

Implementation Report
A Social Robot as a Health Educator for Heart Failure
Patients Using the Teach-Back Method

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IT899XA: Master's Project in Instructional Design and Technology

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April 12, 2026

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Introduction

This report is a summary of the implementation and preliminary evaluation of the Furhat social robot heart failure education pilot. The purpose of the pilot project was to evaluate the feasibility of using the Furhat social robot to deliver heart failure (HF) education using the teach-back method. The pilot implementation provided the opportunity to examine any technical limitations, assess participant reactions, and gather preliminary evidence regarding the efficacy of the social robot-mediated intervention in the acquisition of knowledge related to self-care management in HF.

I developed the social robot skill prototype during the Analysis, Design, and Development phases of the ADDIE model (Lee & Lee, 2025). The social robot, Sheila, delivered education regarding general HF information, medication adherence, sodium restriction, fluid restriction, importance of daily weights, recognition of worsening symptoms, exercise, and guidance about when to contact a healthcare provider to avoid unnecessary hospitalization.

Implementation Setting and Participants

The implementation of the social robot health educator in HF educational prototype was conducted in person over two Saturday sessions held on April 4th and April 11th of 2026. The pilot was conducted at a clinical facility in Southeast Kansas during closed hours that provided a private setting and allowed participants to complete contact and demographic forms and baseline testing in a separate room before engaging with the Furhat social robot. A total of 11 volunteers

participated in the pilot study. They ranged in age from 55 to 80 years of age, with a mean age of approximately 70 years old. The group was divided into eight female participants and three male participants. Volunteers were recruited from communities in Southeast Kansas, primarily Chanute, with additional participants residing in nearby communities of Iola and Humboldt. Some participants had a history of HF or other cardiac conditions such as myocardial infarction (MI), while others did not. All volunteers had normal or corrected-to-normal vision and hearing enough to interact with the robot. Although no participant reported an official diagnosis of cognitive impairment, one participant's spouse confided that she had concerns regarding possible mild cognitive changes that had not yet been formally evaluated.

Implementation Procedure

Each participant was assigned an appointment time. The complete implementation process required approximately one hour. Upon arrival, participants reviewed and signed a consent form that authorized photography, video recording, and audio capture during the session (see Appendix A). The participants completed a contact form (see Appendix B), demographic, and HF history form (see Appendix C) which was immediately followed by the Atlanta Heart Failure Knowledge Test – v2 (AHFKT-v2) as a pre-test measure to establish HF baseline knowledge (Reilly et al., 2009; see Appendix D).

After completing all of the paperwork, the participants were introduced to Sheila, the Furhat social robot that was programmed to function as a HF patient health educator. The participants remained alone in the room with the social robot while I monitored the session from a room adjacent to the room where the interaction was taking place. The instructional interaction took approximately thirty-five minutes. The exact time to complete the session varied depending on the number of correct responses and the amount of reteaching that required remediation.

Following the interaction, the participants completed the AHFKT-v2 a second time and then participated in a brief exit interview (see Appendix E).

Preliminary Observations During Implementation

There were several implementation issues that emerged during the educational sessions. The clinic's overhead lighting occasionally cast shadows across the faces of the participants, which interfered with the facial/user detection system that was used to activate the robot skill. This sometimes delayed the beginning of the interaction. The automated speech recognition system generally functioned well, and the instructional module was successfully completed by all participants. However, several participants, specifically the older adults, required more time to process and respond to the robot's questions. Because participant responses were limited to approximately 60 seconds, some participants were interrupted by default before they were able to complete their answer.

Some participants noted that the robot sometimes failed to recognize what they believed to be correct responses. Other volunteers specifically reported that they felt pressured to adapt their wording to match what they perceived to be key words in their response to ensure the robot understood the meaning or intention of their words. These early findings would suggest that newer iterations of the social robot skill should include more comprehensive or flexible intent recognition, longer allowed response times, and more detailed feedback from the robot following the participant's answers. Participants indicated a desire for greater, more detailed feedback from the robot to signal what parts of their answers were correct and what parts were incorrect. This represents a significant technical challenge.

Preliminary Evaluation Findings

The participants' reactions to the social robot instructional prototype were generally positive. Participants reported that the information was clear, understandable, and was presented in a way that was easy to follow. Volunteers frequently identified the sections on medications, fluid restriction, exercise, and early symptoms of worsening HF as particularly helpful. Additionally, participants indicated that they appreciated hearing the information aloud. They believed that the robot-assisted learning format could be beneficial for individuals who have a learning preference for listening to educational content rather than for written materials. Many participants expressed a desire for greater back-and-forth conversation and increased opportunity for more frequent turn-taking. They also wanted the ability to ask follow-up questions during each section of the learning module and desired more detailed explanations from the social robot when their answers were deemed equivocal or incorrect.

The AHFKT-v2 results indicate preliminary evidence of learning gains following the social robot educational intervention. Eight of the 11 participants improved their overall score after the learning session, two participants showed no change, and one participant had a lower score on the post-test. Overall improvement ranged from 1 to 5 additional correct responses. The pre-test scores ranged from 9 to 21 correct responses. The post-test scores ranged from 14 to 22 correct responses. The largest gains were noted among participants who entered into the study with lower baseline knowledge or little to no previous exposure to HF education.

Planned Revisions for the Final Project

Based on the findings from this pilot implementation, I will make several changes before completing the final instructional module. First, I will attempt to find an off-the-shelf solution that allows me to increase the response time allowed for participant answers to better support older adults and those who require additional processing time to formulate responses. Second, I

will revise and expand the instructional content in each section to clarify or enhance knowledge based on the detailed feedback provided by the participants that highlighted those areas where instruction was unclear or incomplete. Participants indicated that additional content is needed for vaccination recommendations, smoking cessation, concrete examples of high and low-sodium foods, medication timing, and fluid restriction strategies. Finally, future iterations of the HF learning module will explore ways to design a more natural conversational experience that would include opportunities for participants to ask questions and request clarification during each section of the lesson and at the end of the interactions. There are still technical limitations to consider when introducing greater conversational abilities to a social robot skill. Practical solutions could include the use of generative artificial intelligence and retrieval augmented generation to achieve the goal of a human-robot interaction that more accurately mirrors that of human-human interaction while providing safe, accurate information to patients with HF.

In summary, the pilot implementation demonstrated that the Furhat social robot has potential as a supplemental tool in HF education. While there are several technical and instructional revisions needed, the preliminary findings suggest that the HF education using the teach-back method delivered by a social robot may support participant engagement and short-term learning.

References

Lee, D., & Lee, A. (2025). A mobile application for home-based care of indwelling medical devices: Protocol for development and pilot implementation based on the self-efficacy framework and the analysis, design, development, implementation, evaluation (ADDIE) model. *Health Informatics Journal*, 31(3), 14604582251381236.

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Appendix A

Photograph/Video/Audio Release

EMPORIA STATE UNIVERSITY

■ UNIVERSITY PHOTOGRAPHY

I grant to Emporia State University and its legal representatives and assigns, the irrevocable and unrestricted right to use and publish video/audio recordings, and photographs of me, or in which I may be included, for editorial, trade, advertising, and any other purpose and in any manner and medium; and to alter and composite the same without restriction and without my inspection or approval. I hereby release Emporia State University and its legal representatives and assigns from all claims and liability relating to said video/audio recordings and photographs.

Name (Please Print)

Project

Signature

Date

If Minor, Signature of Parent/Guardian

Address

Witness Name (Please Print)

Phone Number

Witness Signature

Date

Appendix B

Participant Contact Information

Full Name **Last** _____ **First** _____ **Middle Initial** _____

Address _____ **City** _____ **State** _____

Telephone (_____) _____

Date of Birth ____/____/____

Email _____

Appendix C

Participant Demographic and Medical History Form

Participant Numeric Identifier XXXXXXXXXX

Gender (circle one) Male Female Not Listed Prefer Not to Answer

What race/ethnicity best describes you?

- ☐ American Indian or Alaskan Native
- ☐ Asian / Pacific Islander
- ☐ Black or African American
- ☐ Hispanic
- ☐ White / Caucasian
- ☐ Multiple ethnicity/ Other (please specify)

Education

- ☐ Some high school, no diploma
- ☐ High school graduate, diploma or the equivalent (for example: GED)
- ☐ Some college credit, no degree
- ☐ Trade or technical training
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Professional degree
- ☐ Doctorate degree

Have you ever received heart failure patient education?

- ☐ Yes
- ☐ No
- ☐ Unsure

How many hours of heart failure patient education from a healthcare professional have you received?

- ☐ None
- ☐ Less than one hour
- ☐ One to three hours
- ☐ Three to five hours
- ☐ Greater than five hours

Appendix D

Atlanta Heart Failure Knowledge Test

ATLANTA HEART FAILURE KNOWLEDGE TEST (AHFKT-V2)

(Correct answers are marked with an asterisk)

We have some questions about heart failure. Select one response for each question. Don't worry if you are not sure of the answers; just do the best you can.

1. Heart failure is a problem in which:

- ☐ a. There is too much blood in the body
- ☐ b. The heart is unable to pump enough blood *
- ☐ c. The blood vessels in the heart are clogged
- ☐ d. The heart skips beats

2. Which of the following statements about heart failure is TRUE?

- ☐ a. It can be cured with drugs and other treatments.
- ☐ b. A person with heart failure cannot live a normal life.
- ☐ c. Heart failure cannot be cured, but it can be controlled.*
- ☐ d. Heart failure means the heart has stopped beating.

People with heart failure can do many things to help themselves. Think about each of these activities and decide if they would be helpful for someone with heart failure.

	Yes	No
3. Avoid salty foods	*	
4. Drink lots of fluids		*
5. Stop smoking	*	
6. Drink alcoholic drinks each day to relax		*
7. Skip heart failure medicines when they feel better		*
8. Know when to call the doctor or nurse for symptoms of heart failure	*	

9. ACE inhibitors (ex. Capoten, Vasotec, Lisinopril, or Zestril) are medicines used to treat heart failure. These drugs help the heart pump stronger by:

- ☐ a. Removing extra fluid and salt from the body
- ☐ b. Causing blood vessels to get smaller
- ☐ c. Blocking the harmful effects of stress hormones*
- ☐ d. Improving blood counts (reducing anemia)

10. People who have heart failure take diuretics (Lasix, "water pills") so that:

- ☐ a. Their kidneys will make more urine and pass more water*
- ☐ b. Their heart will beat more steady
- ☐ c. The blood vessels in their body will widen or relax
- ☐ d. Their heart will pump stronger

11. People with heart failure who are taking a diuretic ("water pill") need to:

- ☐ a. Know if they need to take extra potassium with their water pill*
- ☐ b. Take the diuretic after 3-4 pm in the day
- ☐ c. Not worry about signs and symptoms of dehydration
- ☐ d. Drink lots of water to replace lost fluid

12. If a person with heart failure gains 2-3 pounds in a few days, this usually means he/she:

- ☐ a. Is eating too many calories and gaining weight
- ☐ b. Has extra water in the body*
- ☐ c. Needs to drink more fluid
- ☐ d. Needs to be getting more exercise to burn calories

13. How often should a person with heart failure weigh themselves?

- ☐ a. Every day*
- ☐ b. Every week

- ☐ c. Every month
- ☐ d. Once in a while

14. The best time of day for persons with heart failure to weigh themselves is:

- ☐ a. At bedtime
- ☐ b. Upon awakening in the morning*
- ☐ c. At or around lunchtime
- ☐ d. When they remember to do it

15. Persons with heart failure should call their doctor if they have which of the following symptoms?

- ☐ a. Weight gain of 2-5 pounds in 1-2 days
- ☐ b. Increased swelling of the ankles and/or stomach
- ☐ c. More shortness of breath
- ☐ d. All of the above*

16. How often should a person with heart failure exercise?

- ☐ a. Every week
- ☐ b. Every day*
- ☐ c. Several times a day
- ☐ d. 2-3 times per week

17. A person with heart failure should stop and rest when doing physical activity if:

- ☐ a. They feel short of breath or winded
- ☐ b. They have chest pain or discomfort
- ☐ c. They feel dizzy or lightheaded
- ☐ d. All of the above*

18. Which is a big source of sodium (salt) in the diet?

- ☐ a. Processed foods (such as tv dinners)
- ☐ b. Smoked or cured meats
- ☐ c. Table salt
- ☐ d. All of the above*

19. Which has the LOWEST amount of sodium (salt)?

- ☐ a. Fresh fruits*
- ☐ b. Canned vegetables
- ☐ c. Reduced sodium soup
- ☐ d. Frozen dinners

20. Which food has the MOST sodium (salt)?

- ☐ a. Sliced tomato
- ☐ b. Broiled fish
- ☐ c. Baked ham*
- ☐ d. Skim milk

21. Which dessert has the LOWEST amount of sodium?

- ☐ a. Hot fudge sundae
- ☐ b. Baked apple*
- ☐ c. Low-fat instant pudding made with skim milk
- ☐ d. Chocolate cake made from a mix

22. Select the fast food with the LOWEST amount of sodium.

- ☐ a. Fried chicken
- ☐ b. Cheeseburger
- ☐ c. Baked potato with sour cream and chives*
- ☐ d. Taco salad

23. Some people with heart failure are told by their doctor to limit fluids. Which of the following count as fluids?

- ☐ a. Water and clear liquids
- ☐ b. Milk, ice cream, and yogurt
- ☐ c. Jello, pudding, and soups
- ☐ d. All of the above*

24. If a person with heart failure has a headache or pain, which would be the best medicine to take?

- ☐ a. Aspirin
- ☐ b. Tylenol (Acetaminophen)*
- ☐ c. Advil® or Motrin® (Ibuprofen)
- ☐ d. Anacin Regular Strength or Excedrin

25. The recommended total daily amount of sodium that persons with heart failure should eat is:

- ☐ a. 3,000 milligrams
- ☐ b. 2,500 milligrams
- ☐ c. 1,500 milligrams*
- ☐ d. 500 milligrams

Use the picture of the soup label to answer questions 26 and 27:

26. How many servings are in the can?

- ☐ a. 1

- ☐ b. 2
- ☐ c. 2 ½*
- ☐ d. 3

27. How much sodium is in one serving of soup?

- ☐ a. 15mg
- ☐ b. 890mg*
- ☐ c. 445mg
- ☐ d. 2225mg

Nutrition Facts		Amount/serving	%DV*	Amount/serving	%DV*
Serv. Size 1/2 cup (120mL) condensed soup Servings about 2.5		Total Fat 1.5g	2%	Total Carb. 8g	3%
Calories 60 Fat Cal. 15		Sat. Fat 0.5g	3%	Fiber Less than 1g	4%
		Trans Fat 0g		Sugars 1g	
		Cholest. 15mg	5%	Protein 3g	
		Sodium 890mg	37%		
*Percent Daily Values (DV) are based on a 2,000 calorie diet.		Vitamin A 4% • Vitamin C 0% • Calcium 0% • Iron 2%			

28. A person with heart failure who is trying to limit their fluids may reduce symptoms of thirst by:

- ☐ a. Chewing gum or sucking hard candy*
- ☐ b. Cutting back on their medications
- ☐ c. Drinking small amounts every 30-60 minutes to prevent thirst
- ☐ d. Warming fluids before drinking

29. If a person with heart failure forgets to take their medicine, they should:

- ☐ a. Take their medicines as usual the next day
- ☐ b. Take the medicines as soon as remembered*
- ☐ c. Take double the dose the next day
- ☐ d. Call their doctor immediately

30. It is important for a person with heart failure to:

- ☐ a. Make sure they get the flu shot every year
- ☐ b. Receive the Pneumovax vaccination to prevent pneumonia
- ☐ c. See their heart failure doctor regularly

- ☐ d. All of the above*

Appendix E
Exit Interview

General Experience

Overall, how would you describe your experience interacting with the Furhat Social Robot?

(Open-ended)

On a scale of 1 to 5, how engaging did you find the Furhat Social Robot during the session?

1 = Not engaging at all

5 = Very engaging

Did you feel comfortable communicating with the robot? Why or why not? (Open-ended)

Educational Content

Do you feel that the information provided about heart failure management was clear and easy to understand?

Yes

Somewhat

No

(If “No” or “Somewhat,” please explain.)

On a scale of 1 to 5, how effective was the Furhat Social Robot in teaching you about heart failure management?

1 = Not effective at all

5 = Very effective

What part of the education session did you find most helpful?

(Open-ended)

Was there any information you felt was missing or unclear during the session? (Open-ended)

Perception of the Robot

On a scale of 1 to 5, how trustworthy did you find the Furhat Social Robot?

1 = Not trustworthy at all

5 = Very trustworthy

Did the robot's tone of voice, facial expressions, and responses feel appropriate and empathetic?

Yes, always

Sometimes

No, not really

(If "Sometimes" or "No," please explain.)

How natural did the interaction with the robot feel compared to interacting with a human?

(Open-ended)

Suggestions and Overall Feedback

What improvements, if any, would you suggest for the Furhat Social Robot's interaction or teaching style?

(Open-ended)

Would you recommend this type of robot-assisted education to others with heart failure?

Why or why not?

(Open-ended)

Do you have any additional comments or feedback about your experience?

(Open-ended)