous years.

Summary of waste impacts

- Only 4% of food was recorded as 100% wasted on the app, 48% of food was “used” (33% recorded as 100% used).
- £35.93 of food was wasted and £353.12 of food was used over the intervention. £489.65 was unaccounted for being neither used nor wasted.
- The proportion of reported waste to used decreased over the intervention period. The core user base was buying more and wasting less over the intervention.
- The food waste collection from the halls of residence in 2021 was lower than Monthly Average Weight 2015-2019 but higher than the volumes for 2020. This could be due to increased student numbers staying in halls of residence in 2021.
- Volume of household waste reduced as a result of the intervention is difficult to calculate due to the limitations of data entry, app “clunkyness”, and no baseline. This metric needs to be thought about further in terms of integration into a food waste reduction app.

How successful was the intervention?

Overall this intervention was unsuccessful, not reaching recruitment targets for effective evaluation. However useful data on the use of food waste management apps was collected.

- There were a total of 894 unique users of the Gub Gub app, during the intervention period.
- This intervention was successful with a core group of ~150 users who continued to use the app after the intervention period.
- Gamification and quizzes proved popular with users. However, only 54% (£1168.25) of rewards were claimed, leaving 46% rewards unclaimed or expired.

Wider uptake of the app was blocked by the following barriers:

Clunky data entry procedure: there were 600+ food items enterer that were never updated. This could be due to user attrition/lack of engagement.

Lack of automatic update features: there was a maximum of 200-400 users of the app over the intervention.

COVID-19: barriers to the (face to face) marketing of the app in the wider student community. Many planned recruitment activities cancelled, and less student foot-fall on campus.

Learnings
Recruitment – organisational support is vital.

This intervention has shown that having a wide base of organisational support is vital when deploying an intervention on a university campus. This project has support from teams in the halls of residences, on-campus catering, IT and social media, the students union and university Sustainability teams.

Without this wide support network recruitment would have been slower and less effective.

The rapid pivot to online recruitment due to COVID-19 prevented many of our planned recruitment and marketing actions in November and December 2021 from happening, and this kept out recruitment numbers low.

Any future project needs to provide funding to support a wide range of partners deploy and market an app in both in-person and digital spaces.

Learnings
Apps useful to monitor food waste practices – not just for reduction

The Gub Gub app has been useful to monitor food waste and shopping habits when integrated into wider sets of data. The ability to monitor halls of residence waste, on-campus food purchases, and app engagement all together provide a clearer picture of food waste on campus.

In the future apps can be used as a mechanism to reduce food waste AND to continue to monitor food waste and shopping habits as part of wider food waste monitoring tool kit.

Note: many users did not input all their food shopping into the app (nor does the app collect food purchases and eaten out of home). This means the app does not give a complete picture of food waste and shopping habits for each user.

For specific foods categories like dairy, fruit and vegetables there was enough data to explore usage and shopping patterns further.

Learnings
University campuses are particularly good places for testing out new technologies

We will continue to test new app features and approaches with the Gub Gub app with students, prior to sending out new features to wider audiences as we have found these areas to be “safe spaces” for testing new app features. Many students were happy to test new app features and provide feedback. From previous experience is has been harder to test new app features with people outside of the student community and harder to re engage them if app is modified.

Learnings

App currently too clunky for most students to use - improved food input into app needed

For most students, the app was too clunky to input their food into app. Manual food input took too long. Receipt scanner feature not accurate enough. Many students felt that they would use the app if food could be more easier to add.

Possible ways to go about this are:

Barcode scanning - Allowing users to scan products whilst they are completing shopping (very similar to Shop & Go apps supermarkets already have)

Improved receipt scanning feature - including for online receipts as a number of students were shopping online

Suggested inventory items - Based of previous logged items and possibly commonly purchased items for new starters.

Improved shoppable recipes functionality - Better support planning food shopping but also can help with auto inventory input

Improved user interface layout - Based off student feedback we believe there is a way of making the perceived clunkyness feel less clunky based on where the buttons are laid out. We will be making those changes soon.

Voice editing of inventory - Allow users to say “ two apples, 500g mince, one jar of honey”. Potentially this could also help for easier input of exact expiry dates.

Learnings

Target market for app was primarily financially savvy students, interested in saving money and eating on a budget

Initially we thought that the main users of the app would be environmentalists. In fact the main users were those who wanted to save money and eat on a budget and environmental reasons were a secondary concern. Many of the more enthusiastic app users had above average levels of cooking skills, omnivores who cooked regularly (3+ times a week) and many had adopted good food management skills such as batch cooking and meal planning. Additionally, many of the primary users were interested in trying out new technologies. The future focus of app development and marketing will be to help users save money, manage their food easier and provide personalised recipe suggestions.

The second main user group were those interested in environmental issues. Further down the line we would like to include environmental features for the app (e.g. carbon calculator, low carbon/environmental impacting recipes, composting support features) which can support environmentalists in reaching their goals.

A number of students were interested in health features (e.g. macro and micro nutrient calculator). Many students used apps such as MyFitness Pal to record calories and said that they would instead use Gub Gub if they could measure their diet.

Learnings
Exact expiry dates for food not essential but preferable

Prior to conducting trails, the project team felt having exact expiry dates would be essential for most users. In fact this wasn’t the case and approximations were adequate for most users.

In the future, having QR codes that provide a “digital twin” for food items could create huge opportunities for auto input of food items as well as a number of other things such as supply chain traceability, reducing fake food etc. In the nearer term, having voice editing inventory functionality could potentially help provide an easier way of accurately editing expiry dates. Since exact expiry dates are not a major barrier for app users, this is of a lower priority for future development.

Entering the correct weight of food is a larger barrier to accurate waste measurement.

Learnings
Gamification shows great potential and will be improved upon

There is great potential in gamification and variable rewards, in particular:

a) A number of users were keen to complete the in app quests and hat challenges. Recipe posting went up when hats were awarded and a considerable number of people completed challenges. Digital assets are cheap to provide at scale.

b) The quiz was popular and anecdotal evidence appears to indicate this was a fun activity and helped users gain food knowledge. We intend to expand the quiz functionality and create a levelling system, with lower level users getting easier questions and higher level users getting harder questions to answer. The data provided by the quiz has not been analysed by this project.

Learnings

Variable rewards encourage users to use app and show great potential in create good food management habits

Users liked the variable rewards and is an effective method of gaining users.

Post intervention there were reports from on-site catering teams of abuse of the variable reward functionally in a small number of cases (students using multiple phones to gain multiple rewards).

The project team believes that there are sustainable methods of providing variable rewards for users in return for monetization opportunities for users data as well as providing opportunities for food and drinks companies or supermarkets to target market produce and potentially carbon trading in the future. This would allow WRAP/companies to understand how food products are wasted, and how they can support consumers to optimise their shopping and product storage to be fresher for longer.

Significant investment would be needed to make variable rewards functionality successful. However this could be a high impact feature, and enable mass adoption of the app (i.e. creating it in a way so that users essentially save money on shopping by using the app to prove they are reducing their food waste).

Future Plans – Gub Gub

The Gub Gub team are continuing to develop the app but this is dependant on obtaining further funding. The current expansion plan looks is as follows:

June 2022 - August 2022: Once app is fully updated (approx end of June 2022) acquire small funding pot from Cornwall based organisations to develop app functionality and test app within households.

August 2022 - December 2022: Complete trails of testing app with Cornish based households and further testing with students at universities in Falmouth and Sheffield

December 2022 - March 2023: Begin wider testing and promoting of app. Aim to acquire 10,000 users. Additionally aim to collaborate with a local council to support wider app adoption

March 2022 - August 2022 - Secure additional investment in order to develop new features for app and wider scale promoting.

Immediate features to develop

Below are a couple of “quick wins” we have identified that the Gub Gub team intend to develop soon.

These features have been chosen based upon a combination of ease of development, cost, desirability by users and time to implement. Most of the features we have chosen are based on aiming to help user save money, support food management and aid users inputting food into app. Main features to add are as follows:

a) Adding meal planning and batch cooking functionality - Allow users to plan day by day the meal that they are going to eat. This links to the shoppable recipe functionality and would link to users calendars (either within app or to outlook/google calendar). Batch cooking was a popular habit with users and the functionality would help users plan, prepare and manage this.

b) Develop content for reducing food waste, including tips and recipes – e.g. when preparing vegetables a lot people don't know what parts of the veg they can and can't use. This could be further integrated into the in app Quiz and Love Food Hate Waste existing content.

c) Food sharing functionality - Similar to Olio but users directly share food from their digital inventory. This can be used with other app users.

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The Resource Action Fund is an £18 million fund, provided by Defra and managed by WRAP, which supports resource efficiency projects in England in the key areas of food, plastics, textiles, recycling and litter. It does so through a variety of mechanisms including large and small-scale grants

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