Sound to Sight: The Effects of Self-generated Visualization on Music Sight-Singing as an Alternate Learning Interface for Music Education within a Web-Based Environment

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Abstract. This paper discusses the efficacy of self-generated visualization on pitch recognition for the music sight-singing learning from the Internet. The self-generated visualization on music sight-singing learning system incorporates pitch recognition engine and visualized pitch distinguishing curve with descriptions for each corresponding stave notation on the web page to bridge the gap between singing of pitch and music notation. This paper shows the conducted research results that this web-based sight-singing learning system could scaffold cognition about aural skills effectively for the learner through the Internet.

Keywords: pitch recognition, self-generated visualization, sight-singing, music education.

1 Introduction

Sight-singing skills tone up a music learner's ability to be more accurate when performing unread music[2,4]. Many constituent elements are involved in the process of sight-singing which includes an individual's perceptive competence, knowledge, and experiences. Multiple cognitive procedures are involved concurrently when learners read music by sight [1,6]. In traditional schooling, where students learn music from notations, sight-singing demonstrates a student's music literacy and music understanding. However the process of sight-singing involves the conversion of musical information from sight to sound [3]. It is hard for the learners to distinguish their sound of soundness by themselves. As the web environment is becoming an effective educational media [5], the goal of this study with pitch recognition design is to construct a facilitating sight-singing learning interface which adopts visualization strategy to transform the singing sound to a wave curve. By comparing with the standard wave curve of music notations, the learners would identify the correctness of their music sight-singing from the self-generated wave curve. Thus learners can build their own foundation of sight-singing skills by themselves from the Internet.

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2 Self-generated Visualization on Music Sight-Singing Design

The design of web-based learning system of self-generated visualization on pitch recognition (Fig. 1) is based on pitch recognition engine running on Windows platform. It integrates a voice recorder as a music sight-singing input producer. It also connects with the standard MIDI pitch producer from the music software Finale. The standard MIDI pitch producer could act like threshold for learners to distinguish their sight-singing status. Each pitch of music note sang by a user could be explicitly

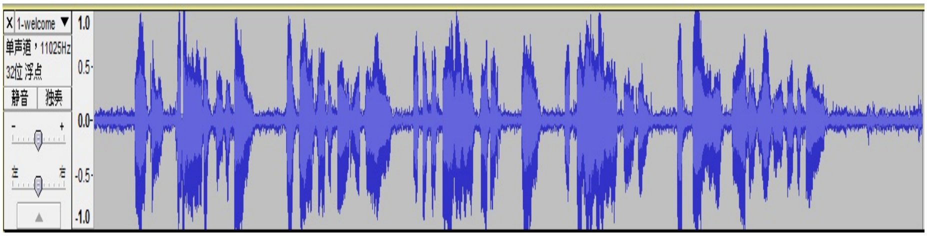

Fig. 1. Web-based learning system of self-generated visualization on pitch recognition

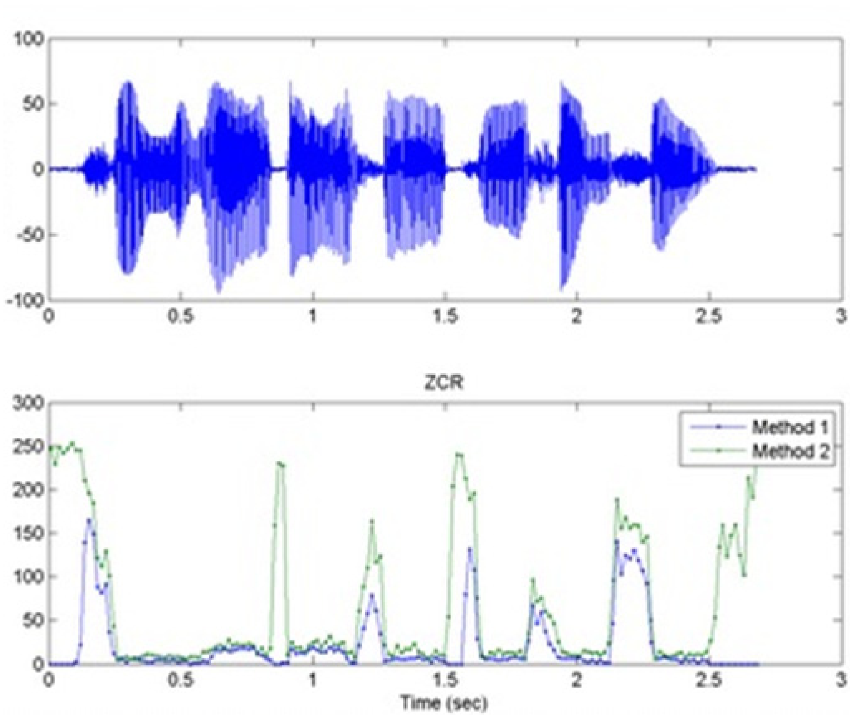

Fig. 2. Visual responding accuracy of sight-singing note

recognized by web-based learning system of self-generated visualization on pitch recognition and responded visually with the compared results of accuracy (Fig. 2). The integrated web-based learning system of self-generated visualization on pitch recognition software is installed at client side. This design not only reduces the overload of server computation, but also avoids redesigning of the existing web sites for the user's special hearing needs.

The design of web-based learning system of self-generated visualization on pitch recognition provides a useful visual mechanism of accessible learner sight-singing. The goal of this design is to construct automatic visual interfaces for sight-singing learning in web-based environment. For each the music notes would be sampled via the voice recorder once sung by a learner, the pitch recognition engine could then perform the following functions as requested to facilitate the access of sight-singing of music notes.

```
private static Double[] bytesToDoubles(byte[] bytes) {
   Double[] double = new Double[bytes.length / 2];
  for(int i=0; i < bytes.length; i+=2) {
     double[i/2] = bytes[i] | (bytes[i+1] << 8);
   }
  return double;
}
```

1. transforming each music into corresponding wave forms, which is used to compare with the standard MIDI pitch producer
2. producing compared result of each music note with the wave forms corresponding to the music staff
3. highlighting the error of sight-singing note
4. replaying the sight-singing of user with feedback of pitch accuracy comparing

Thus, user can access the sight-singing of music notations visually on the Internet through this web-based learning system of self-generated visualization on pitch recognition.

3 Method and Results

This research made use of quasi-experimental method. Children were selected from the 6th grade of a primary school in Taipei Taiwan. These students were randomly divided into treatment group and control group. Children of treatment group could access the web-based learning system of self-generated visualization on pitch recognition through the Internet at classroom and home. Students of control group took the same learning materials and instructions under traditional sight-singing pedagogy. The experiment proceeded over 6 weeks.

The participants were briefed on the rationale behind the test and the basic testing procedure and presented with a consent form. An informal interview was then carried out, to ascertain general information on the individual music backgrounds, their music and computer experience. Baseline measurement was taken while the participant of treatment completed the computer manipulation instructions. The participants of treatment then were encouraged to navigate learning materials in the Internet via using the web-based learning system of self-generated visualization on pitch recognition. This was used to create scaffolding mechanism for the treatment group in sight-singing learning. The questionnaire items were evaluated by computer and music education experts through Delphi approach and confirmed by experienced primary school teachers. The music performance test items were all evaluated and analyzed by music education experts to get the item's difficulty and discrimination coefficient. The students of the two groups received the pretest of music notation related performance after taking the first two weeks of traditional lessons and filled the attitude questionnaires. On completion, an informal interview was conducted to ascertain the state of the participant. The next phase of the experiment was conducted separately at the actually different learning environments. The participants were conducted with the experiment under normal schedule in primary school.

There were 40 children with evaluation of limited sight-singing skills conducted in this study. Participants were given pre and post-tests. The test included identifying pitch, intervals, and rhythm. And a System Usability Questionnaire proceeded after the post-test. In addition to overall satisfaction score, the responses can be divided into three sections: system usefulness, information quality, and interface quality.

The experiment data were gathered and analyzed using SPSS. Both performances of the two groups on pre-test and posttest have been given in Table 1. An independent t-test was inspected to examine if there was any significant difference between the two groups. The compared results of pretest and posttest for each group were presented in Table 2.

Table 1. Performances of the two groups on pre-test and posttest

		Pre-test		Post-test	
Group	N	Mean	SD	Mean	SD
Experiment	20	51.23	8.21	67.16	8,27
Control	20	51.20	7.80	59.80	10.85

Table 2. T-tests of pretest and posttest

	df	t	Sig.
Experiment Group Pretest/Posttest	19	6.76	.000*
Control Group Pretest/Posttest	19	3.16	.000*

The questionnaire data suggested satisfied in all three usability categories (system usefulness, information quality, and interface quality). System usefulness, which measures the users' perception of how the system can improve their sight-singing performance, improved the most with 93% scores.

4 Conclusion

The learning interface of self-generated visualization on music sight-singing could move learners beyond basic drill exercises to a competence that is tailored to the content of individual needs in the sight-singing training. And the recording and replay functionalities created from the web environment facilitate learners to master the skills. The remediation would be visualized by the exercise itself. Sight-singing skills development occurs when learners interact with the learning interface of self-generated visualization on music sight-singing in a continuous drill. Many singing sound faults could then be tuned up through the combination of practice and immediate visual feedback.

References

1. Grutzmacher, P.A.: The effect of tonal pattern training on the aural perception, reading recognition, and melodic sight-reading achievement of first-year instrumental music students. Journal of Research in Music Education 35(4), 171–181 (1987)
2. Lehmann, A.C., Ericsson, K.A.: Performance without preparation: Structure and acquisition of expert sight-reading and accompanying performance. Psychomusicology 15(1-2), 1–29 (1996)
3. Lehmann, A., McArthur, V.: Sight-reading. The science and psychology of music performance: Creative strategies for teaching and learning. Oxford University Press, New York (2002)
4. Sloboda, J.A.: Experimental studies of music reading: A review. Music Perception 2(2), 222–236 (1984)
5. Web-based Education Commission (WBEC). The power of the Internet for learning: Moving from promise to practice (Report), pp. 17–49. U.S. Department of Education, Washington, DC (2000)
6. Wolf, T.E.: A cognitive model of musical sight-reading. Journal of Psycholinguistic Research 5(2), 143–171 (1976)