Project D: Educational Software

Queen: The Most Powerful Role in Your Kingdom

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Introduction

This project is a section of an educational software program – *Chess for Kids*. The section implemented in this project is *Queen: The Most Powerful Piece in Your Kingdom*, a lesson in the unit of *How to move your pieces*. This is a self-instructional program. Learners will learn how to use the queen in chess games. The queen is the most powerful piece in chess, but it is also the most difficult piece to use for beginners. This project tries to provide a series of puzzles for learners through a problem-based learning. An interactive chess board with embedded chess rules is presented to learners. Learners don't need to remember the rules of the queen's movement. They will understand and use the rules automatically while they are solving puzzles during the learning process.

Learner Analysis

The target learners of the program are chess beginners with age from 7-11. The chess beginners here refer to those who don't have any experience and knowledge in chess game and just begin to know the game. A typical example is a child who grabs a chess book from a bookshelf in a library and decides to try it, because the child is attracted by the shapes of pieces on the book cover.

The lesson described in this project is not the first section of the program, so learners who will learn the lesson have already learned some fundamental concepts of chess.

According to Piaget's stages of cognitive development, children at ages from 7 to 11 are at the concrete operational period (Driscoll, 2005). Children at this stage are able to solve problem with concrete logical reasoning, but they have difficulty in thinking systematically. Children at this age range are also interested in discovering new things. This program is designed for general populations at this stage, so there is no specific personal characteristics analysis conducted.

As to the general characteristics of the target learner, the program can use childish languages, for example, use *puzzle* instead of *problem*, and use *your kingdom* rather than *your side*, so learners can take it as a game. To encourage learners, the program can use more positive words. Learners should be able to control the pace of the program. Feedback should be more informative by providing more details based on their actions. During the instruction, more guidance and cues might be needed for the target learners, for example, show them the valid paths of the pieces at the beginning of the instruction.

Learning Task Analysis

This lesson is focusing on how to use the queen in chess. There are three learning objectives:

1. In a chess board, learners can move the queen correctly (principle).
2. Given a chess puzzle, learners can identify the square(s) to attack a single target for the queen in less than two moves (problem solving).

3. Given a chess puzzle, learners can identify the square(s) to attack multiple targets for the queen in one move (problem solving).

The prior knowledge that is recommended for this section includes:

- The concepts of *piece*, *square*, *light square*, *dark square*, *file*, *rank*, and *board*
- The concepts of *moving on rank*, *moving on file*, and moving on diagonal.
- The symbols for chess pieces, including *king*, *queen*, *bishop*, *knight*, *rook*, and *pawn*
- The principles of *move* and *capture*

Assessment

This project integrates assessment into practice. The assessment items are distributed into each stage of learning process. When learners counter with a puzzle (assessment item), the only way to move forward is to solve the puzzle. The distributions of assessment items are shown in table 1. The total number of screens in this lesson is 27.

Table 1

The distributions of assessment items

Screen#	Objective #	Criteria
4	Entry skill	Capture the black knight in one move
5	Entry skill	Capture the black knight in one move
8	O.1, O.2	Capture the black knight in one move
9	O.1, O.2	Capture the black knight in one move
10	O.1, O.2	Capture the black knight in one move
12	O.1, O.2	Capture the black knight in two moves
13	O.1, O.2	Capture the black knight in two moves
14	O.1, O.2	Capture the black knight in two moves
15	O.1, O.2	Capture the black knight in two moves
16	O.1, O.2	Capture the black knight in two moves
17	O.1, O.2	Capture the black knight in two moves
18	O.1, O.2	Capture the black knight in two moves
22	O.1, O.3	Move to the square where can attack all black pieces in one move
23	O.1, O.3	Move to the square where can attack all black pieces in one move
24	O.1, O.3	Move to the square where can attack all black pieces in one move
25	O.1, O.3	Move to the square where can attack all black pieces in one move

Because this is a section of an instructional unit of *How to move your pieces*, there is no separated pre-assessment and post-assessment for this lesson.

Instructional Plan and Strategy

Overall Design

Problem-based learning. Problem-based learning is "an approach to instruction that structures course and entire curricula on problems" (Smith & Ragan, 2005, p. 233). This educational program is connected with a series of problems (puzzles) for the target learner. The strategy is to let learners apply the principle of the queen's movement into solving problems. Bruner believe that "the heuristics of discovery can only be learned through the exercise of problem solving" (as cited in Driscoll, 2005, p. 234). The difficult level of problem is increasing as the learning process going on. The problems in this program also function as assessment. Learners have to solve the problems to continue their learning. Solving the problems means the learners can apply their knowledge, not just remember it.

Interactive board. This program uses an interactive chess board to interact with learners. The interactive board manipulates chess rules using real time algorithm, so learners must stick with the rules. This will reinforce learners to move pieces in the correct way. If learners need hints, the board also can show the valid paths for different pieces.

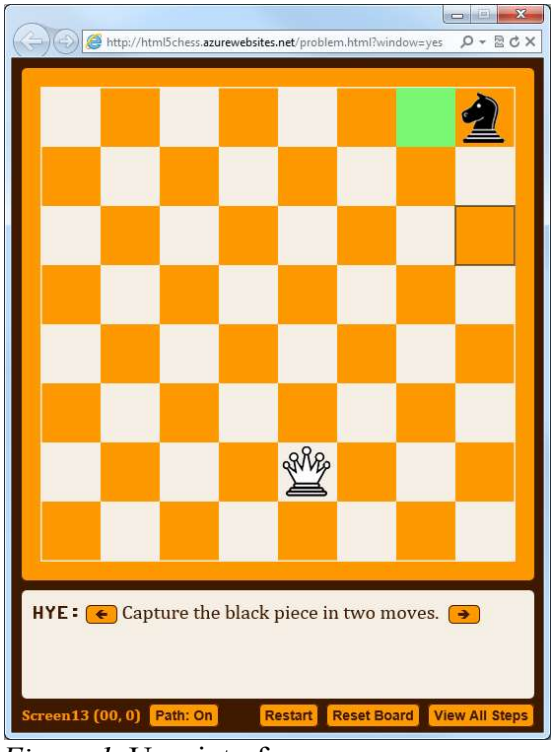


Figure 1. User interface

With this interactive board (figure 1), learners also can discovery the rules by themselves. They can try to move the pieces on the board, and get sound feedback if they made a right movement or a wrong movement. Therefore, learners can learn the rules by discovering on the board.

Cyber styled text instruction. The program uses a cyber-chatting styled text to deliver the text instructions. The target learners are 7~11 years old children. Children at these ages are fascinated with mystery things like a chess master is chatting with them from the past. With the typing styled text presenting way with typing sound, children are attracted. I have two try-out learners tried this lesson, and they said the cyber-chatting styled text was interesting.

Scaffolding. As mentioned before, the interactive board can show valid paths in real time (figure 2). Chess beginners have difficulties to mentally find out all the possible moves which a piece can do, especially for pieces like queen and knight, because they have unusual movements than others. To help them develop the mental skill of finding potential movement, the movement hints can work as scaffolding.

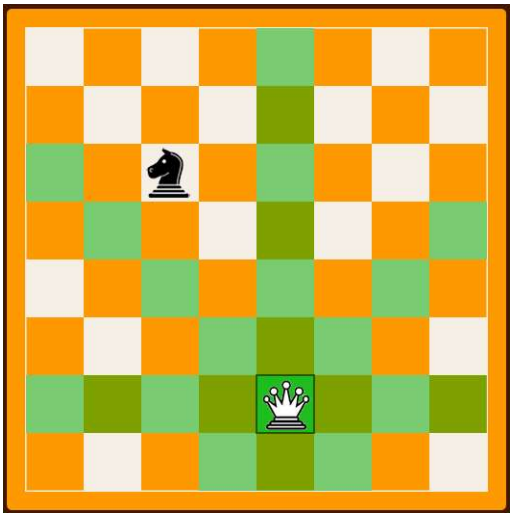


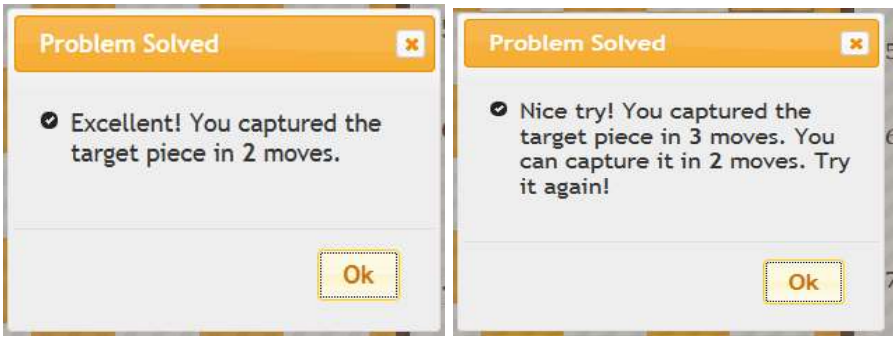
Figure 2. The path of the queen

According to Vygotsky's theory of the zone of proximal development (Vygotsky, 1978), learners who have learned the rules of movement need helps to develop their problem solving skills. In this program, the scaffold is provided at the first 9 puzzles, and it is removed in the following puzzles.

Feedback. Mayer (2008) notes that "for skill learning, practice with feedback resulted in improved performance" (p. 290). In this program, two main feedback approaches are employed. The first approach is using sound effects. Sounds will be played when learners click to pick up a piece, make a correct move, or make a wrong move. The sound for each action indicates what a learner is doing. After learners get familiar with these feedback sounds, they can discriminate which move is correct and which one is wrong by listening to the sounds. These sounds play a reinforcement role in the program as well. If learners hear the invalid movement sound, they know that they are making wrong move and will try to avoid the same wrong move again. This is an

application of the law of effect, which is that "learning depends on the effect of each response" (Mayer, 2008, p. 263).

The other approach in this program is message box. Mayer (2008) suggests that learners can use the information in feedback to help revise their response. When learners solve a puzzle, whether it meets the criteria or not, a message box will pop up, and give feedback to learners. If the learner solves the puzzle successfully and meet the criteria, the feedback will contain why this is a correct solution (figure 3 (a)); otherwise, the feedback will tell the learner what the problem is (figure 3 (b)).



(a) (b)

Figure 3. Message feedback

Another particular design here is using different words in feedback. Psychologically, learners will getting bored if they always see the same word. This program is providing different greeting words, even for the same problem. The greeting words used in the message box are randomly selected from two words pools. One pool is for successful solution, including *well done, nice job, excellent, wonderful, fantastic*, and *excellent move*; the other pool is for unsuccessful trying, including *good job*, *good try*, *nice try*, and *good move*.

Instructional Plan[1]

This lesson is designed to be completed in 10~15 minutes in a linear sequence at the first time. After the learners completed the lesson, the learners then can jump to any steps of the lesson to review it.

Introduction. Deliver learning goal to the learners. Use words like *most powerful* and *kingdom* to attract the learners (Screen #1).

Body. Start from introduce detailed learning objectives (Screen#2~ #25).

Recall relevant prior knowledge. Learners need to know the concepts of moving on rank, moving on file, and moving on diagonal. The two pieces, rook and bishop, which are learned in previous lessons are using these concepts. The rook moves on files and ranks, the bishop moves on diagonal, and the queen moves on files, ranks, and

[1] Please visit http://html5chess.azurewebsites.net to review the screens.

diagonal. Therefore, in this lesson, the rook and bishop will be used to recall learners' prior knowledge (Screen#3).

Practice. There are two puzzles for learners to recall how to move the rook and the bishop on the board. Learners must solve these puzzles to continue (Screen#4~#5).

Process information. Deliver the information that the queen's movement combines the power of rook with that of the bishop. Learners can click the queen on the interactive board to check her power (Screen#6#7).

Focus attention. Let learners know that next will be some practices on using the queen (Screen#8).

Practice with assistance. First, the interactive board shows the valid movements of the queen to help learners remember the path of the queen. The next three puzzles let learners capture the black piece in one move with moving on file, rank, and diagonal. These puzzles will create basic moving patterns for the learners (Screen#8~#10). Then another two puzzles are following with Screen#11, which is to explain what's next, to let learners learn how to capture a piece in two moves (Screen#12-13).

Focus attention. Let learners know that they will not have hints on path of the queen in the following puzzles, which means the scaffolding is fading (Screen#14).

Practice. Next five puzzles will assess learners' skills in using the queen without any help (Screen#14-#18).

Focus attention. Learners are shown a board with one white queen and eight blacks piece. The queen's power is restated here to refresh learners' memory (Screen#19-20).

Employ learning strategies. Because the queen can attack opposite pieces from eight directions, the opposite pieces could be attacked from the queen by eight directions. One way to identify where to attack is to mentally draw lines on the target piece to eight directions and find the intersections. Those intersections are potential attacking square (Screen#21).

Practice. Four more puzzles need learners to identify the square where the queen can attack all the pieces on the board without hints (Screen#22~#25).

Conclusion. Next two screens will do summary and close.

Summarize. Summarize this lesson on what we have learned and restate that the queen is the most powerful piece in chess (Screen#26).

Re-motivate and close. Note that next lesson will be the most valuable piece, the king. Use the words *most valuable* to motivate learners move to next lesson (Screen#27).

Summary

In this project, I developed an educational software program to teach how to use queen in chess game. The target learner is chess beginners at the age of 7~11. Several strategies are used in the program, such as scaffolding, feedback, and problem-based

learning. This is a small section of the whole program, but many designs in this project are reusable, for example, the interactive chess board can be used in face-to-face chess instruction as well. Instructors can customize their problem on the board and preprogram the solution for learners to follow. The program still has some limitations. The instructional text could be more native for English learners. The user experience still needs to improve. In the try-out test, one learner found its not so convenience to use on touch screen, because many interactions are designed for mouse operation. The selection of problems might be better if they can be selected randomly from a problem pool. The user profile isn't created in this version of the program. Providing a user profile will make it possible to track user's learning status and provide personalized instruction.

Reference:

Driscoll, M. P. (2005). *Psychology of learning for instruction* (3rd ed.). Boston, MA: Pearson Allyn and Bacon.

Mayer, R. E. (2008). *Learning and Instruction* (2nd ed.). Upper Saddle River, NJ: Person Merrill Prentice Hall.

Smith, P. L., & Ragan, T. J. (2005). *Instructional design* (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Vygotsky, L. S. (1978). *Mind in Society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner & E. Souberman Eds.). Cambridge, MA: Harvard University Press.

Appendix:

Appendix A: System Requirements

Hardware:

- Any computers or mobile devices with internet connection

Software:

- Browsers which can run HTML5, CSS3, and JavaScript
- Internet Explorer 9.0 or later, Firebox 19.0 or later, Chrome 22.0 or later, and Safari 6.0 or later are recommended

Appendix B: Development Technologies and Tools

Technologies:

- HTML5
- CSS3

- JavaScript (with jQuery and modernizr library)

Tools:

- Graphic design: Microsoft Windows Paint
- Sound design: Microsoft sound recorder
- Programming tool: Microsoft Visual Studio 2012 Professional
- Published website: http://html5chess.azurewebsites.net at Windows Azure platform