COSC 419: Mobile Educational Game Development

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The Source

- Honours thesis project
- Aimed at teaching highschool students about power
  - Where they come from
  - Benefits and costs of a variety of energy sources
- Project focus
  - Design and implementation
  - Evaluation with 20 students

Game Goal

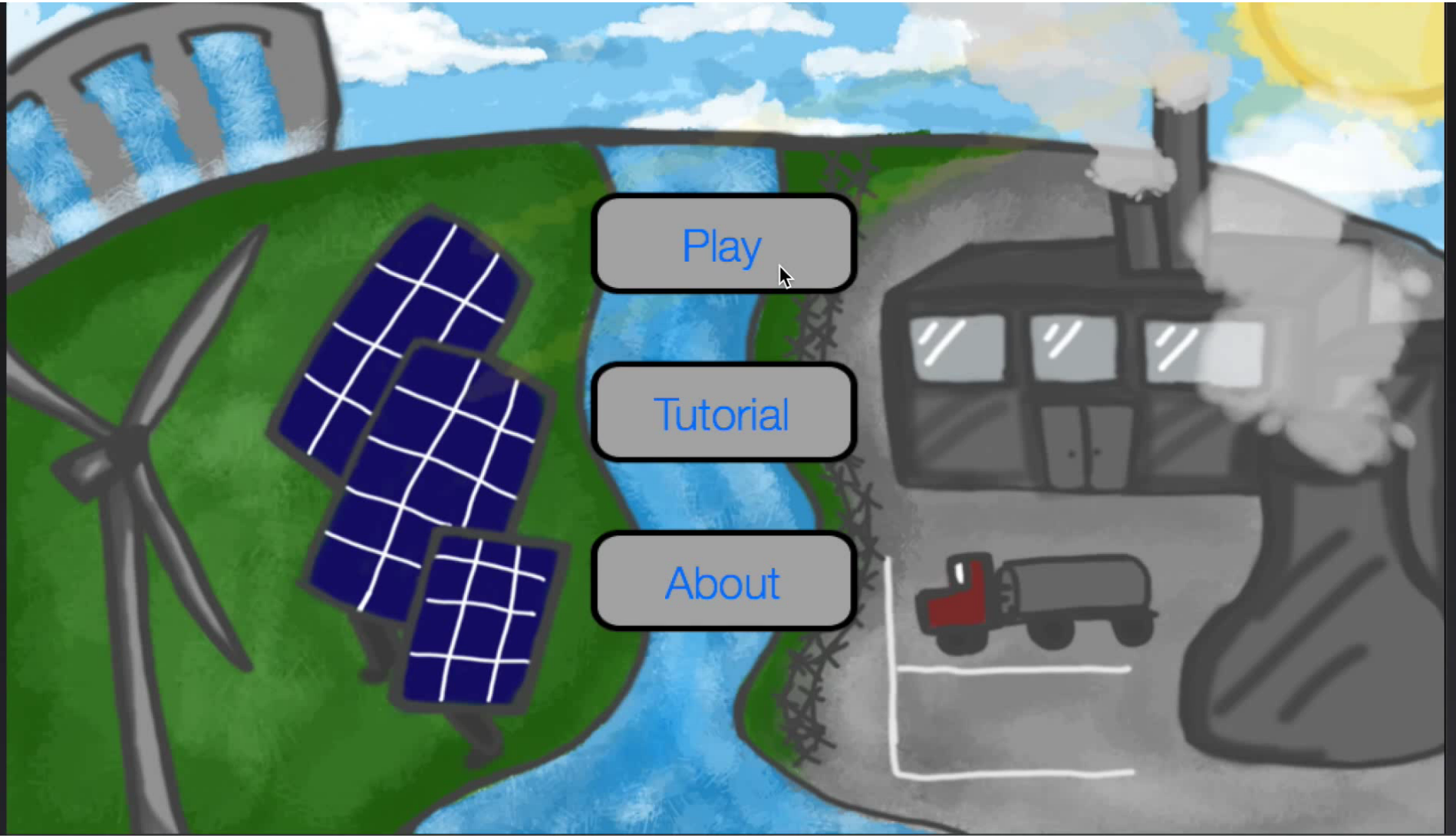
- To build a city that survives as long as possible
- Game context:
  - Energy simulator where players have to supply power to a population of people
  - Over time, population grows, demand increases

Learning about Energy

- Energy types:
  - Solar, wind, hydro, coal, oil, gas, nuclear
- Players learn costs and benefits of each
  - Coal may displease environmentalists because burning coal introduces pollutants into atmosphere
  - Sustainability of each power plant
  - Availability of resource
  - Renewable sources don’t produce as much energy as fossil fuels

Player Activities

- Purchase power plants on designated land
- Excavate/mine resources as needed
- Power supply leads to monetary payment
- Buy ads to teach population to not waste power, which leads to usage reduction
- Buy public service e.g., geologist who tells player where to mine resource
- Ads and public services influence population behaviour and opinions


Play
Tutorial
About

Navigation: Screens

- Business Screen
- City Screen
- Power Plant Screen
- Land Screen
- Resource Screen
- Hydro Screen
- Solar/wind Power Screen
- Fossil Fuels Screen

Navigation: Screens

- Business Screen – buy ads/services, see progress
- City Screen
- Power Plant Screen
- Land Screen
- Resource Screen
- Hydro Screen
- Solar/wind Power Screen
- Fossil Fuels Screen

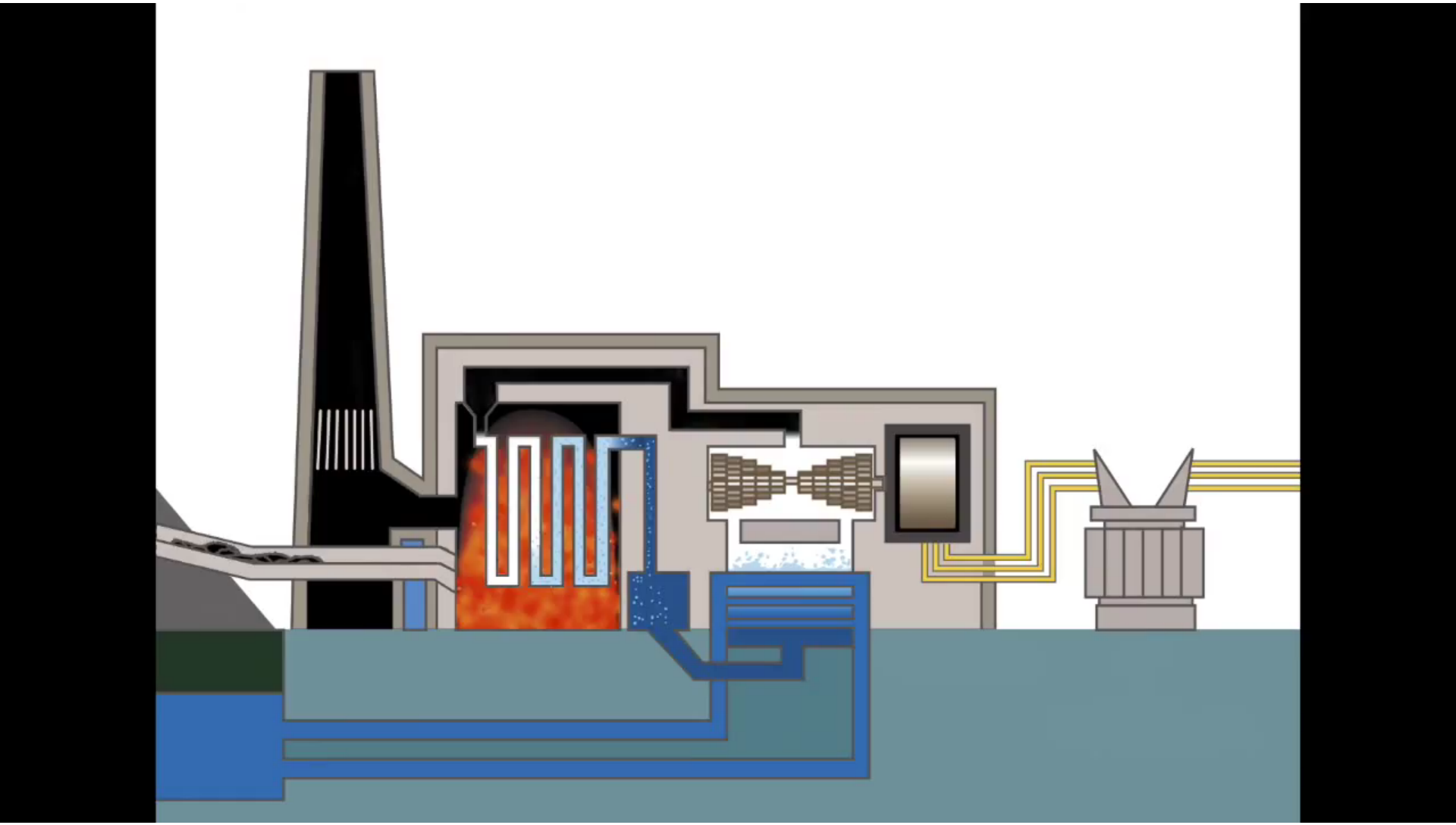
Navigation: Screens

- Business Screen
- City Screen – population stats
- Power Plant Screen
- Land Screen
- Resource Screen
- Hydro Screen
- Solar/wind Power Screen
- Fossil Fuels Screen

Navigation: Screens

- Business Screen
- City Screen
- Power Plant Screen – educational info on energy
- Land Screen
- Resource Screen
- Hydro Screen
- Solar/wind Power Screen
- Fossil Fuels Screen

Coal Animation



Navigation: Screens

- Business Screen
- City Screen
- Power Plant Screen
- Land Screen – place to build power plants
- Resource Screen
- Hydro Screen
- Solar/wind Power Screen
- Fossil Fuels Screen

Navigation: Screens

- Business Screen
- City Screen
- Power Plant Screen
- Land Screen
- Resource Screen – map of resources available
- Hydro Screen
- Solar/wind Power Screen
- Fossil Fuels Screen

Navigation: Screens

- Business Screen
- City Screen
- Power Plant Screen
- Land Screen
- Resource Screen
- Hydro Screen – rivers to build dams
- Solar/wind Power Screen
- Fossil Fuels Screen

Navigation: Screens

- Business Screen
- City Screen
- Power Plant Screen
- Land Screen
- Resource Screen
- Hydro Screen
- Solar/wind Power Screen – grid of windmills or solar panels
- Fossil Fuels Screen

Navigation: Screens

- Business Screen
- City Screen
- Power Plant Screen
- Land Screen
- Resource Screen
- Hydro Screen
- Solar/wind Power Screen
- Fossil Fuels Screen – possible land for mining

Data Collection Plan

- Metrics to address possible design issues:
  - Number of times each ad was activated
  - Number of times each public service was activated
  - Number of times fast forward button used
  - Number of fossil fueled power plants built
  - Number of windmill and solar panels built
  - Number of dams built
  - Number of blackout occurrences
  - Number of tiles mined
  - Current amount of money
  - Amount of each resource currently used
  - Power demanded and supplied
  - Current year

Game Activity

Current game state

Data Collection Plan

- Metrics to address possible design issues:
  - Number of times each ad was activated
  - Number of times each public service was activated
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Utility of items

Data Collection Plan

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Game pace too slow

Data Collection Plan

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  - Number of dams built
  - Number of blackout occurrences

Utility of each power plant

Data Collection Plan

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  - Number of times each ad was activated
  - Number of times each public service was activated
  - Number of times fast forward button used
  - Number of fossil fueled power plants built
  - Number of windmill and solar panels built
  - Number of dams built
  - Number of blackout occurrences

} Game difficulty

Usability Data Plan

- Likert scale and open-ended questions about:
  - Usefulness of game items
  - Game perceptions (e.g., difficulty, pace, etc.)
  - Frustration
  - Educational value

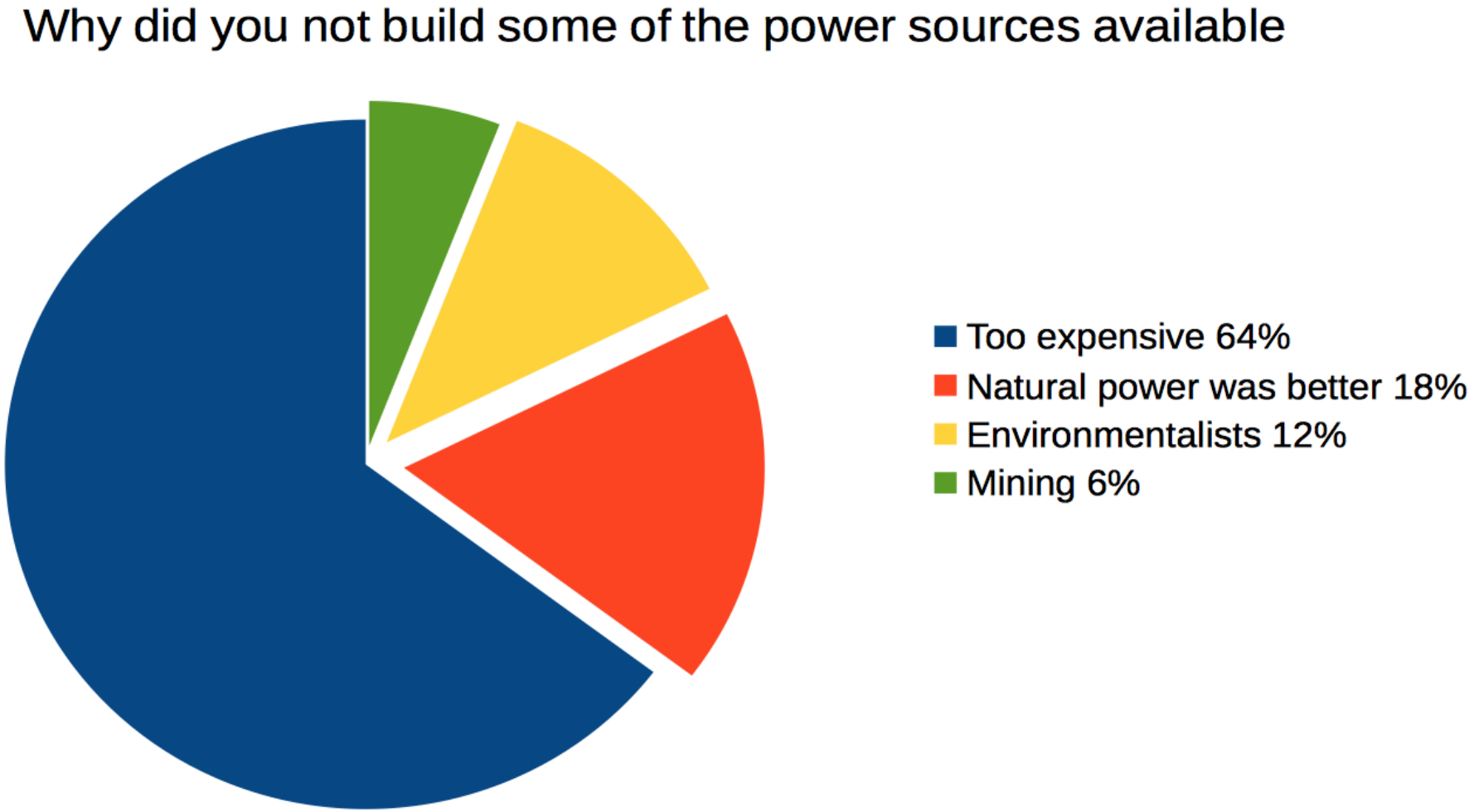
Evaluation

- Pre-test on energy knowledge
- Play game
  - Go through tutorial
  - Play unlimited number of trial runs
  - Play once (until game ends)
- Post-test (same questions as pre-test)
- Usability questionnaire

Power Plant Purchases

Power Source	Times Bought
Coal	0
Oil	2
Gas	1
Nuclear	9
Wind	68
Solar	39
Hydro	8

The Usability Data

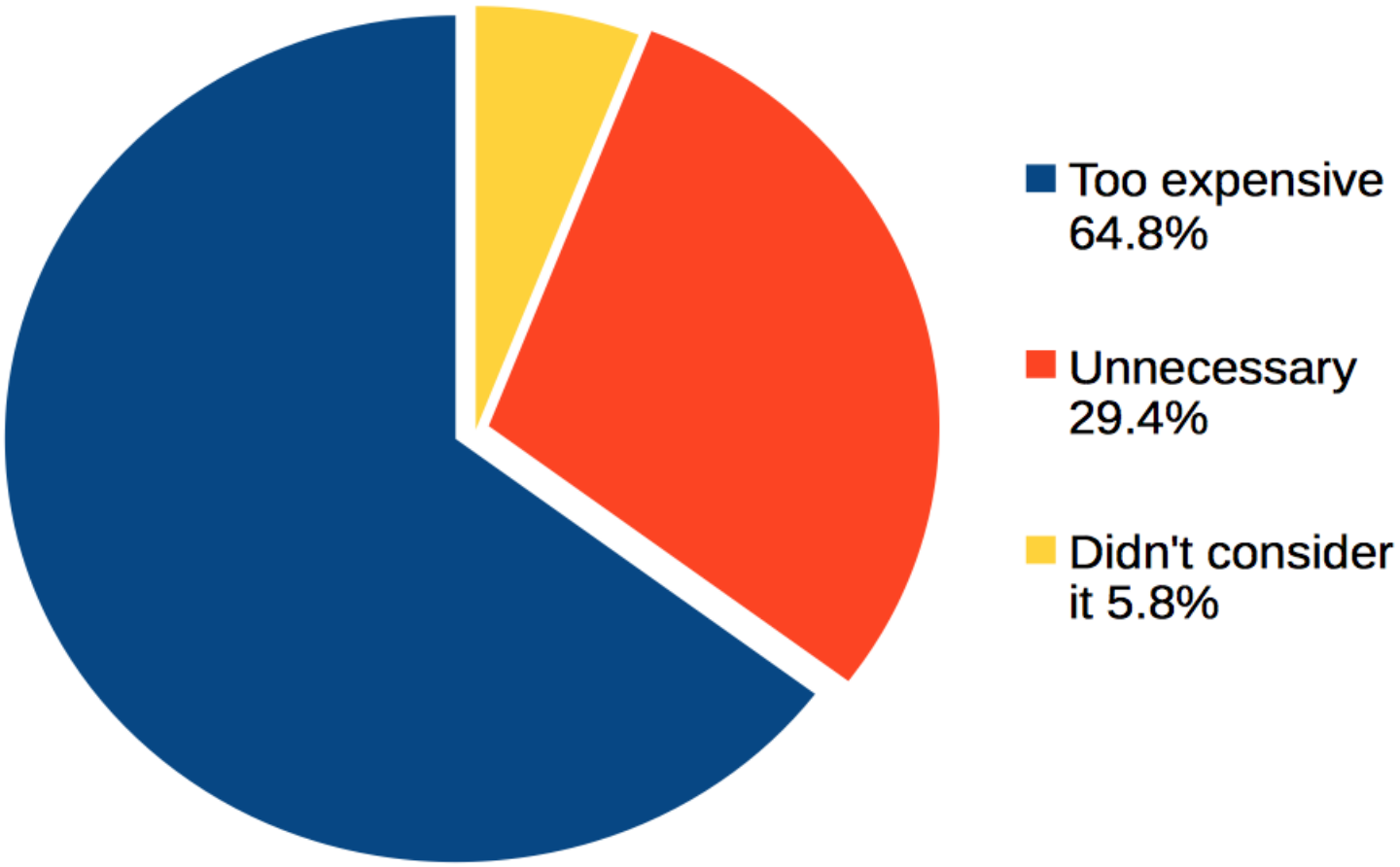


Additional Items Purchases

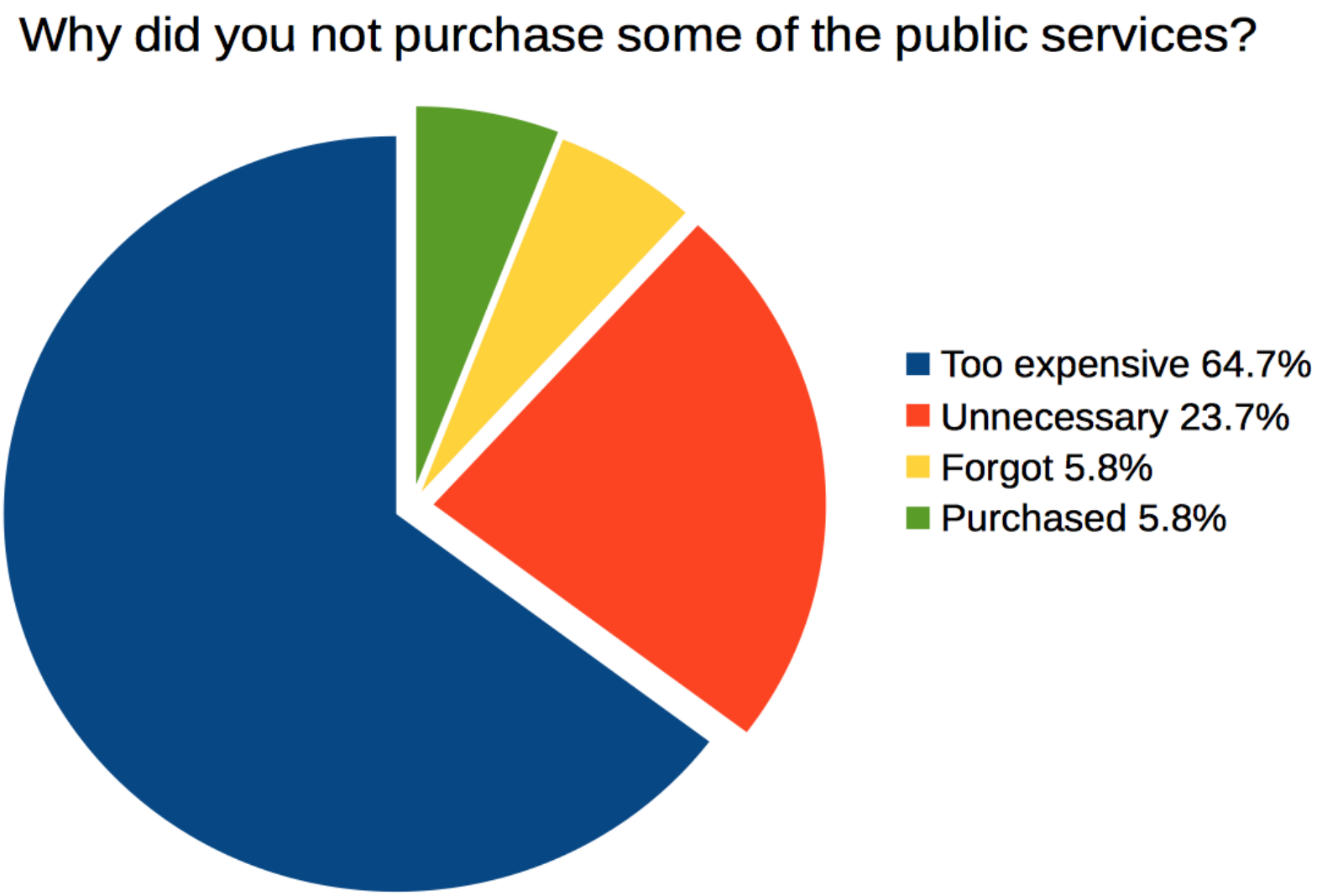
Additional Items	Times Bought
Advertisements	0
Public Service	3

The Usability Data

Why did you not purchase some of the advertisements?



The Usability Data



Game Difficulty

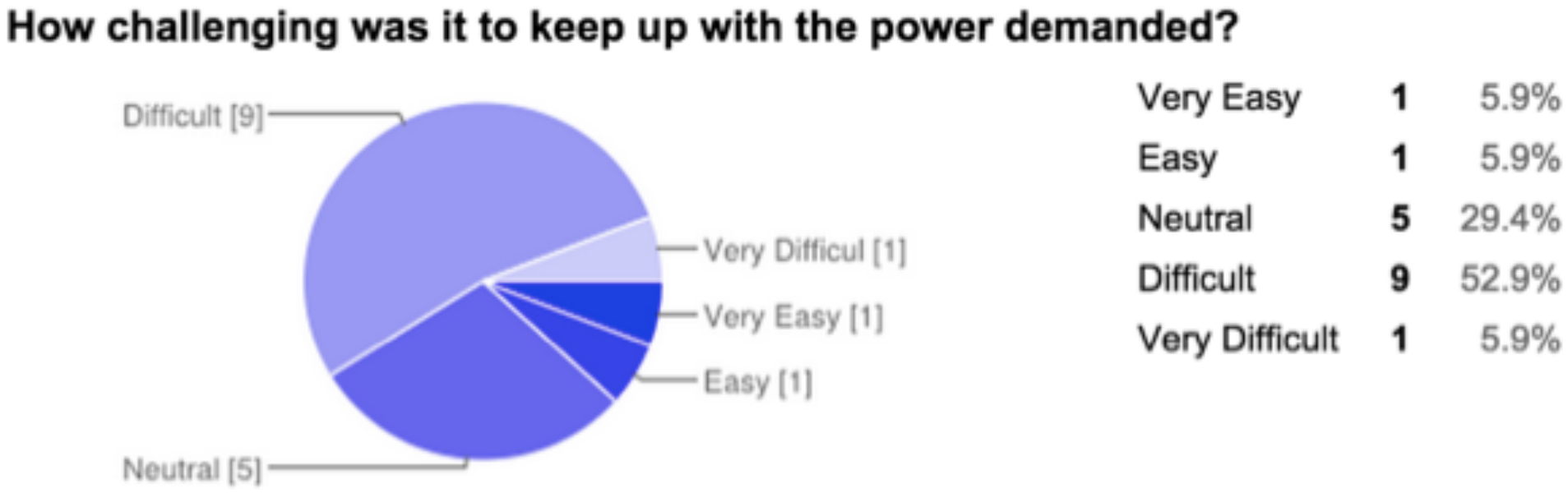
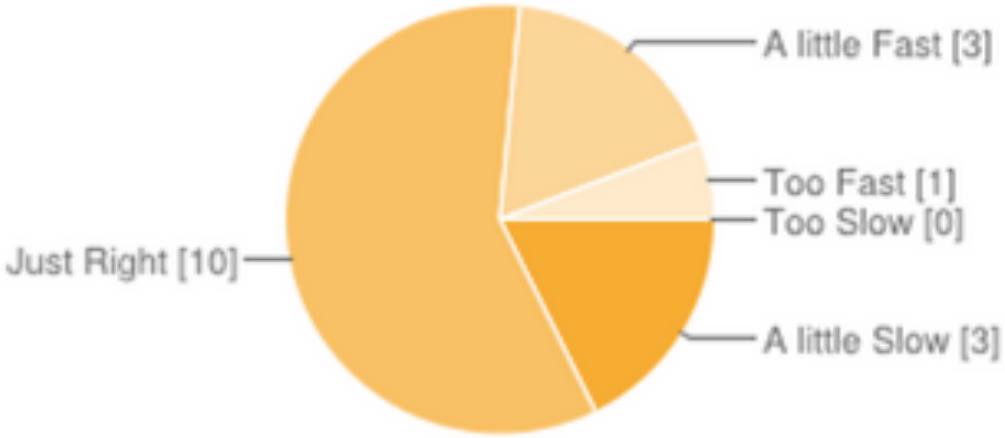


Figure 5.4: Power Demand Difficulty Level

Game Difficulty (cont.)

Please rate how you felt the pace of the game was.

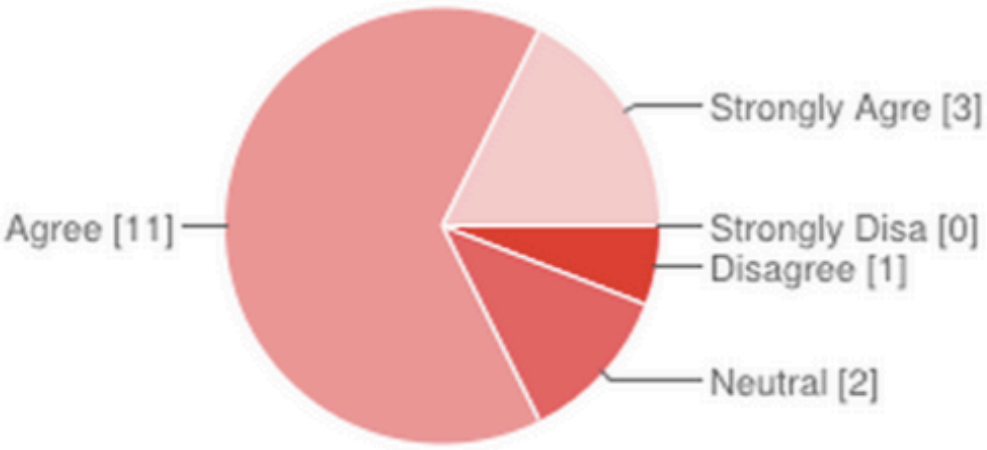


Too Slow	**0**	0%
A little Slow	**3**	17.6%
Just Right	**10**	58.8%
A little Fast	**3**	17.6%
Too Fast	**1**	5.9%

Figure 5.5: Game Pace Rating

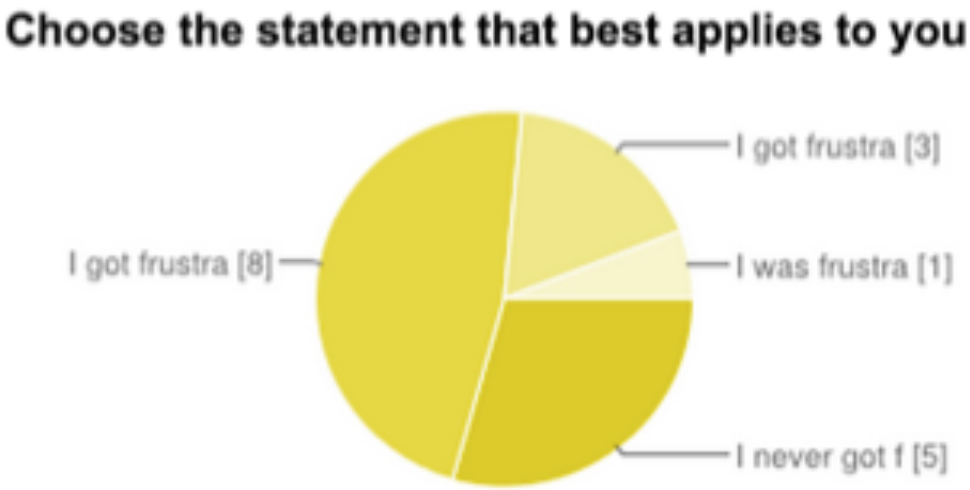
Game Difficulty (cont.)

Items too expensive or too cheap, thus making the game too hard or too easy to play.



Strongly Disagree	**0**	0%
Disagree	**1**	5.9%
Neutral	**2**	11.8%
Agree	**11**	64.7%
Strongly Agree	**3**	17.6%

Game Perceptions



I never got frustrated	5	29.4%
I got frustrated a little	8	47.1%
I got frustrated a lot	3	17.6%
I was frustrated all the time	1	5.9%

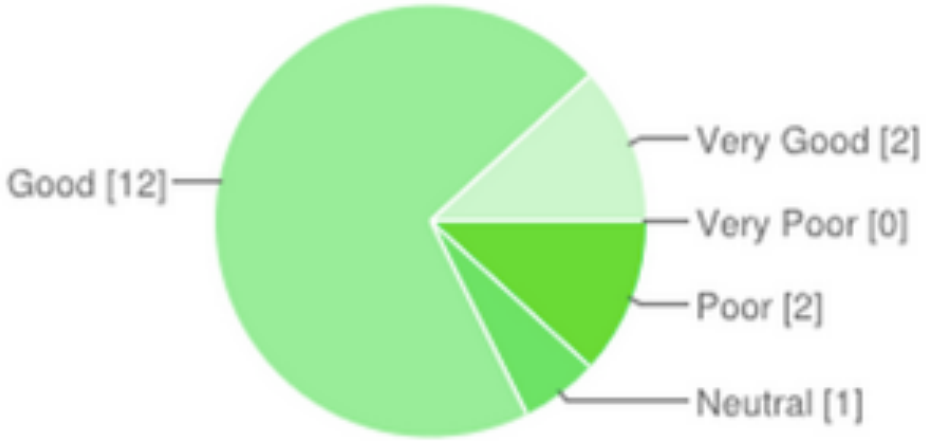
Figure 5.7: Frustration Levels

Game Perceptions (cont.)

Figure 5.10: Mis-Click Rate

Game Perceptions (cont.)

What would you rate your playing experience?

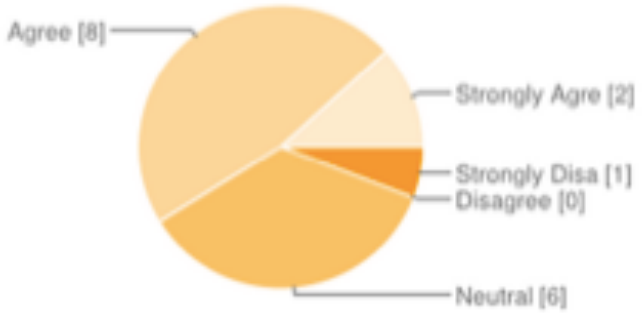


Very Poor	**0**	0%
Poor	**2**	11.8%
Neutral	**1**	5.9%
Good	**12**	70.6%
Very Good	**2**	11.8%

Figure 5.8: Playing Experience Rating

Game Perceptions (cont.)

Please state how much you agree with the following statement. "After going through the tutorial. I felt that I understood the major aspects and mechanics of the game"



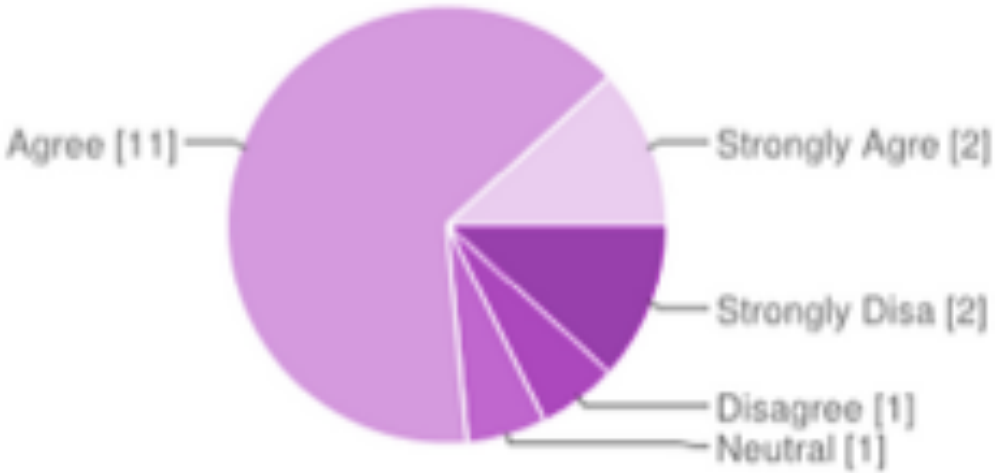
Strongly Disagree	1	5.9%
Disagree	0	0%
Neutral	6	35.3%
Agree	8	47.1%
Strongly Agree	2	11.8%

Figure 5.11: Tutorial Experience

The Knowledge Data

- Did people learn after playing the game?

I learned about energy from playing this game.



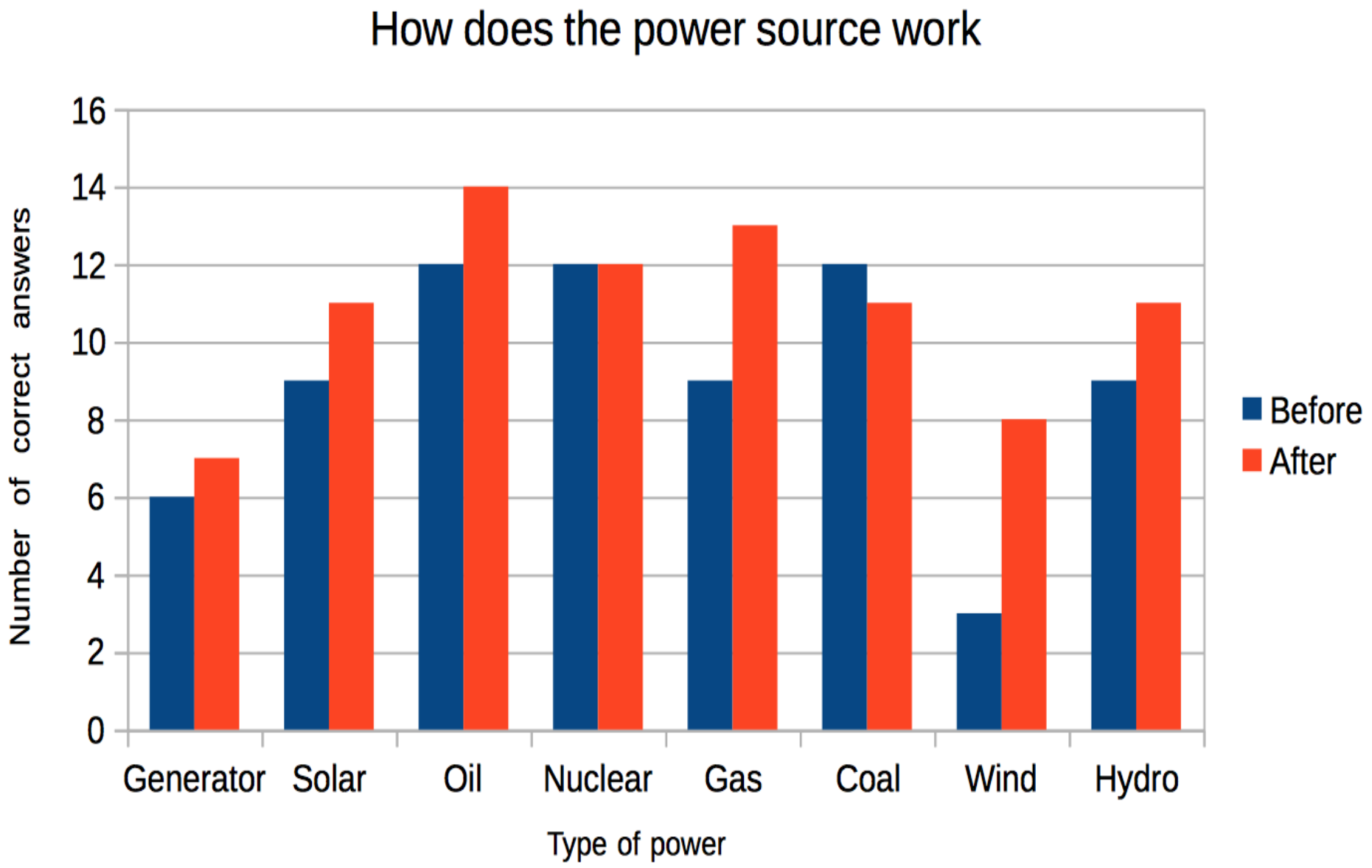
Strongly Disagree	2	11.8%
Disagree	1	5.9%
Neutral	1	5.9%
Agree	11	64.7%
Strongly Agree	2	11.8%

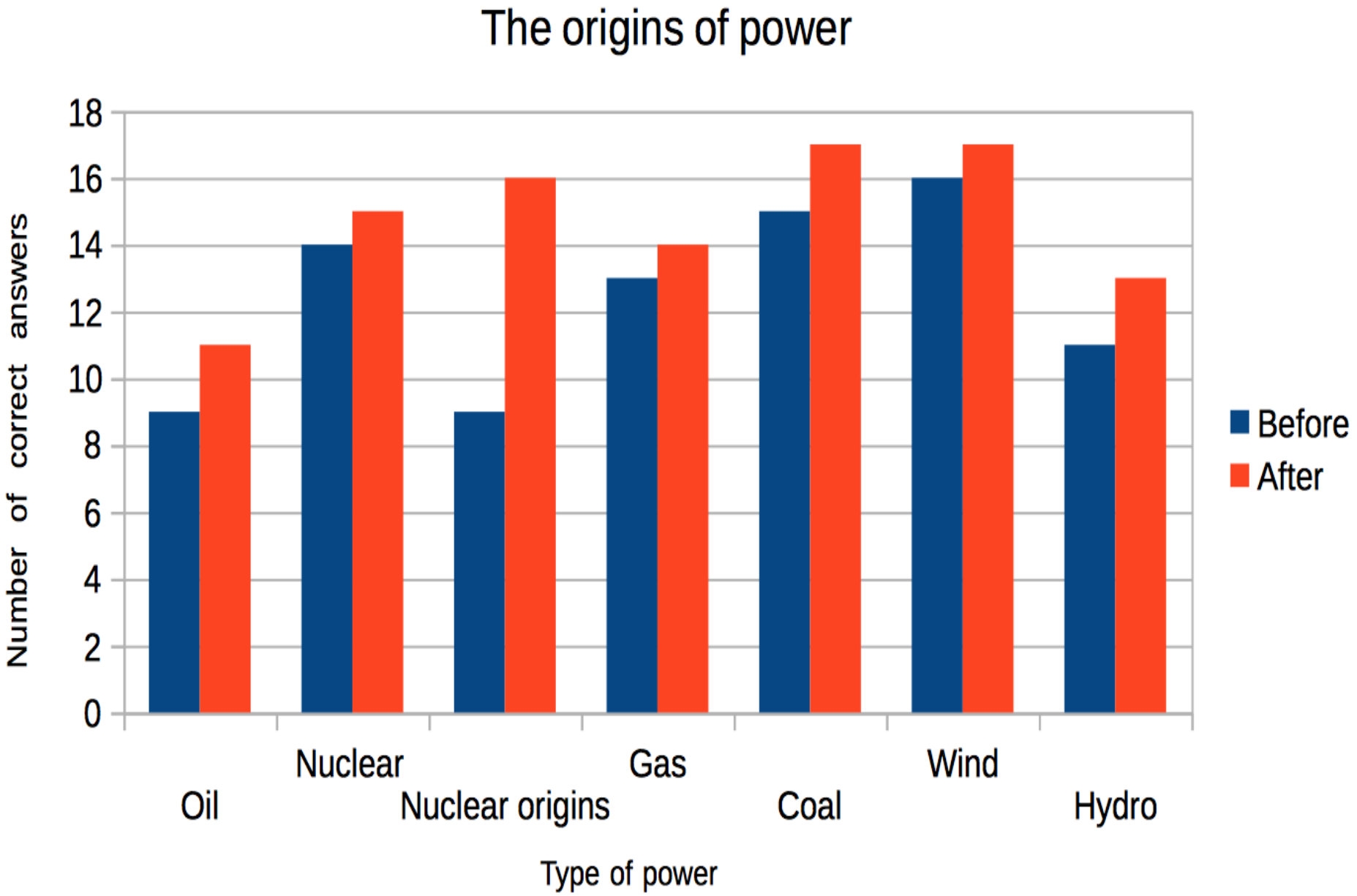
Figure 5.9: Learning Level

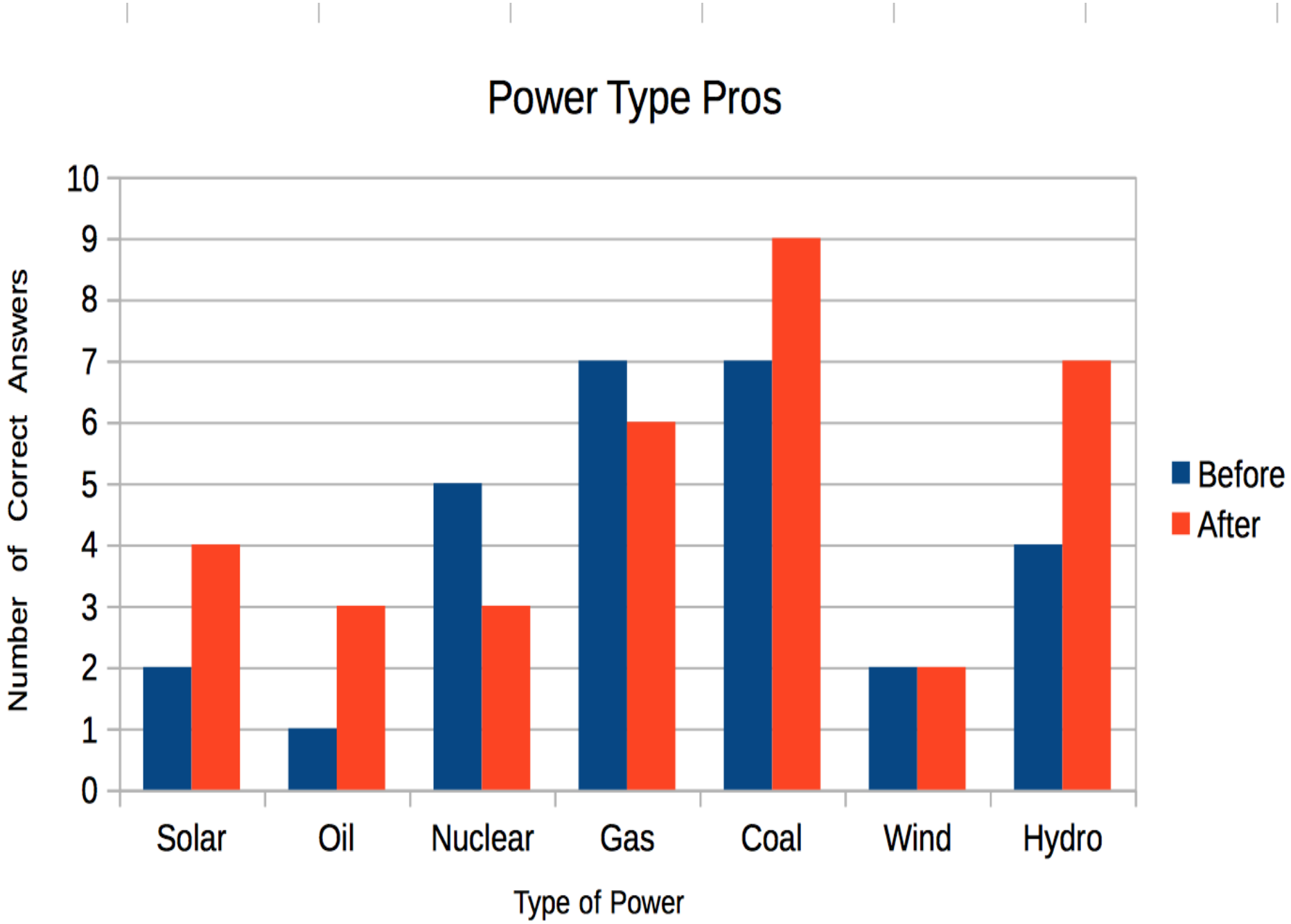
The Knowledge Data (cont.)

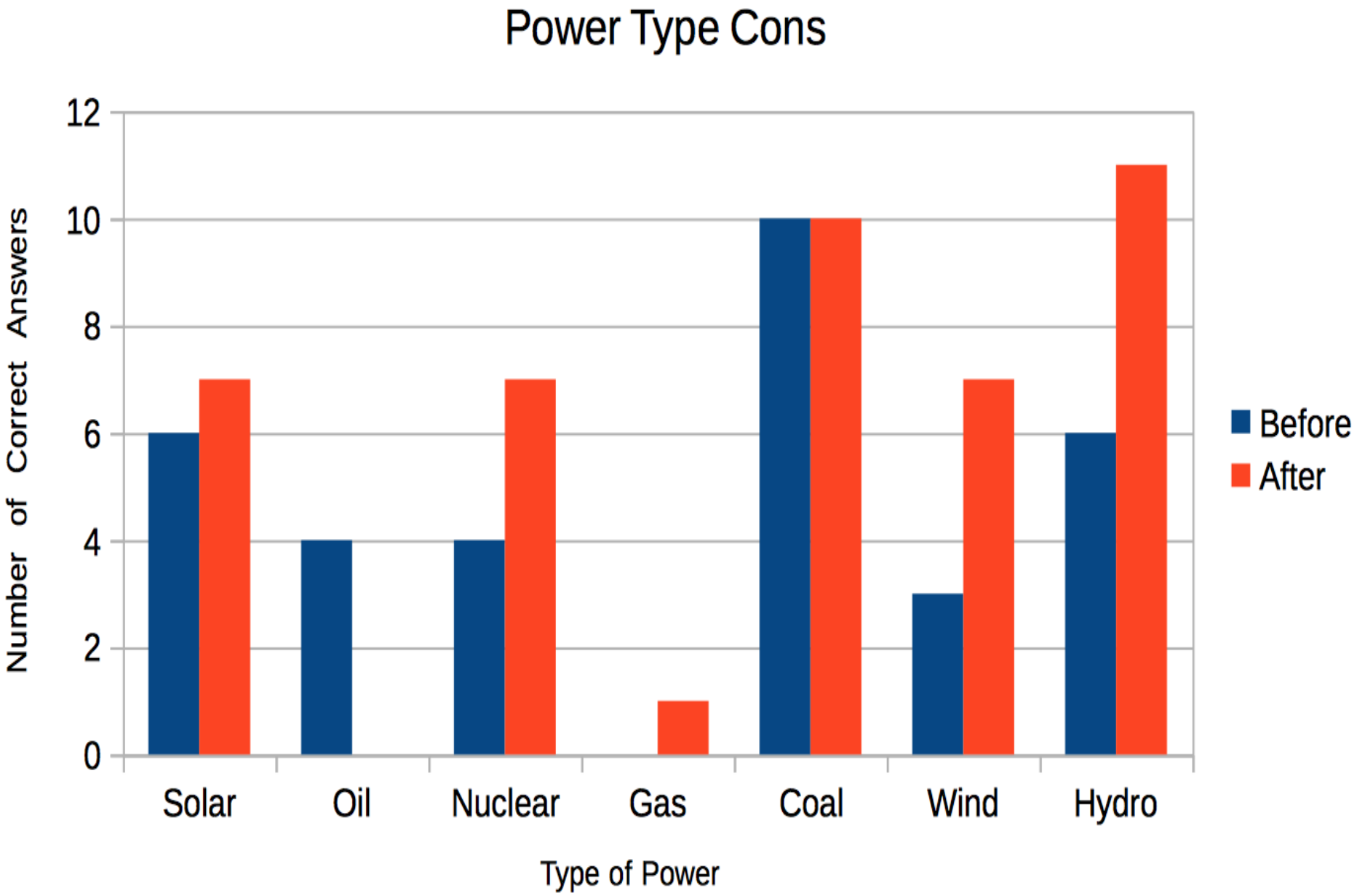
- Did people learn after playing the game?

- Four subsections:
  - Inner-Workings
  - Origins
  - Pros
  - Cons


How does the power source work
Number of correct answers
16
14
12
10
8
6
4
2
0
Generator
Solar
Oil
Nuclear
Gas
Coal
Wind
Hydro
Type of power
Before
After


The origins of power
Number of correct answers
18
16
14
12
10
8
6
4
2
0
Oil
Nuclear
Nuclear origins
Gas
Coal
Wind
Hydro
Type of power
Before
After


Power Type Pros
Number of Correct Answers
10
9
8
7
6
5
4
3
2
1
0
Solar
Oil
Nuclear
Gas
Coal
Wind
Hydro
Type of Power
Before
After


Power Type Cons
Number of Correct Answers
12
10
8
6
4
2
0
Solar
Oil
Nuclear
Gas
Coal
Wind
Hydro
Type of Power
Before
After

The Knowledge Data Summary

	Improvement average over people and power types (%)	P-Value
Workings of Power Source	24.3	0.101 *
Origins	57.7	0.058 *
Pros	6	0.266
Cons	11.6	0.240

Inspirational Content

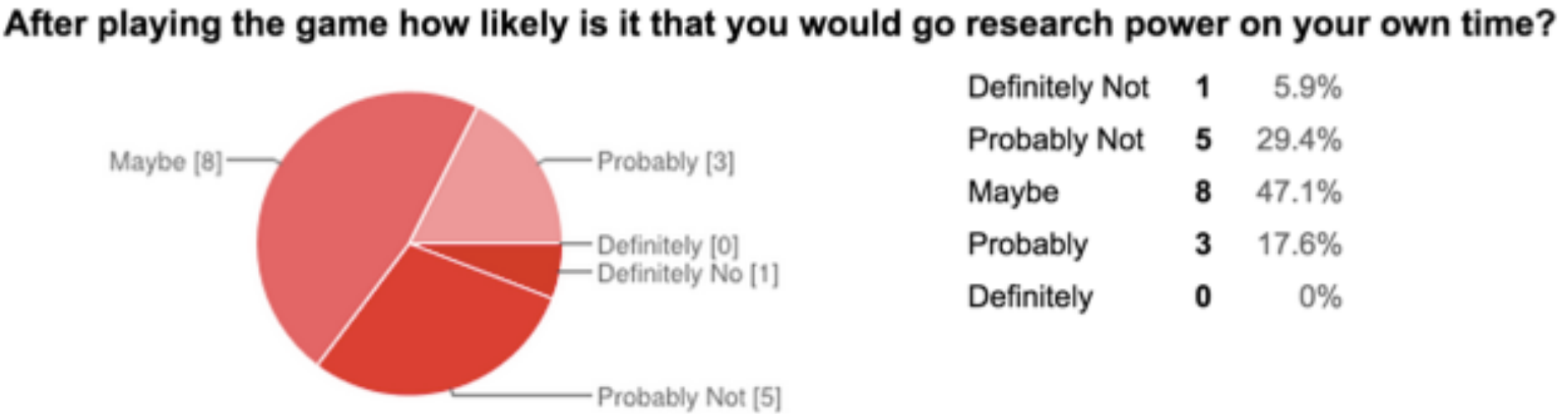


Figure 5.12: Likelihood Of Self Research

Summary

- Deployed at: https://play.google.com/store/apps/details?id=com.gmail.kudlac.raffi.src&hl=en
- Knowledge data showed improved learning
- Usability data shows:
  - Generally positive perception of game
- Design issues identified:
  - Some items too expensive
  - Need better way to improve learning pros/cons