

Proposing a Process for Using Music Analysis Software to Improve Teaching Authentic Arab Singing and Ornamenting

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Abstract

We present a new process in which we utilize music analysis software as an effective way to teach Arab singing and ornamenting in educational workshops. We discuss the analytical, visual and performance capabilities of a couple of software. Then, we review the aspects of the process: tasks, methodology, work-schedule and requirements. A thorough description of the process has been distributed to a sample of the local musical community. Afterwards, a comprehensive analysis to the responses has been conducted. The views on the process aspects express a collective satisfaction with a mean rate of 79.6%. In addition, the views on the effectiveness of the process in achieving its educational goals came with a mean rate of 76.2%, and thus highlighting the importance of involving latest technology in the educational process even when teaching traditional and classical Arab music. The general view to the entire process came with an average rate of 82.3%. Thus, reflecting a collective encouragement toward adopting our process in Arab music education.

Keywords: Music Education, Arab Music, Singing and Ornamenting, Music Analysis Software, Educational Process

1. Introduction

The recent years have witnessed an unprecedented openness of media through the Internet and satellite channels on all kinds of music around the world. Moreover, Arab youth today have an increasing appetite to use computer and mobile technologies to learn, practice, and share their singing talents over virtual social networks.

These developments have increased the responsibility on Arab music educators. Nowadays, we need a trendy style to draw the attention of young people toward appreciating and learning authentic Arab singing. Since the young generation already trusts and uses the digital technology in various educational aspects, we believe that computer and mobile applications are the best way to teach youngsters the maqamat, forms and special ornaments of Arab music. Not only because such applications are stylish, but also because computers have the magnificent ability to analyze and illustrate numerous musical features with extraordinary accuracy and speed. In this contribution, we propose a process for using analytical computer applications as an effective method for teaching Arab singing and ornamenting.

In the past few years, there has been an increasing interest in proposing new techniques to improve music education in Jordan. In (Haddad et al. 2009 & 2010), an educational toolbox was developed for Arab Woodwinds. It was based on a music information retrieval system (MIR) designed for such instruments and presented in (Al-tae et al. 2009). In Haddad's contribution, four applications were suggested and evaluated; Automatic Transcription, MIR to serve polyphony in Arab music (simple harmony and Organum), "query-by-playing" for retrieval from musical libraries, and a simple tool for melodic analysis. The accuracy of the four applications was found satisfactory, especially when the tempo of the inputted melody is around adagio. Al-Dalal'ah (2004) conducted a study to measure the efficiency of computers as learning tools for teaching musical concepts to students majoring in classroom teaching. Al-Dalal'ah confirmed the efficiency of using computers as learning tools and supported findings with statistical analysis.

Al-Dalal'ah also found that students show positive attitude toward learning via computers in the music education process. Hijazi (2012) conducted a study targeted at finding an efficient approach to develop the skills of singing in an Arab choir throughout studying score reading "solfeggio". The end goal was to minimize vocal mistakes in traditional Arab school-choirs. The study was applied on a sample of students in private schools in Amman, the capital of Jordan. Hijazi introduced to the sample a number of skills applied to vocal music such as breathing, intervals, dynamics and modulation. The results of the study portrayed a significant improvement in the performance of Arab choirs in schools after the introduction of the abovementioned skills. Hijazi supported her findings with statistical analysis as well. Amari (2012) carried out a research targeted at measuring the influence of learning to perform on the recorder in ameliorating the skills of sight reading in Jordanian private schools. Amari discovered that learning to perform on the recorder would lead to a notable improvement in the students' understanding of the duration relationships among musical notes. Moreover, this also led to improving the students' performance in general.

Tayseer (Tayseer et. al. 2014) conducted a study on the use of the various Arab maqamat in contemporary songs. The study alerted to the fact that only a small number of maqamat is used nowadays. Furthermore, there is a tendency toward the replacement of notes having small microtonal variations with chromatic even-tempered ones. The study also underlined the importance of considering the particularity of Arab music when using modern production tools. Moreover, the study drew attention to the importance of designing musical software that is singularly dedicated to Arab music. (Al-tae et al. 2008-2010) and (Al-Ghawanmeh et. al 2011) are examples of contributions which attempted to consider the individuality of Arab music and instruments when designing musical applications. Such consideration improved the efficiency of musical applications when used to serve Arab music.

The rest of this article presents the several stages of our process that uses some efficient international and Arab software in academic music education. We focus on using software to improve teaching authentic Arab singing and ornamenting in an approach mindful of the particularity of Arab music. In section two, we discuss examples of software suitable for this process. Section three gives details about the major aspects of the process: tasks, methodology, work schedule and the requirements of each workshop. In section four we present views on the process collected from the local musical community, and we discuss them in section five. Finally, conclusions and future work are included in section six.

2. Examples of suitable software

There are several high-quality software to employ. We discuss two examples of software in this section. The first example is "Tartini" (McLeod 2008); it is a music analysis software designed for singers and instrumentalists. Using this software is simple; the user is only required to plug in a simple microphone before commencing to sing. The software, then, will provide him/her with a package of analytical capabilities in real-time, all graphical and interactive.

Among the most prominent analytical capabilities offered by Tartini is the melodic contour. It can accurately visualize several ornaments and intonations such as vibrato, trill, acciaccatura and glissando. The software can also visualize loudness in order to help analyze the musical dynamics. Both loudness and melodic contours can be demonstrated in real-time and one above the other. This makes Tartini a convenient platform to study the mutual influence of both contours when expressive performances are demonstrated. Figure one shows Tartini's demonstration of the melodic and loudness contours for four ornaments common in Arab music.

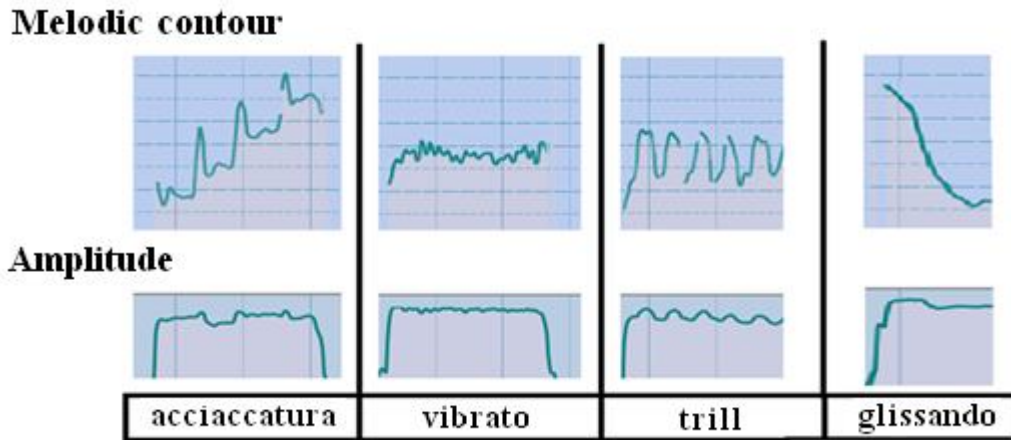


Figure 1. Four ornaments common in Arab music as graphically analyzed by Tartini

Figure two presents a more detailed analysis of the vibrato ornament. Tartini shows the precise speed and width of vibrato. In this example, the speed is 5 Hz, or five vibrations per second, and the width is 51 cents which is about one quartertone.

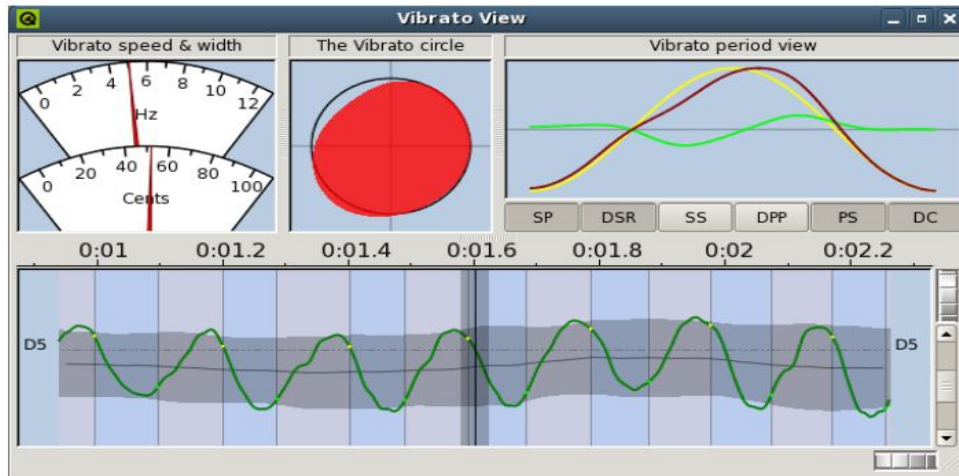


Figure 2: Detailed analysis of vibrato as shown in Tartini (McLeod 2008)

This analysis is important and useful in the process of practical learning and teaching. This is especially because the common musical notation does not usually present the precise analytical details as when offered graphically and numerically by the software. For example, figure three shows the musical score and automatic melodic analysis for the first figure of the improvisation “Yit ana el-gantara” by the Arab singer Awad Al-Dokhi (n.d.). The score, as shown in figure 3-a, informs that the performance is expressive and tells where the trill and acciaccaturas are. Yet, it does not give many details about the expressiveness. On the other hand, the automatic analysis, as shown in figure 3-b, depicts all the expressiveness of the melodic contour and describes ornaments visually and numerically. The first D note, for instance, has a vibrato at a speed of 5 Hz and width of 15 cents at the end of the first second of the recording. The figure also shows the note Eb trilled in its first half with a speed of 6 Hz and a width of 240 cents, which is about 60 cents the upper scale note, F#, in the hijaz maqam. This accuracy of analysis can be of a great help to students learning and imitating expressive singing.



Figure 3-a. Score of the figure.

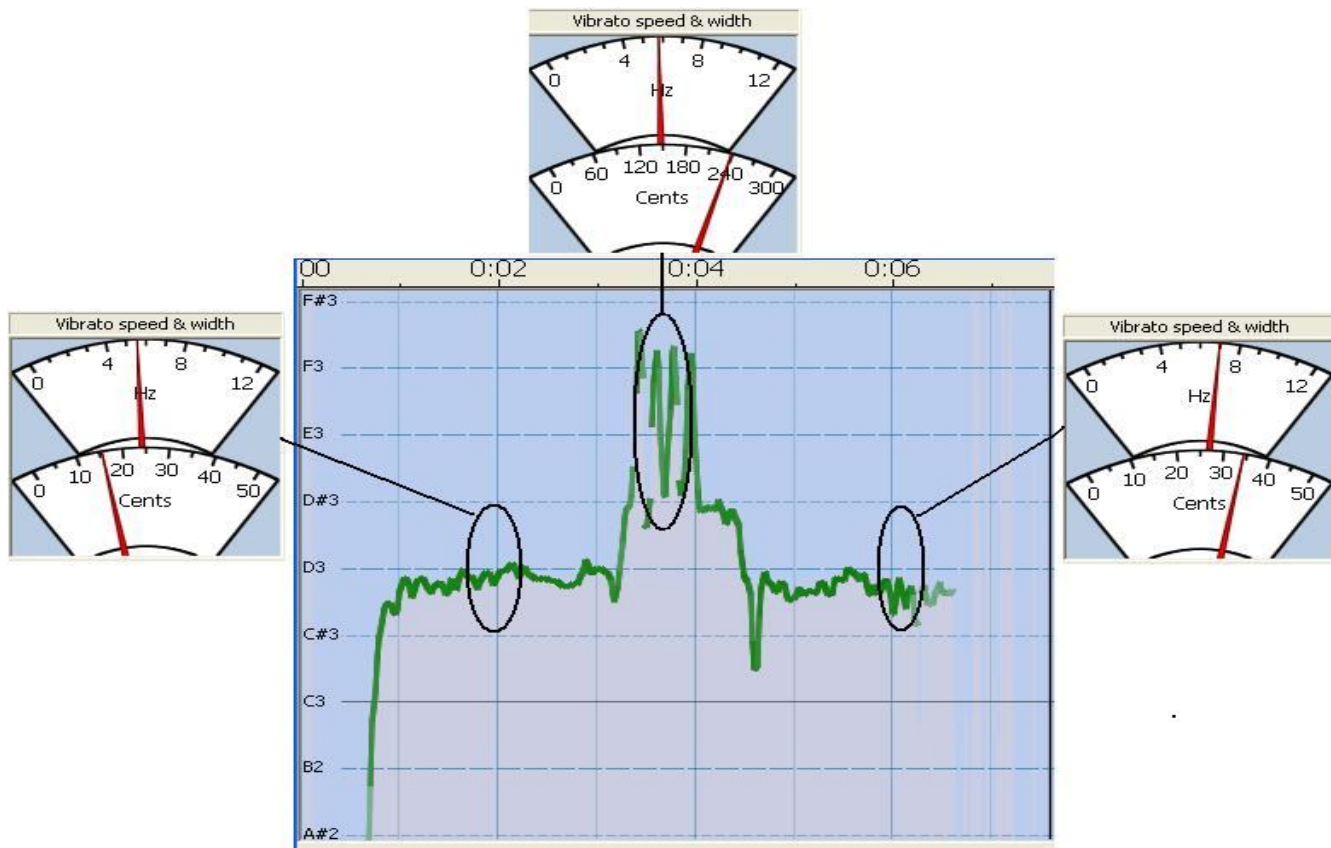


Figure 3-b. automatic analysis of the figure using Tartini

Figure 3: Musical score and automatic melodic analysis for the first figure of the improvisation “Yit ana El-gantara” by Awad Al-Dokhi.

This software also offers some more real-time analytical tools; all could be explored after downloading this software. Tartini is available for free at its webpage within the website of the University of Otago in New Zealand (Tartini 2009).

Another tool that can be used for such process in corresponding workshops is the “Mawaweel” web application.

This application offers an automatic instrumental accompaniment to the Arab vocal improvisation, called, in Arabic: Mawwāl (plural: Mawaweel) (Al-Ghawanmeh 2012). In the application website (Mawaweel 2013), the user can record his/her vocal improvisation then listen to its playback with different ways of musical accompaniment. Figure four shows the Mawaweel application as it appears on the website.

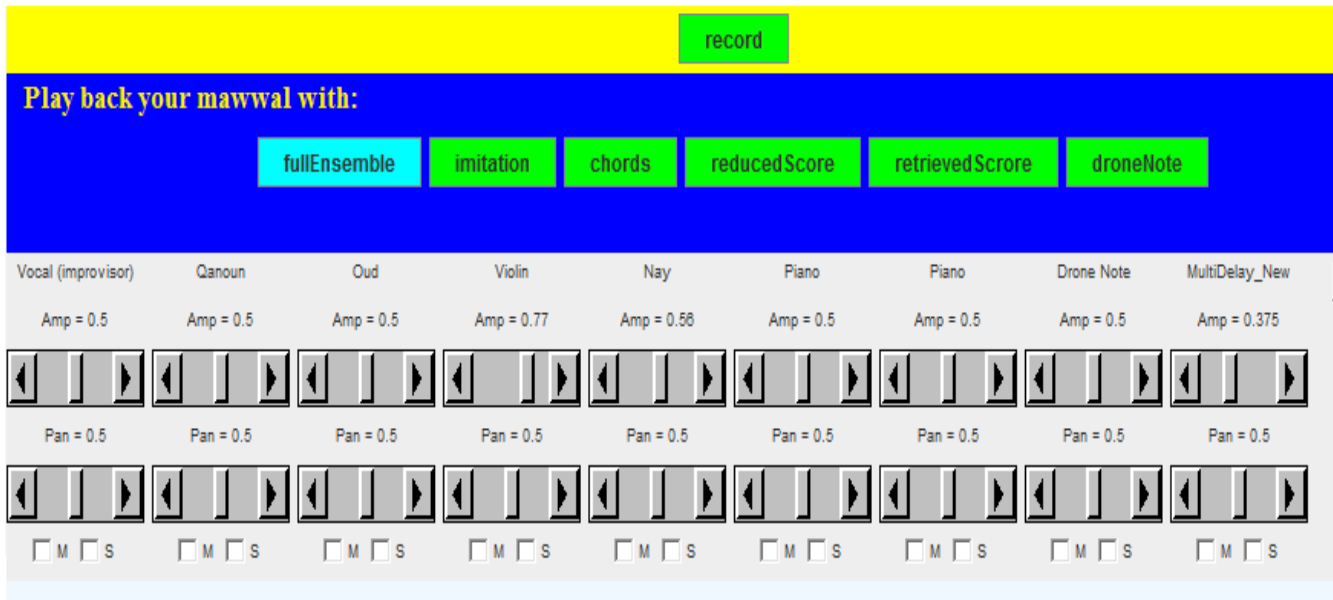


Figure 4: The graphical user interface of the Mawaweel application (Mawaweel 2013).

Since improvisation has been one of the most prominent ways to improve singing and ornamenting proficiencies, the Mawaweel application can help vocal students feel and get accustomed to the ensemble accompaniment. This is important because whether in practicing or listening to a vocal improvisation, the performance can have different impact in each of the two different cases: the presence or absence of musical accompaniment. The Mawaweel application can also help its users to practically recognize and get used to some common ways of accompaniment such as imitation and harmonic accompaniment. In addition, the application's audio mixer helps the user control the amplitude and pan levels of each instrument, thus controlling the overall musical density and stereo image.

3. The Process

The next sub-sections explain the following aspects of the process: tasks, methodology, work Schedule and the requirements of each workshop (human resources and devices).

3.1 Proposed tasks (ordered):

We propose five ordered tasks for any potential implementation of the proposed process. Those are as follows:

- i. Electing a number of creative singing examples from the classical and contemporary Arab repertoires. Such examples should present expressive performance talents. More specifically, innovative performances of ornaments and intonations such as vibrato, glissando, trill and acciaccatura.
- ii. Analyzing each example comprehensively. i.e. analyzing the musical form, maqam, expressive performance, and even the lyrics.. This also includes a computerized numerical and visual analysis of the melodic contour, dynamics, ornaments and intonations.
- iii. Preparing a smooth educational material based on the elected and analyzed examples. This should be carried out while taking into account the consistency among the three main parts of the educational material: audio, written and visualized.
- iv. Experimenting the prepared educational material on groups of music-majored students as well as on groups of singing amateurs. Preferably, this experiment should be performed in professional workshops dedicated for the purpose of teaching authentic Arab singing and ornamenting. We propose a gradual procedure of two stages for this teaching process.
 - a. In the first stage, instructors can use available multimedia devices (computers, projectors, smart boards, etc.) to present and describe each of the three parts of the educational material.

- b. In the second stage, interactive learning with computers would take place. In this fully practical stage, tutors request each student to listen to a short extraction of a particular vocal sound clip that depicts a well-ornamented melody. Next, the student is asked to imitate the vocal content. Throughout listening and imitating, the computer is used to analyze, visualize and compare between the different performances of the same vocal melody. The procedure of listening, imitating and analyzing could be repeated for several times until achieving a satisfactory improvement in the student's performance. Finally, the student can move to another sound clip that depicts another ornament. Such an exercise with such involvement of advanced computer capabilities is expected to increase the student's performance as well as self-assessment abilities.
- v. Preparing a final documentation in which a comparison is made between the expected and the accomplished outcomes. Participants, instructors and tutors would all be requested to fill feedback surveys in order to improve any following workshops.

Moreover, Music education institutes in Jordan could be requested to adopt this process if it is found efficient.

3.2 Methodology and Work Schedule

Although this process is generally experimental, the implementation would also include tasks within the comparative, descriptive and analytical approaches. This ought to be made through three sequential stages; the educational material is prepared in the first stage and is experimented by means of educational workshops in the second stage. In the last stage, the outcomes of the workshops are discussed and documented. Proposed durations for the three stages are six months, twelve months and 6 months, respectively. Table one depicts the tasks, approaches and durations of each stage.

Table 1. Tasks, approaches and durations of each stage

N.	Stage	Tasks	Approach	Duration
1	Preparing the educational material.	Electing a number of creatively-performed vocal examples from the classical and contemporary Arab repertoires.	Comparative	Six months
		Expert and computer analysis of all elected examples followed by preparing a smooth educational material.	Analytical & descriptive	
2	Experimenting the educational material	Experimenting the prepared educational material on music-majored students & singing amateurs in professional workshops	Experimental	Twelve month
3	Discussing, documenting and disseminating outcomes	Preparing a final documentation that includes: the procedure, feedbacks and a comparison between expected and accomplished outcomes.	Descriptive	six months
		Disseminating the conclusions of the whole experience in conferences, academic articles and/or press.	Descriptive	

3.3 Requirements

Table two shows a proposed distribution of the requirements for each session, mainly human resources and devices. It should be mentioned here that each workshop would have several sessions. Each session requires an expert in music technology & education to present and describe the three parts of the educational material: audio, written and visualized. The session also requires 3 tutors to whom the educational material would have already been explained before. The tutors should also be familiar with the technical details of using electronic devices in such practical learning. The required devices include a computer, microphone, speakers, projector and board for the use of the instructor. The devices also include a computer and headset for each of the twelve students.

Table 2: Devices and people involved in each session

Designation	N. of persons	required devices
Instructor	1	computer, microphone, speakers, projector and board
tutor	3	---
student	12	computer and headset for each student

4. Views from the musical community

A comprehensive description of the process has been distributed to a sample of the local musical community, mainly those who are very concerned with developing the process of Arab music education; such as music instructors, students and professionals. The total number of respondents was 14. Each one was asked to fill a three-part form in which he/she rates the different aspects of the process according to his/her professional views and experience. For each aspect, the respondent selects one out of five possible rates: very good, good, fair, weak and unacceptable.

In each of the following three tables, we present one or more aspects of the proposed process together with the rate of each aspect. In each line of each table one aspect is shown together with the percentage of respondents voting for each rate and the average rate of that aspect (also as percentage).

The average rate represents the overall rate of an aspect, and is computed like this:

The rate of each respondent is converted to a numerical representation as follows: very good is converted to 100%, good to 75%, fair to 50%, weak to 25% and unacceptable to 0%. The average rate is then computed for each aspect, i.e. the numerical representation of the rates collected from all respondents are combined then divided by the total number of respondents.

Table three displays the respondents' views on the major four aspects of the process: proposed software, tasks, approach & time frame and requirements. For each aspect, the table shows the average rate and the percentage of respondents voting for each of the five possible rates. The table also shows the mean and standard deviation of average rates. Table four displays the respondents' views on the effectiveness of the process toward achieving the anticipated educational goals. Ten anticipated goals have been introduced to the respondents. The table presents each goal together with its average rate and the percentage of respondents voting for each of the five possible rates. The table also shows the mean of average rates and the standard deviation of average rates. The last table in this section, table five, displays the respondents' general views on the process. It shows the average rate and the percentage of respondents voting for each of the five possible rates. Statistics displayed in all these tables are discussed in the following section.

Table 3: Respondents' views on the major four aspects of the process

N.	Aspect	Percentage of respondents voting for each of the following rates					Average rate
		Very good	Good	Fair	Weak	Inacceptable	
1	Appropriateness of proposed software	36%	57%	7%	0%	0%	82.3%
2	Appropriateness of proposed tasks and their order	29%	64%	7%	0%	0%	80.5%
3	Appropriateness of methodology and adequacy of time frame	36%	36%	28%	0%	0%	77%
4	Appropriateness of requirements (human & devices) of each session	21%	72%	7%	0%	0%	78.5%
Mean of average rates →							79.6%
Standard deviation of average rates →							2.3%

Table 4: Respondents' views on the effectiveness of the process toward achieving anticipated educational goals

N.	Aspect	Percentage of respondents voting for each of the following rates					Average rate
		Very good	Good	Fair	Weak	Inacceptable	
1	Facilitate the transfer of knowledge from the teacher to the student by using advanced multimedia capabilities and diverse audio and automatic accompaniment examples.	14%	79%	7%	0%	0%	76.8%
2	Use software as an efficient method in teaching Arab singing and ornamenting.	28%	36%	36%	0%	0%	73%
3	Save time and effort when using a pre-prepared educational material with audio, written and visualized examples.	42%	29%	29%	0%	0%	78.3%
4	Save money. This is because the interactive analysis and visualization offered by music software could improve the efficiency of self-study and distance learning.	14%	57%	29%	0%	0%	71.3%
5	Minimize human errors in the process of teaching Arab singing and ornamenting. This is because the teacher is not required to have advanced levels of creative performance or precise analysis when using such software in the educational process.	22%	57%	14%	7%	0%	73.5%
6	Provide clear and precise practical examples in the fields of singing, ornamenting and accompaniment.	14%	72%	7%	7%	0%	73.3%
7	In group learning: improve the quality of education, equality and quantity of learners	14%	57%	29%	0%	0%	71.3%
8	Make the singing class more fun, this is due to the tendency of students to enjoy using computers applications.	29%	64%	7%	0%	0%	80.5%
9	Developing a new, practical, and improvable concept in teaching Arab singing and ornamenting.	50%	36%	14%	0%	0%	84%
10	Encourage the educational environment to propose new processes or software of educational goals.	36%	50%	14%	0%	0%	80.5%
Mean of average rates →							76.2%
Standard deviation of average rates →							4.4%

Table 5. Respondents' general views on the process

N.	Aspect	Percentage of respondents voting for each of the following rates					Average rate
		Very good	Good	Fair	Weak	Inacceptable	
1	The extent to which the process could be considered positive on both the implementation and the achievement of the goals.	36%	57%	7%	0%	0%	82.3%

5. Discussion

The statistics displayed in tables 3-5 reveal a general satisfaction with the proposed process. In table three displaying the respondents' views on the major four aspects of the process, the mean of the average rates is 79.6% and the standard deviation of the average rates is only 2.3%. Half of the average rates are within one standard deviation from the mean, and all of them are within two standard deviations. This indicates that the four major aspects of the process are homogeneous in terms of having a high quality rank between good and very good. Moreover, within each aspect and when considering the percentage of respondents voting for each of the five possible rates, we notice that the idea of common tendency to rank all aspects as high quality is also applied. Indeed, most of the ranks are located within the good and very good categories, and rarely fall into a lower category. Accordingly, we can say that the respondents' views on the major four aspects of the process are very encouraging.

In table four which displays the respondents' views on the effectiveness of the process toward achieving anticipated educational goals, the mean of the average rates is 76.2% and the standard deviation of the average rates is 4.4%. Seven out of ten average rates are within one standard deviation from the mean, and all of them are within two standard deviations. Such a close distance between the average rates and their mean is an indication that the process is almost equally effective toward achieving each of the ten anticipated educational goals. Moreover, for each goal and when considering the percentage of respondents voting for each of the five possible rates, we can also notice the common tendency to consider all anticipated goals as effectively-achieved by such an educational process. Indeed, most of the ranks are located within the good and very good categories. Accordingly, we can say that the respondents' views on the effectiveness of the process toward achieving its ten goals are very satisfactory. In addition, it is quite interesting that one goal obtained a remarkably high average rate: 84%. This goal is "developing a new, practical, and improvable concept in teaching Arab singing and ornamenting". We believe that this is an obvious testimony from a sample of the Arab musical community on the importance of involving new technologies in music education even when teaching classical and traditional music.

In table five which displays the respondents' general views on the proposed process, the average rate is 82.3%. We consider this rate as another indication that our process has gained the respondents' approval whether it is concerning the implementation or the ability to achieve its goals. In addition, when considering the percentage of respondents voting for each of the five possible rates, we notice that the idea of common tendency to rank the process as a high quality is also applied. Indeed, the results displayed in table five are in line with the results displayed in tables three and four and reflect a collective encouragement toward approving our proposed process in Arab music education.

6. Conclusions and Future Work

This contribution comes at a time in which Arab music education gains extra attention among youth as well as media. Since youth have an increasing appetite to use the digital technology to learn, practice, and share their singing talents, we propose a novel process in which we use music software as an effective mean to teach Arab singing and ornamenting in educational workshops. We have discussed the analytical, visual and performance qualifications of a couple of software that could be used efficiently for this purpose. Moreover, we talked over the different aspects of the process: tasks, methodology, work schedule and the requirements. A comprehensive description of the process has been distributed to a sample of the local musical community. The sample views on the major four aspects of the process express a common satisfaction with a mean rate of 79.6%. The views on the efficiency of the process toward achieving its anticipated educational goals came with a mean rate of 76.2%. Thus, reflecting a common tendency to consider all anticipated goals as effectively-achieved by such a process. Our sample also considered it important to involve newest technologies in music education even when teaching traditional and classical music. The general view on the process as a whole came positive with an average rate of 82.3%. Hence, the conclusion that there is a collective support toward adopting our process in Arab music education.

Future work would include implementing the process over a large sample of students including groups from several educational institutions, different geographical locations and different educational and cultural backgrounds. This could be followed by further steps of evaluation, improvement and customization to the requirements of the different groups of potential learners.

References

- Al-dalalah , O. (2004). *Dawr al-hasūb kawasīlah ta'līmīyah fī ta'allom talabat mo'allim al- saf fī jami'at al-yarmūk lilmafahīm al-mūsiqīyah wa ittījahatihim nahwah* [The Computer as a Learning Tool to Teach Students of Classroom-Teachers Specialization at the Yarmouk University the Musical Concepts, and Their Attitudes Toward It]. Unpublished master's thesis, University of Jordan.
- Al-Doukhi, A. (n.d.). Yīt ana El-gantara. Retrieved March 5, 2014 from <http://www.youtube.com/watch?v=2lio186hg7M>.
- AL-Ghawanmeh, F., AL-Ghawanmeh, M. & Haddad, R. (2009). Appliance of Music Information Retrieval System for Arabian Woodwinds in E-Learning and Music Education”. *Proc. of the International Computer Music Conference, ICMC09*, Montréal, 16-21 August (pp.17-20). Ann Arbor, MI: MPublishing, University of Michigan Library
- Al-Ghawanmeh, F., Jafar, I., Al-Taee, M., Al-Ghawanmeh, M., & Muhsin, Z. (2011). Development of Improved Automatic Music Transcription System for the Arabian Flute (Nay). *Proc. of the 8th International Multi-Conference on Systems, Signals and Devices (SSD-11)*, Sousse, Tunisia, 22-25 March. doi: [10.1109/SSD.2011.5993561](https://doi.org/10.1109/SSD.2011.5993561).
- Al-Ghawanmeh, F. (2013). *Automatic Accompaniment to Arab Vocal Improvisation 'Mawwāl'*. Unpublished Master's Thesis, New York University, New York City, USA.
- Al-Taee, M., Al-Rawi, M. & AL-Ghawanmeh, F. (2008). Time-Frequency Analysis of the Arabian Flute (Nay) Tone Applied to Automatic Music Transcription. *Proc. of The 6th ACS/IEEE International Conference on Computer Systems and Applications (AICCSA-08)*, Doha, Qatar, 31 March - 4 April (pp.891-894). doi: [10.1109/AICCSA.2008.4493636](https://doi.org/10.1109/AICCSA.2008.4493636)
- Al-Taee, M., Al-Ghawanmeh, M., Al-Ghawanmeh F., & Omar, B. (2009). Analysis and Pattern Recognition of Arabian Woodwind Musical Tones Applied to Query-By-Playing Information Retrieval. *Lecture Notes in Engineering and Computer Science*. 2176(1). Hong Kong: Newswood Limited.
- Al-Taee, M. & Al-Ghawanmeh, F. (2010). Tahlīl wa istikhlas al-khasa'is al-mūsiqīyah linaghamāt alat al-nay Al-Arabi [Analysis and Features Recognition of Arabian Flute (Nay) Musical Tones], *Jordan Journal of the Arts*. Irbid: Yarmouk University.
- Amari, A. (2012). *Fa'alīyat istikhdam alat al-flute that al-mabsam fī tatwīr maharat al-qira'ah al-mūsiqīyah al-fawrīyah lada al-talabah fī madāres al-ta'līm al-khās* [The Effectiveness of Using the Recorder to Develop the Sight Reading Skills for Students at Private schools]. Unpublished master's thesis, University of Jordan.
- Haddad, R., AL-Ghawanmeh, F., & AL-Ghawanmeh, M. (2010). Educational Tools Based on MIR System for Arabian Woodwinds. *Journal of Music, Technology and Education*, 3(1), 31-45. Bristol: Intellect Ltd.
- Hijazi, L. (2012). *Athar ta'allom al-qira'ah al-solfa'īyah fī tatwīr maharāt al-ghina' al-taqlidi lilalabat almarhalah al-asasīyah al-'olia fī madāres al-ta'lim al-khās* [The Impact of Learning “Solfage” in Developing Traditional Singing Skills for students in elementary private schools]. Unpublished master's thesis, University of Jordan.
- Mawaweel: Web Application for Automatic Accompaniment to Arab Vocal Improvisation ‘Mawwāl’. (2013). Retrieved December 12, 2013 from <http://www.mawaweel.com>.
- McLeod, P. (2008). *Fast, Accurate Pitch Detection Tools for Music Analysis*. Unpublished PhD thesis, University of Otago, Otago, New Zealand.
- Tartini: The Real-Time Music Analysis Tool. (2009). Retrieved December 10, 2013 from <http://miracle.otago.ac.nz/tartini/>.
- Tayseer, A., Haddad, R., Sukkarieh, H. & Al-Ghawanmeh, F. (2014). Al-maqamāt fī al-oghniyah Al-Arabia al mo'asirah [Modes (Maqamat) in Contemporary Arab Songs]. *Dirasat Journal of Human Sciences*. Amman: University of Jordan.