# Development of Technical Wine Assessment Skills in Tertiary Students

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## Abstract

Learning to objectively evaluate wine sensory properties (such as appearance, aroma, flavour, taste and mouthfeel attributes) features prominently in wine education programs. Formal, structured sensory classes that involve recording detailed observations and perceptions is the traditional approach to build perceptual and linguistic learning. This research explored students' behaviour in maintaining wine tasting notes and their perceptions of wine sensory classes by survey across four Australian institutions (n=109) and by focus groups (n=24). International students were not as confident in class room discussions or describing wine, and did not perform as well in sensory exams, suggesting that language ability and/or cultural/life experience is important for technical wine assessment. Given that 98% of students surveyed owned a smartphone, mobile learning may provide an opportunity to enhance and facilitate learning of wine sensory analysis outside of the classroom. The *My Wine World^{TM}* App (developed for smartphones) was evaluated by academic staff and students as a potentially valuable e-learning tool for the development of perceptual and linguistic memory of sensory attributes.

## Introduction

Wine sensory attributes such as appearance, aroma, flavour, taste and mouthfeel determine wine quality and consumer acceptability (Iland, Gago, Caillard, & Dry, 2009). Tertiary students in viticulture, winemaking and wine business must therefore learn to objectively describe wine sensory attributes as well as to differentiate wines on the basis of grape variety, wine style and quality. Written descriptions of wine are often 'concrete' in nature and refer to concepts or objects that can be easily experienced and/or remembered (Huang, Lee, & Federmeier, 2010). As such, the meanings of the descriptors used for wine reviews are grounded in perception (Paradis & Eeg-Olofsson, 2013) which is in turn influenced by context, frequency and familiarity (Binder & Desai, 2011). Furthermore, concrete words and concepts are processed differently to abstract ones, enabling language comprehension through more easily evoking mental imagery, especially of our own experiences in life (Huang, et al., 2010). The involvement of taste and smell in emotional processes is also expected to affect linguistic reflection and understanding (Winter, 2016). Because of the intermediary role that language plays between the subjective individual nature of sensation and the sensory environment (taste, smell, colour etc.) (Majid & Levinson, 2011), the descriptors for wine need to have a shared, meaningful understanding between individuals (Paradis & Eeg-Olofsson, 2013). Indeed, a

precise use of descriptors is the main factor that defines an expert from a novice (Solomon, 1990) as without extensive training, most individuals struggle to use linguistic terms to describe the sensory attributes of wine (Parr, Heatherbell, & White, 2002). Experts, due to their enhanced perceptual skills, are less susceptible to verbal overshadowing, a form of memory illusion where verbally describing a complex stimulus (such as taste or smell) can impair subsequent attempts at identifying that stimulus (Parr et al., 2002). Trained individuals are also more able to use vague and abstract terms as cues for identification (Gawel, 1997). Formal, structured sensory classes that focus on perceptual and linguistic dimensions therefore play an essential role in the development of technical wine assessment skills.

Traditionally, development of technical wine assessment skills in tertiary students has involved the recording of detailed observations and perceptions of wines. This approach is successful because it develops tacit knowledge with students 'learning by doing' (Herdenstam, Hammarén, Ahlström, & Wiktorsson, 2009) and more specifically develops their ability to distinguish particular sensations (Solomon, 1990). However, tacit knowledge is more likely to be further consolidated when also using a pragmatic constitutive approach where students are able to instantaneously verbalise and communicate their experience and compare with others (Herdenstam et al., 2009). Other methods such as drawing mind-maps to make associations between words and how they are used have also been suggested to enable better learning outcomes (Hirokawa, Flanagan, Suzuki, & Yin, 2014) in technical wine assessment.

The advent of mobile technologies, tablets and smartphones in particular, offers convenient, electronic platforms with which highly functional applications (Apps) can be developed to facilitate flexible and adaptive approaches to learning and teaching (Manuguerra & Petocz, 2011). Importantly, they provide students with 'the ability to learn within one's own context when on the move in time and space' (Melhuish & Falloon, 2010, p. 3). M-learning (mobile-learning) opportunities can be personalised to increase learner choice, agency and motivation (Kearney, Schuck, Burden, & Aubusson, 2012) as well as to improve critical thinking (Vallance, 2008) and reflection (Yang, Newby, & Bill, 2008). However, to be successful M-learning requires appropriate integration with the curriculum via authentic tasks that provide contexts that allow students to practice the type of activities they would encounter outside formal learning settings in the 'real world' (Kearney et al., 2012). M-learning has most often been evaluated for its use in language instruction (Crompton & Bourke, 2018). However, as recently identified in a systematic review by Crompton and Bourke (2018), there is minimal evaluation of how M-learning is used in specific disciplines and therefore limited discipline-specific understanding of best pedagogical practice.

In 2012, Wilkinson and Grbin (2014) developed a prototype iPad App which was specifically designed to guide students through a technical wine assessment as taught in sensory classes. Although the evaluations of the prototype were generally favourable (Wilkinson & Grbin, 2014), the prototype had limited functionality and students were unlikely to take the iPads to wine tastings outside of the classroom (such as their workplace, cellar door or wine festivals). However, these represented approximately 60 to 80% of most student's wine tasting experience (Wilkinson & Grbin, 2014). The prototype was therefore developed further into the *My Wine World App*[TM] (http://www.mywineworld.com.au/) to enable smartphone usage and greater functionality aimed at improving student participation and engagement in learning, both during classes and outside of class. In addition, the App has an online database that captures and differentiates individual students' tasting notes, enabling academics to provide students with feedback on their descriptive language. This paper provides a case study on the use of the *My Wine World App*[TM] in learning and teaching. Furthermore, it provides insight to the

development of wine technical assessment skills in tertiary students and the reliance on the development of linguistic capabilities in a classroom setting specifically.

## Methodology

The project employed action research (Ozanne & Saatcioglu, 2008) as a methodological framework and was approved by the University of Adelaide's Human Research Ethics Committee (H-2014-198). In the preliminary phase, a workshop was held to evaluate the usefulness of the prototype App (Wilkinson & Grbin, 2014) with academics at each of the universities involved in the study (University of Adelaide, UA; Charles Sturt University, CSU; University of Melbourne, UM; and University of Southern Queensland, USQ). Academics (n=5) were asked to beta-test and discuss its structure, content and functionality bearing in mind the methods used at their university to assess students' sensory skills and experience. This feedback was then used in the development of the *My Wine World* $^{TM}$ App for iPhone and Android platforms by the digital media company Enabled Solutions (Malvern, Australia).

Because of the interest in development of smartphone versions of the App, ***online surveys*** of students were also conducted at each participating institution to determine students' use of tablets and smartphones as well as the current methods by which students record their wine tasting notes and experience (n=109). Students enrolled in wine-related courses offered at each of the participating universities were invited to participate in an online survey administered via SurveyMonkey$^{TM}$. Response rates were 67% (52/78), 33% (24/72), 23% (28/124) and 100% (5/5) for students from UA, CSU, UM and USQ, respectively. The six-section survey was based on one used in a preliminary study (Wilkinson & Grbin, 2014), but incorporated additional questions related to subjective wine knowledge (Flynn & Goldsmith, 1999) and participation in class discussions (McCroskey, 1984). The first section captured demographic information about gender, year of birth, nationality, language spoken at home, ownership of mobile devices (i.e. tablets and smartphones) as well as the nature of the degree students were enrolled in (winemaking or wine business, undergraduate or postgraduate). The second section required students to use a 9-point Likert scale (where 1=strongly disagree and 9=strongly agree) to answer questions determining wine involvement (Bruwer & Huang, 2012) (Table 1A). Participants were then asked open questions about how much wine tasting experience they had, any experience working in the wine industry, how often they taste wine and the attributes they consider most important to wine. In the fourth section, students were asked to estimate where they taste/consume wine by percentage; for example, the proportion of their wine tasting that occurs during sensory practical classes at University, whilst working in bottle shops, or visiting cellar doors or wine festivals. If students usually recorded notes when tasting/consuming wine, they were asked to indicate how often they would record tasting notes for each of these scenarios using a 9-point Likert scale (where 1= never, 3=occasionally, 5=sometimes, 7=usually and 9=always). Students then needed to indicate how they record tasting notes and the details they record before using another 9-point Likert scale to show how likely they would refer to an aroma wheel (https://www.winearomawheel.com/), wine tasting guide, winery website, read the back label of the wine bottle, take photos with a tablet/smartphone, record notes on a tablet/smartphone, and, refer back to their previous tasting notes (where 1=highly unlikely and 9=highly likely). In sections 5 and 6, students were asked to indicate to what extent they agreed or disagreed with a series of statements relating to participation in class discussion and their perceptions of wine sensory classes, respectively (again using 9-point Likert scales where 1=strongly disagree and 9 = strongly agree) (Table 1B). Data was analysed for significant differences (P<0.05) using analysis of variance (ANOVA) in Genstat (17$^{th}$ Edition, VSN International Ltd). Internal consistency was

confirmed with Cronbach's alphas which were 0.90 and 0.86 for the 6 class discussion and 11 perceptions of wine sensory class statements respectively.

**Table 1: Questions using a 9 point Likert Scale (1=strongly disagree and 9=strongly agree) from an online survey about wine involvement, participation in and perception of wine sensory classes.**

| **1A. Section 2: Wine Involvement** |
|---|
| I know a lot about wine |
| I know how to judge the quality of wine |
| I know enough about wine to feel confident when I make a purchase |
| I do not feel very knowledgeable about wine |
| Among my circle of friends, I'm one of the experts on wine |
| Compared to most other people I know less about wine |
| I have heard of most of the wines that are around |
| When it comes to wine, I really don't know much |
| I can tell if a wine is worth the price or not |
| **1B. Section 5: Participation in Class Discussion** |
| I dislike participating in group discussions |
| I am comfortable while participating in group discussions |
| I am tense and nervous when participating in group discussions |
| I like to get involved in group discussions |
| Engaging in a group discussion makes me tense and nervous |
| I am calm and relaxed while participating in group discussions |
| **1C. Section 6: Perception of Wine Sensory Classes** |
| I enjoy wine sensory classes |
| I find it difficult to evaluate the sensory attributes of wine |
| I am confident describing wine sensory attributes in detail |
| I think other students write more detailed tasting notes than I do |
| I think my wine vocabulary is good |
| I often use 'fruity' or 'oaky' as descriptors for wine aroma/flavour |
| I think other students use more descriptive language than me |
| I often participate in discussions during sensory classes |
| I am confident sharing my tasting notes/opinions during sensory classes |
| I worry that my tasting notes/opinions are wrong or not good enough |
| I prefer to let other students share their tasting notes/opinions |

The second phase then involved *focus groups* conducted with a subset of students enrolled in the University of Adelaide's Foundations of Wine Science course (both undergraduate and postgraduate students, in 2014 and 2015; n=24). Discussion developed the themes identified in the online survey and particularly sought to explore students' perceptions of sensory practicals, familiarity with common wine sensory descriptors and willingness to participate in group discussions. Students were also asked about the impact of the App on their learning and wine vocabulary as well as how they felt about the use of the database captured in the App for assessment purposes. *Results* from sensory exams at the University of Adelaide were also analysed over a 5 year period (2010 to 2014) to determine to what extent diversity in students' language backgrounds influenced learning outcomes and performance. Data was analysed for significant differences ($P<0.05$) using analysis of variance (ANOVA) in Genstat (17th Edition, VSN International Ltd).

The third phase involved an *academic evaluation* of the *My Wine World App[TM]* at participating institutions. Approximately 6 months after release, academics (n=8) were specifically asked

about their current approach to teaching and assessing wine sensory skills, whether the App captured useful content, the potential for the App to be used for teaching; and additional functionality that might enhance the App.

## Findings and discussion

The *My Wine World App^{TM}* was successfully developed and released on iPhone and Android in mid-2015. The App allows wine specifications (such as wine producer, name, vintage, variety, style, region, country of origin and price) to be recorded together with photos of the front and/or back labels (Figure 1A). A number of attributes can be easily selected from drop-menus (please see Figure 1B for an example) while colour charts assist wine colour determination (Figure 1C). The App also has a glossary of aroma and flavour descriptors to encourage students to use a broader range of more specific terms. New terms can be added to the glossary. Student tasting notes are captured via an online database that can be accessed by teaching staff to download as an excel file.

**Online survey**
Only 2 of the 109 students surveyed (Table 2) did not own a smartphone whereas only 55% owned a tablet. This observation justified development of the App for a smartphone rather than a tablet. Of the 109 students surveyed (Table 2), 58% were male with an average age of 27 years (but ranging from 19 to 57). However, there was a higher proportion of male students at CSU and USQ where the students were also older and were more likely to have industry experience (87.5% of students at CSU and 100% at USQ compared with 44% at UA and 4% at UM). The greater number of students with experience at these two Universities might reflect the male dominance of the wine industry (ABS 2008; Bryant & Garnham, 2014). These students also scored significantly higher for the wine involvement scale. Industry roles ranged, depending on duration of industry involvement, from cellar door and cellar hand role (1-5 years of experience) to more senior roles as winemakers, viticulturists and wine marketers (10+ years of experience).

The majority of students were undergraduate and studying viticulture and/or oenology, although the UM students were all undergraduate and primarily from other degrees. UA had the most students, with a greater proportion of postgraduate students (29%) than CSU (13%) and USQ (20%). In addition, the majority of students at UA were international (54%) compared with CSU (8%) and UM (25%) while there were no international students at USQ. Domestic students rated their wine involvement significantly higher than international students (P<0.001) (Table 2) with domestic students participating in wine tasting more frequently than international students (Figure 2). Male students rated their involvement as significantly higher than female students (P<0.001) (Table 2), while whether a student was an undergraduate or postgraduate had no significant effect on wine involvement score. Indeed, the patterns of wine consumption were similar between undergraduate and postgraduate students (data not shown). Furthermore, a higher proportion of males (63%) than females (28%) consumed wine two or more times per week. The vast majority of CSU and USQ students (96% and 100% respectively) reported that they consumed wine two or more times per week whereas students from UA and UM consumed wine less frequently (38% and 18% respectively. These observations may reflect the greater industry involvement for the CSU and USQ students and the greater numbers of international students at UA and UM.
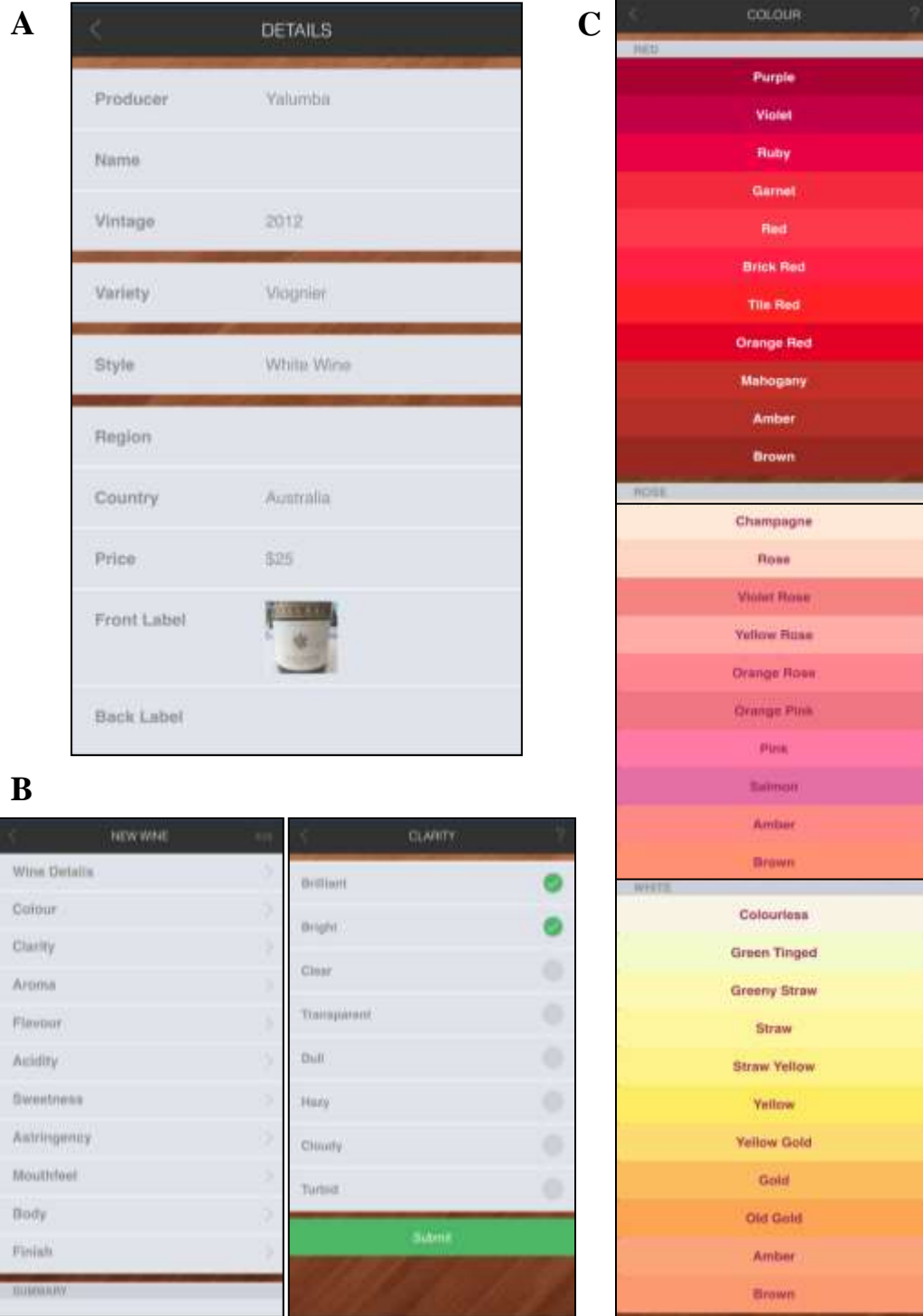
**Figure 1: Screen shots of the *My Wine World ᵀᴹ* App.** A) Details of the wine specifications that can be recorded. B) An example of the drop down menus using industry-relevant terms (for clarity). C) The colour charts to assist wine colour determination, using descriptors common in industry.

**Table 2: Demographics of students surveyed. (**The totals for each category, as well as the means ±SE for each institution, are shown.)

| | | Total (n=109) | UA (n=52) | CSU (n=24) | UM (n=28) | USQ (n=5) |
|---|---|---|---|---|---|---|
| *Gender* | Female | 46 | 27 | 5 | 13 | 1 |
| | Male | 63 | 25 | 19 | 15 | 4 |
| *Age* | Range | 19–57 | 19–50 | 24–54 | 19–31 | 26–57 |
| | Average | 27±0.9 | 24±0.9 | 38±1.7 | 21±0.5 | 44±5.2 |
| *Study Area* | Viticulture and/or oenology | 62 | 33 | 23 | 1 | 5 |
| | Wine marketing/business | 14 | 13 | 1 | – | – |
| | Other | 33 | 6 | – | 27 | – |
| *Level* | Undergraduate | 90 | 37 | 21 | 28 | 4 |
| | Postgraduate | 19 | 15 | 3 | – | 1 |
| *Status* | Domestic | 72 | 24 | 22 | 21 | 5 |
| | International | 37 | 28 | 2 | 7 | – |
| *Wine Involvement* [a] | Range | 2.4–8.7 | 2.6–8.2 | 4.4–8.7 | 2.4–7.6 | 6.9–8.4 |
| | Average | 5.9±0.1 | 5.5±0.2 | 7.0±0.2 | 5.5±0.2 | 7.5±0.3 |
| *Years of wine consumption* | Range | 0–35 | 0–35 | 6–30 | 0–6 | 5–35 |
| | Average | 6.9±0.8 | 5±0.8 | 16±1.5 | 2±0.3 | 17±5.1 |
| *Years of industry experience* | Range | 1–27 | 1–25 | 1–27 | – | 1–20 |
| | Average | 6.5±0.6 (n=50) | 4±0.7 (n=23) | 9±1.4 (n=21) | 2±0.0 (n=1) | 7±3.4 (n=5) |
| *Ownership of mobile technology* | Tablet | 60 (55%) | 29 | 10 | 17 | 4 |
| | Smartphone | 107 (98%) | 51 | 23 | 28 | 5 |

[a] Involvement determined using the wine involvement scale (Bruwer and Huang 2012), with scores < 5.0/9 indicating low involvement and scores ≥ 5.0/9 indicating high involvement.

The majority of students' wine tasting occurs outside of University (81%) and in particular, at home (42%) (Table 3), confirming our previous observations (Wilkinson and Grbin 2014). International students were more likely to rely on University tastings than domestic students, as did undergraduates when compared with postgraduates. Postgraduates were also more likely to taste wine at restaurants, cafes, bars, cellar doors or wine festivals, possibly reflecting their easier access to wine financially, as a function of their greater age and/or time in the workforce. Given that the CSU and USQ students had greater industry experience and were more likely to already be working in industry, the observation that they had a greater proportion of their wine tasting at work compared with UM and UA students was as expected (Table 3).

Only 37 of the 109 students surveyed indicated that they usually record any notes when tasting/consuming wine (Table 3). Given that all students would be required to record notes during sensory classes at University, this response probably reflects the fact that most students are usually more likely to be tasting wine elsewhere. As such, the responses provided by students about the likelihood of where they record notes is probably only indicative of those students that were likely to partake in the activity outside of University.
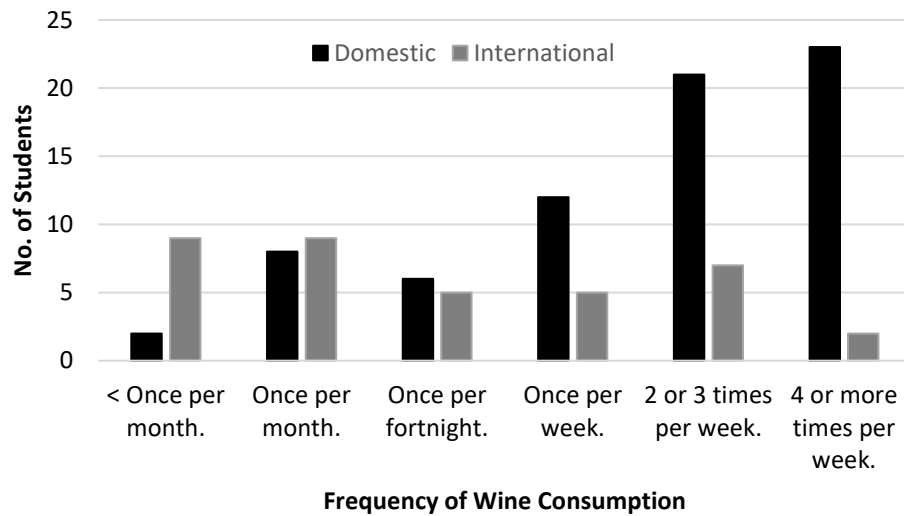
**Figure 2: Frequency of wine tasting by domestic (n=72) and international (n=37) students.**

Students are far more likely to record tasting notes at University or work especially domestic students (when compared with international students). Postgraduate students and those students with greater industry experience at USQ and CSU were more likely to record tasting notes at work. The more experienced USQ and CSU students were also more likely to record notes at other tastings while postgraduate students were more likely to record tasting notes at home than undergraduates. Regardless of status or level, students were not likely to record notes at cellar doors, wine festivals, cafes, bars, or retail outlets (Table 3). Therefore, the development of skills and practice of note taking during tasting of wine needs to occur in the classroom to prepare students for the workforce.

The majority of students who record tasting notes indicated they take note of sensory properties such as appearance/colour, aroma, flavour, taste and mouthfeel descriptors; as well as price, brand, vintage, region and quality scores. Some students also recorded the presence of taints, liking scores, grape variety, alcohol content and place of purchase/tasting. For the 20 students at UA that usually record notes, 16 indicated they use a journal, notebook or diary with 8 indicating they use an App or use their phone. A similar trend was observed for the CSU and USQ students with the majority recording written notes (6 of the 9 and 2 of the 3, respectively) and using an App or their phone (5 of the 9 and 2 of the 3, respectively). The use of both written notes and a mobile device (App/photo) suggests that students value the flexibility and choose the most appropriate method for their situation. Several students who use their phone to record tasting notes indicated they took photos of wine bottle labels. Of the 5 UM students that recorded written notes, only 1 used digital means but used a laptop.

When considering respondents that usually record notes (n=37), the majority indicated that they usually read the back label of the bottle when tasting wine and often take a photo of the wine bottle label (Table 3). Most students would only sometimes refer to an aroma wheel or tasting guide, refer back to their own tasting notes or record tasting notes on a mobile device. Referring to the producer's website was occasional. Whether a student was an international or domestic student did not influence their choice but postgraduate students were more likely to read the back label of the wine bottle and take a photo of the wine bottle label. Students from

UA and UM were more likely to refer to an aroma wheel or tasting guide, while UA and CSU students were more likely to read the wine bottle label. USQ students were the only institutional cohort that indicated they usually record their tasting notes on a mobile device while UM students were the only cohort to indicate they only occasionally take a photo of the wine bottle label.

The majority of students enjoy wine sensory classes (Table 4). Most appear to enjoy and are comfortable participating in group discussions during sensory classes, and most are confident about sharing their tasting notes (Table 4). However, the USQ and CSU students appear to enjoy and/or be more confident in class discussions to a greater extent, perhaps reflecting their greater experience in the wine industry. Postgraduate students are also more likely to be confident and want to be involved in group discussions perhaps reflecting their maturity and breadth of prior learning experiences. However, international students are less confident and comfortable in participating in class discussions. This observation fits with research that has shown many Non-English Speaking Background (NESB) students feel uncomfortable or unfamiliar with conversational English and cultural expectations in the classroom in Australia (Sawir 2005). The lack of confidence in the international students was also greater for them when describing sensory attributes using technical language with the majority feeling their wine vocabulary and descriptive language abilities were lacking (Table 4).

**Focus groups**
Three focus groups were held across 2014 and 2015 with a total of 11 postgraduates (all international) and 13 undergraduates (5 domestic and 8 international) from the University of Adelaide. Constant comparison analysis of focus group discussions (Onwuegbuzie, Dickinson, Leech, & Zoran, 2009) was used to develop a set of themes that confirmed the importance that vocabulary plays in the learning of wine sensory skills (Figure 3). Students were generally not confident in their knowledge of words used in sensory analysis, especially if international. However, most students were positive about their intensive learning experience in residential schools which are an intense one week block of learning comprising practicals on grapevine anatomy, variety identification, berry ripening, and the development of skills in technical wine evaluation (that is, training in recognition and evaluation of different wine styles and their characteristic sensory attributes). Students also wanted to practice or learn more about wine sensory outside of their structured classroom experiences. Most were positive about traditional tools, such as aroma wheels, and also had a positive attitude towards the *My Wine World*$^{TM}$ App. Interestingly, half of the comments made regarding the use of wine tasting notes were negative (Figure 3).

**Table 3: Student wine tasting by venue and for those students that usually record notes when tasting/consuming wine: likelihood of recording tasting notes at different venues and tools used during that process.** Data is shown as a total and by institution, level and status.

| | | Total (n=109) | UA (n=52) | CSU (n=24) | UM (n=28) | USQ (n=5) | Undergrad. (n=90) | Postgrad. (n=19) | Domestic (n=72) | Internat. (n=37) |
|---|---|---|---|---|---|---|---|---|---|---|
| *Percentage of wine tasting occurring:* | At University | 19 | 22 | 8 | 29 | 1 | 22 | 9 | 16 | 27 |
| | At work | 12 | 10 | 23 | 4 | 37 | 12 | 13 | 16 | 6 |
| | At home | 42 | 40 | 51 | 38 | 41 | 42 | 39 | 45 | 36 |
| | At cellar doors or wine festivals | 7 | 10 | 5 | 4 | 3 | 6 | 13 | 4 | 9 |
| | At restaurants, cafés or bars | 15 | 15 | 9 | 20 | 8 | 13 | 21 | 14 | 17 |
| | At retail outlets | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 2 | 4 |
| | At other tastings | 2 | 1 | 2 | 3 | 6 | 2 | 1 | 2 | 1 |
| *Students who usually record notes when tasting/consuming wine* | | (n=37) | (n=20) | (n=9) | (n=5) | (n=3) | (n=29) | (n=8) | (n=22) | (n=15) |
| *Likelihood of recording tasting notes... *#^* | At University | 7.2±0.5a | 7.1±0.6 | 8.3±0.3 | 6.2±1.7 | 5.7±2.4 | 7.3±0.5 | 6.8±1.0 | 8.3±0.4a | 5.5±0.8b |
| | At work | 4.8±0.5b | 4.7±0.7a | 6.3±0.9a | 1.5±0.5b | 6.0±2.5a | 4.4±0.6 | 6.1±1.0 | 5.4±0.7 | 4.1±0.8 |
| | At home | 4.4±0.4bc | 4.8±0.5 | 4.4±0.7 | 3.2±1.2 | 3.7±1.8 | 4.1±0.4 | 5.3±0.8 | 4.4±0.5 | 4.4±0.6 |
| | At cellar doors or wine festivals | 3.7±0.4bcd | 4.1±0.6 | 4.2±0.9 | 3.0±1.0 | 1.0±0.0 | 3.4±0.5 | 4.8±1.1 | 3.6±0.5 | 3.9±0.8 |
| | At restaurants, cafés or bars | 2.0±0.3e | 1.9±0.3 | 2.4±0.7 | 2.0±0.9 | 1.0±0.0 | 1.9±0.3 | 2.1±0.5 | 2.0±0.4 | 1.9±0.4 |
| | At retail outlets | 2.6±0.4de | 2.6±0.6 | 2.9±0.8 | 3.7±1.0 | 1.0±0.0 | 2.8±0.4 | 2.3±0.8 | 2.7±0.5 | 2.6±0.6 |
| | At other tastings | 3.6±0.5cd | 3.0±0.6 | 4.8±1.2 | 1.0±0.0 | 7.0±1.6 | 3.7±0.6 | 3.3±1.4 | 4.7±0.7a | 2.1±0.6b |
| *When tasting wine, how often do you... *#^* | Refer to an aroma wheel or tasting guide? | 4.9±0.4c | 5.6±0.6a | 4.1±0.6ab | 5.2±0.8a | 2.0±0.6b | 4.8±0.4 | 5.3±1.2 | 4.5±0.4 | 5.4±0.7 |
| | Refer to the producer's website? | 3.6±0.4d | 3.1±0.5 | 4.7±0.7a | 4.4±0.7ab | 2.0±0.6b | 3.6±0.4 | 3.4±0.7 | 3.8±0.4 | 3.2±0.6 |
| | Read the back label of the wine bottle? | 7.4±0.4a | 8.0±0.4 | 7.8±0.4 | 5.8±1.0 | 4.3±2.4 | 7.1±0.5 | 8.4±0.3 | 7.4±0.5 | 7.3±0.6 |
| | Take a photo of the wine bottle label? | 6.0±0.4b | 6.5±0.6 | 6.1±0.5 | 3.6±0.5 | 7.0±2.0 | 5.8±0.5 | 6.8±0.9 | 6.0±0.5 | 6.1±0.7 |
| | Record tasting notes on a phone/tablet? | 4.4±0.4cd | 4.3±0.6 | 4.2±0.9 | 3.0±0.7 | 7.3±1.2 | 4.2±0.5 | 4.8±1.0 | 4.6±0.5 | 4.0±0.7 |
| | Refer back to your own tasting notes? | 4.9±0.4c | 5.1±0.6 | 4.4±0.6 | 4.8±1.1 | 5.3±2.2 | 4.9±0.4 | 4.9±1.2 | 5.0±0.4 | 4.7±0.7 |

*Values are means ±SE from 9-point Likert scale responses, where 9 = always, 7 = usually, 5 = sometimes, 3 = occasionally and 1 = never.

^ Means followed by different letters are statistically significant within the column for all students (one-way ANOVA).

# Means followed by different letters are statistically significant within rows for students by institution, level and status) ($p < 0.05$, one-way ANOVA)

**Table 4: Student participation in class discussion and perceptions of wine sensory classes**, as a total and by institution, level and status. Values are means ± SE from 9-point Likert scale responses, where 1 = strongly disagree and 9 = strongly agree. Means followed by different letters are statistically significant (within the column for all students or within rows for students by institution, level and status) ($p < 0.05$, one-way ANOVA).

| | Total (n=109) | UA (n=52) | CSU (n=24) | UM (n=28) | USQ (n=5) | Undergrad. (n=90) | Postgrad. (n=19) | Domestic (n=72) | Internat. (n=37) |
|---|---|---|---|---|---|---|---|---|---|
| I dislike participating in group discussions. | 3.5±0.2b | 3.9±0.3a | 2.8±0.3ab | 3.6±0.4a | 2.0±0.4b | 3.6±0.2 | 2.8±0.3 | 3.4±0.2 | 3.7±0.3 |
| Generally, I am comfortable while participating in class discussions. | 6.4±0.2a | 5.8±0.3b | 7.0±0.4ab | 6.9±0.4ab | 7.8±0.4a | 6.4±0.2 | 6.8±0.4 | 6.7±0.2a | 5.9±0.3b |
| I am tense and nervous while participating in group discussions. | 3.7±0.2b | 4.0±0.3 | 3.5±0.4 | 3.6±0.4 | 2.8±0.7 | 3.8±0.2 | 3.6±0.5 | 3.4±0.2b | 4.3±0.3a |
| I like to get involved in group discussions. | 6.3±0.2a | 5.9±0.3 | 6.8±0.4 | 6.3±0.3 | 7.4±0.5 | 6.1±0.2b | 7.2±0.3a | 6.4±0.2 | 5.9±0.3 |
| Engaging in a group discussion with new people makes me tense and nervous. | 3.9±0.2b | 4.0±0.3 | 3.9±0.4 | 3.8±0.4 | 2.6±0.8 | 4.0±0.2 | 3.5±0.4 | 3.7±0.3 | 4.1±0.3 |
| I am calm and relaxed while participating in group discussions. | 6.0±0.2a | 5.5±0.2b | 6.5±0.3ab | 6.1±0.3ab | 7.0±0.8a | 5.9±0.2 | 6.4±0.4 | 6.2±0.2a | 5.5±0.3b |
| I enjoy wine sensory classes. | 7.8±0.1a | 7.5±0.2b | 8.5±0.2a | 7.5±0.3b | 8.2±0.6a | 7.7±0.2 | 7.9±0.3 | 8.0±0.1a | 7.3±0.3b |
| I find it difficult to evaluate the sensory attributes of wine. | 4.4±0.2f | 4.7±0.3 | 3.9±0.5 | 4.4±0.4 | 3.2±0.9 | 4.2±0.2 | 5.2±0.4 | 4.0±0.2b | 5.1±0.3a |
| I am confident describing wine sensory attributes using technical language. | 6.1±0.2b | 5.7±0.2b | 7.0±0.3a | 5.9±0.3ab | 6.4±0.9ab | 6.1±0.2 | 6.0±0.4 | 6.4±0.2a | 5.5±0.3b |
| I think other students write more detailed tasting notes than me. | 5.4±0.2cde | 5.4±0.3 | 5.3±0.5 | 5.6±0.4 | 4.6±0.7 | 5.3±0.2 | 5.8±0.4 | 5.2±0.3 | 5.8±0.3 |
| I think my wine vocabulary is good. | 5.8±0.2bc | 5.2±0.3c | 6.8±0.2ab | 5.7±0.2bc | 7.2±0.7a | 5.8±0.2 | 5.6±0.4 | 6.4±0.2a | 4.6±0.3b |
| I often use 'fruity' or 'oaky' as descriptors for wine aroma/flavour. | 4.1±0.2f | 3.8±0.3 | 4.1±0.4 | 4.3±0.4 | 5.6±1.0 | 4.0±0.2 | 4.6±0.5 | 4.1±0.3 | 4.2±0.3 |
| I think other students use more descriptive language than me. | 5.2±0.2de | 5.2±0.3 | 5.0±0.4 | 5.4±0.3 | 4.2±1.0 | 5.1±0.2 | 5.6±0.4 | 4.9±0.2b | 5.7±0.3a |
| I often participate in discussions during sensory classes. | 6.1±0.2b | 5.5±0.3b | 7.2±0.4a | 5.9±0.4b | 7.2±0.8a | 6.0±0.2 | 6.3±0.4 | 6.4±0.2a | 5.5±0.3b |
| I am confident about sharing my tasting notes/opinions during sensory classes. | 6.1±0.2b | 5.6±0.3b | 7.2±0.3a | 5.7±0.4b | 7.6±0.7a | 5.9±0.2b | 6.8±0.3a | 6.3±0.3 | 5.8±0.3 |
| I worry that my tasting notes/opinions will be wrong or not good enough. | 5.0±0.2e | 5.1±0.3 | 4.9±0.5 | 5.3±0.5 | 3.0±0.9 | 5.0±0.3 | 5.1±0.6 | 4.9±0.3 | 5.3±0.4 |
| I prefer to let other students share their tasting notes/opinions. | 5.6±0.2bcd | 5.9±0.2 | 5.0±0.4 | 5.8±0.4 | 4.6±0.8 | 5.5±0.2 | 6.0±0.4 | 5.3±0.2b | 6.3±0.3a |
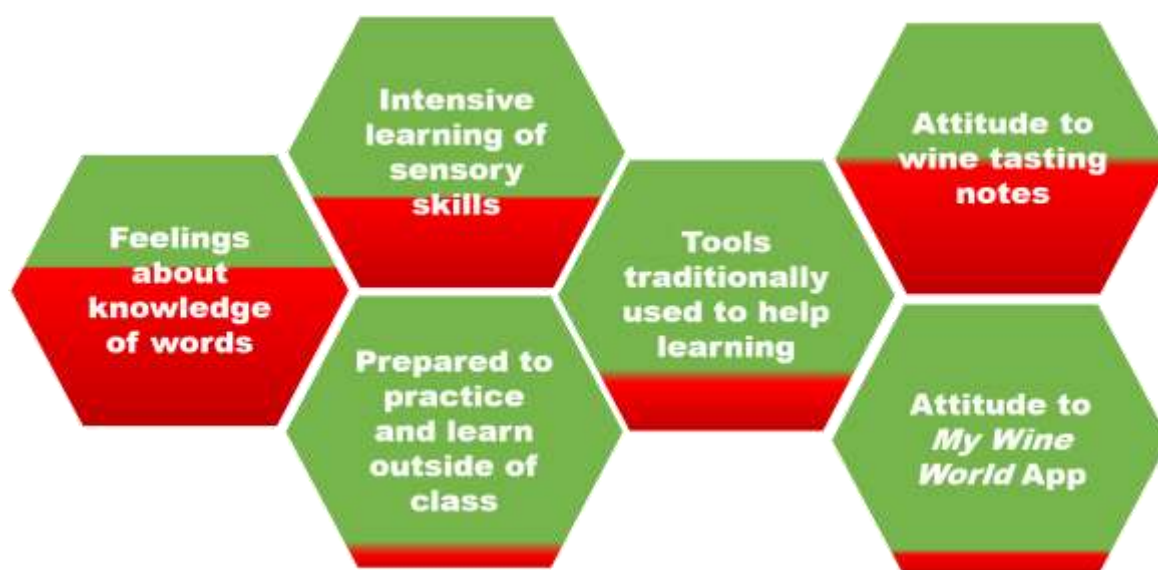
**Figure 3: Common themes that emerged from the focus groups.** The attitude of focus group comments for each theme is indicated as either positive (green) or negative (red).

When considering the student's ***feelings about knowledge of words***, the international students felt more challenged when faced with wine sensory vocabulary. For example, comments included:

> *We are from different countries. We just use food flavour to describe the wine but normally we use different food. So we cannot encounter some foods.'*

> *A special problem for international students. We don't have any experience and the knowledge of the word.*

As a result some felt that they were not comfortable discussing the sensory attributes of a wine in class:

> *Not really (comfortable). With some foods, it is different between China and Australia so the flavour, probably, for example, the musk flavour, I don't really know what it is. I had never smelt that before and it was hard to find the particular thing.*

However, all students (regardless of nationality) indicated that when faced with new words or descriptors, it was sometimes difficult to conceptualise. This mostly seemed to be linked with whether in fact the students had experienced that flavour before tasting wine. Indeed, when asked about certain descriptors, some of the students were not comfortable with some words such as flint, balsamic and umami. For example, comments included:

> *Something like flint is hard too because it is not something you'd eat. Most people don't associate flint with food unless they eat rocks or dirt! It is hard to conceptualise.*

> *If someone gave me a wine that tasted like balsamic and told me that, then I might be able to pick it. But if you haven't had it, it could be hard to pick it.*

These comments by the students support the notion that the ability to name a particular sensation relies on familiarity with that sensation (Majid and Levinson 2011).

Although the majority of comments about the ***intensive sensory learning experience*** in residential schools was positive, many of the students had mixed feelings related to the amount of learning. They enjoyed the setting and felt that they had improved their sensory vocabulary considerably but struggled with the amount of learning required of them in a short period of time. Comments included:

> *I learnt more in one day than what you can in two or three years of enjoying wine, which was hugely beneficial.*

> *With intensive practice, I think my ability to express how it (wine) tastes and how it smells is much improved. I think if I only did it once a week, I think I will forget how we express what we taste in wine.*

> *In only a few days we have to pick up most words. So real hard. So it is a big challenge for us.*

> *I think the second two days were more beneficial for me as I had very little experience in wine tasting before so I was not familiar with the different body styles and the different complexities. So I learnt a lot through doing that first.*

Given that students need a framework and time to reflect upon their learning (Biggs, 1999; Boud, Keogh, & Walker, 1985), these comments are not surprising especially when extensive training is needed to develop linguistic terms associated with wine (Parr et al., 2002).

Students enjoyed the opportunity to learn from other students in this setting as indicated by these comments:

> *Because I gained a lot from people that had tasting experience. I learnt more from them than anyone else. They would smell a certain set of descriptors and then I would give it a second look. I would not have been able to pick them out on my own but hearing other people's perceptions helped a lot.*

> *Especially for international students, you can discuss with Australian students and can learn from them and they can help us to improve.*

Furthermore, most students indicated that the intensive learning experience bolstered their confidence, with comments such as:

> *I'm less shy. I feel more confident to say exactly what I think.*

> *I had a basic understanding but did not feel confident to verbalise the things I really knew but now I do feel more confident to say this or more confident to predict or explain in other company.*

> *When drinking with others, I used to say when it was a good wine and not say what was inside. After residential school, I can say something and say main aromas and flavours and what type of wine.*

These comments support Herdenstam and colleagues' conclusion that the best way to learn sensory skills is the pragmatic constitutive approach where students are able to share their experience with others instantaneously (Herdenstam et al., 2009).

Interestingly, most comments from students about the need to continue practicing the use of their sensory skills and broaden their vocabulary were positive. Students appeared to be ***prepared to learn and practice*** wine vocabulary through a number of means:

> *If we have a list of food flavours we could go to the markets and find them.*

> *If you don't know the words, take six weeks leading up to residential school to start making an effort to taste wines, watch YouTube videos and eat things like fruit.*

> *I bought the peach and the apricot to try to learn to recognise them.*

> *Use the dictionary to translate it but it is tricky.*

However, there was some acknowledgement that this could be difficult with limited knowledge or budget, and probably needed to occur as an extension of any intensive training. Students also indicated that they would like to see the academic's tasting notes for various wines as a guide, especially for more complex wines:

> *…when it is a complex aroma or taste, sometimes you are not sure so like just a few words for the wine – so you can go back and compare your notes with their notes.*

Most were very mature about learning and acknowledged that vocabulary is learnt over time and requires constant usage. Comments included:

> *You need it right in front of you so you can check the flavour or aroma in the wine and go back to it to see what is similar. You need to build up a memory until you don't need to do that anymore eventually.*

> *It is also having the words in your head already, every time you need them*

> *Sometimes you have a taste or sensation of something and you go 'what is it?' and if you have a word in your head already and then you know what word you can use.*

Therefore, the novice acknowledges the basis of expertise is in the precise use of language (Solomon, 1990) but that experience will build their perceptual ability (Parr et al., 2002).

Most of the students indicated that they used some ***'traditional' descriptor tools*** to help them remember vocabulary. These included the aroma wheel ("*an aroma wheel is beneficial*" but "*it can be confounding and pick out things just because they are there*"), professional wine taster's notes and books that contain essences. Given their acknowledgement that "*we need to train our memory*", it was surprising that so many students had a negative ***attitude towards keeping written wine tasting notes***. In many cases, this seemed to be related to time management or when students tended to taste wine, that is, with other people. Some just took photos or used the Vivino App ("*Just to remember what I drink*"). Comments included:

> *We won't take any notes because it is time-consuming.*

> *I've always had an up and down experience with tasting notes. I'll go for a few weeks and really make an effort and then I'll forget about it for a few weeks.*

> *I could make my own but I just read the tasting notes on the bottle.*

When asked what their **attitude to the My Wine World$^{TM}$ App** was, the majority of comments were positive. Even though some students felt that "*some situations are not appropriate and I'd rather not use an iPhone or iPad*". This was particularly the case if tasting wines with friends ("*not really good to take notes or use my phone when tasting wine with friends*"). Other students felt that it was less imposing than writing tasting notes manually because "*it can take photos*" and "*helps me to decide quickly*" what descriptor could be used for a wine.  Students saw it as a useful tool that enabled them to "*develop their memory*". Therefore, this M-learning opportunity is serving to allow students to interact with the App when it suits them (as per Melhuish & Falloon, 2010) through its use in a 'real-world' activity of relevance to the student (Kearney et al., 2012).

There were however mixed responses with regards to its potential use as an assessment tool. While one student indicated that "*I think it could be used like a middle-term assignment*", others indicated "*No!*" in response to that comment. However, all were supportive of its use to help provide formative feedback on their progress during their entire degree and recognised its potential (for example, "*Maybe if the students and teacher can use the app together to discuss and learn something from each other*"; "*maybe it can just help us to do wine tasting in our daily lives and to help practice about note-taking*"). When asked about the use of the descriptors in the App, all students were satisfied with the descriptors used for colour, aroma and flavour ("*There are a lot of different definitions. I am happy with the choices*"). However, they indicated that "*an option where they can describe the wine and use their own words is better*" because they felt the App could "*constrain their mind*" unless they were using it to "*help me to decide*" and when "*new words come to mind*". They also struggled to use the clarity descriptors but acknowledged this was because "*I didn't really get that in residential school*".

**Sensory exam analysis**

The results from sensory exams in undergraduate and postgraduate University of Adelaide courses (*Introductory Grape and Wine Knowledge, Foundations in Wine Science, Vineyard Winery Operations I, Vineyard and Winery Operations II, Sensory Studies*) from 2010 to 2014 (inclusive) were used in an association analysis attempting to identify the impact of various language-related factors on their exam performance. These included whether a student was international or domestic, regarded themselves as non-English-speaking background (NESB) or English speaking background (ESB), the main language spoken at home, and if international, their IELTS upon admission to the University. There were 849 instances of students sitting and completing a sensory exam over the five year period with the mean mark $\pm$ SE awarded to students being $75.5 \pm 0.4\%$ (with a range from 41.5 to 99.2%). The 443 domestic students performed at a consistently higher level (P=<0.001) achieving $78.9 \pm 0.4\%$ when compared with the 406 international students who achieved $71.7 \pm 0.5\%$. If the performance of students was compared on the basis of whether they were undergraduate or postgraduate, there was no significant difference [$75.3 \pm 0.5\%$ (n=538) compared with $75.7 \pm 0.6\%$ (n=311) respectively; P=0.728]. Furthermore, the consistently higher performance by domestic students when compared with international students occurred for both undergraduates [where domestic students averaged $78.4 \pm 0.3\%$ (n=342) compared with $70.1 \pm 0.7\%$ (n=196) for international students; P=<0.001] and postgraduates [domestic students (n=101) averaged $80.7 \pm 0.6\%$ compared with $73.3 \pm 0.5$ (n=210) for international students; P=<0.001].

Although there were differences across the years, the domestic students always outperform the international students (Figure 4) by between 6.5 to 7.7% (P=<0.001). This may not necessarily reflect the language ability of students because there are some NESB students that are domestic and ESB students that are international. The mean sensory exam mark for ESB students (78.8±0.4%, n=493) was significantly higher than that for NESB students (70.9±0.5%, n=356, P<0.001). If English was the main language spoken at home, the mean sensory exam mark was 79.2±0.4% (n=467). For students that spoke another language at home, the mean sensory exam mark was significantly lower (71.0±0.9%, n=382). Interestingly though, when individual language groups are compared, students whose main language spoken at home was English did not have the best sensory exam performance (Figure 5). However, some of the language groups were represented by only one individual making it difficult to draw conclusions. Based on those language groups with 8 or more individuals, the students that spoke English at home had a significantly higher mean mark than those that spoke Mandarin Chinese or Cantonese but were not significantly different from those that spoke Japanese or Spanish (Figure 5, P=<0.001).

For 163 of the NESB students, they had sat an IELTS test prior to admission to UA. Performance in IELTS and performance in the sensory exams appeared correlated (Figure 6). For example, those students with IELTS of less than 6 did not achieve 70% for the sensory exam while those that had an IELTS of 7.5 or above had marks more similar to those seen for ESB/domestic students ($\sim \geq 80\%$). The majority of students had an IELTS of $\leq 6$ suggesting this lower English language ability contributes significantly to their lower sensory exam marks
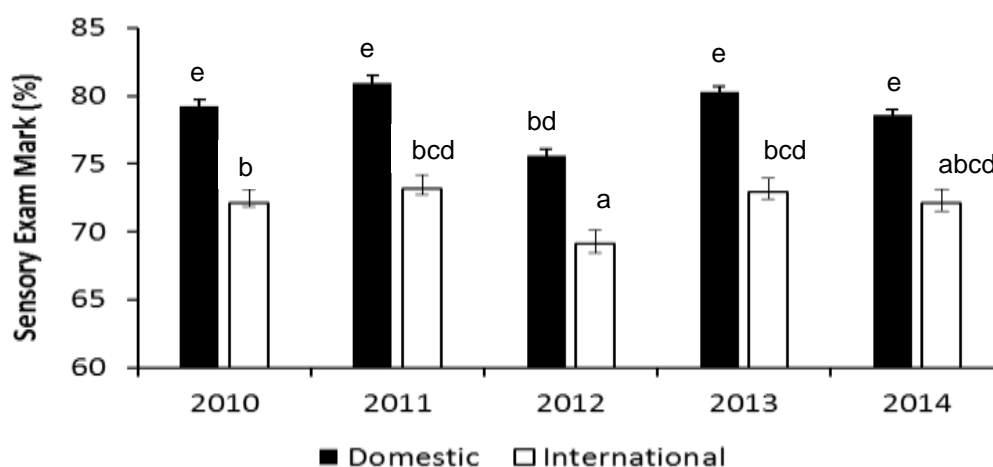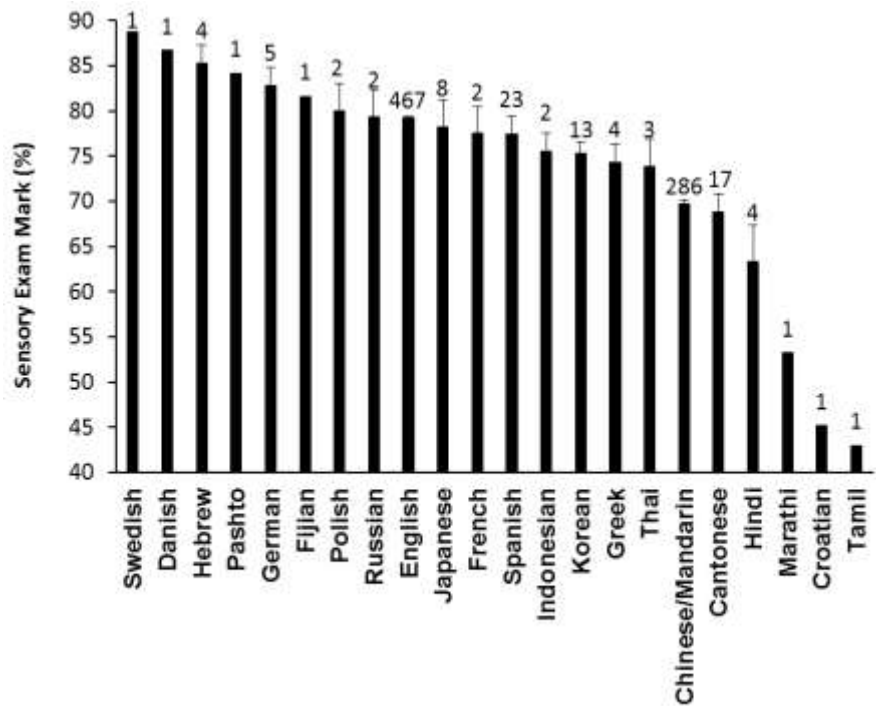


**Figure 4: Mean sensory exam mark of UA students from 2010 to 2014 inclusive.**
The mean mark (±SE) is shown for international (dark bars) and domestic (clear bars) students in each year. For domestic students, n=109, 91, 88, 85, 70 in 2010, 2011, 2012, 2013 and 2014 respectively while n=71, 82, 96, 71, 85 for international students. Different letters denote means that are statistically significant (*P*<0.05) where LSD $_{status.year}$ = 2.6.

Some students (n=54 NESB and 24 ESB) had participated in two sensory exams (first year versus second year). Given the opportunity for another year of English language development for the NESB, the assumption would be that their sensory exam performance might improve. However, the exam mark significantly decreased from 76.5±1.2% to 67.5±1.1%. For NESB students, 26% maintained a similar mark between years (≤5% different), 5% significantly improved (>5%) and 69% significantly declined

in performance (>5% less). However, a similar trend was also observed for ESB students: 56% had a similar mark between years, 3% had better marks in the second year, and 41% significantly declined in performance.



**Figure 5: Mean sensory exam mark of UA students by language from 2010 to 2014 inclusive.** The mean mark (±SE) is shown for each language group with the number of students in each group shown above the bar.
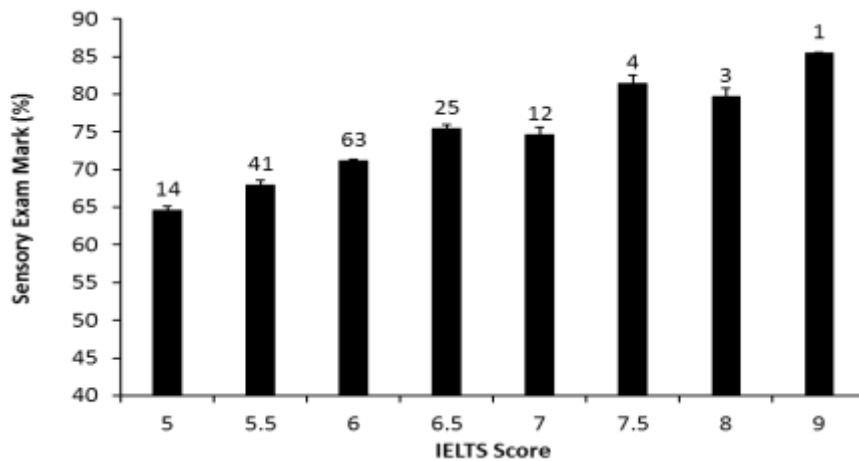


**Figure 6: Mean sensory exam mark of UA students based on their IELTS score at admission (2010 to 2014 inclusive).** The mean mark (±SE) is shown for each IELTS group with the number of students in each group shown above the bar.

**Academic evaluation**

Formal evaluations of the *My Wine World*$^{TM}$ App and online database were obtained from eight academics, all of whom coordinate and/or deliver courses comprising sensory practicals at the participating institutions. At the time of evaluation, sensory practicals predominantly comprised of structured wine tastings that are intended to showcase different wine styles, varietal expression, production methods and/or technical aspects of winemaking. In some cases sensory practicals are led by guest presenters (e.g. winemakers and wine show judges); with emphasis placed on the importance of recording appropriate tasting notes and participating in class discussions, irrespective of institution. Several academics conducted sensory examinations to assess students' sensory skills, with marks awarded based on the recognition of key sensory attributes and quality of tasting notes; while others marked tasting notes recorded during the practical and/or student participation in class discussions. In one instance, sensory skills were not formally assessed at all. Academics unanimously agreed that the App (and online database) captured information that enabled students' wine tasting experience and tasting notes to be evaluated, albeit two academics suggested the App was better suited for evaluating: (i) beginners, i.e. a broader range of options would be required to evaluate more experienced tasters; and (ii) tastings conducted outside the classroom, rather than in sensory practicals. However, all of the academics were able to envisage opportunities for using the App within their teaching, for example: to support the development of students' wine vocabularies, in particular beginners or students from non-English speaking backgrounds: to facilitate assessment through online access to a spreadsheet of students' tasting notes for marking; to support wine sensory evaluation in distance education courses; to monitor student learning during self-guided tastings; and to encourage students to record tasting notes and formally assess wines during tastings outside of the classroom environment. One academic indicated they had already introduced use of the App into wine sensory classes. Further research into how students use it and the effectiveness of the App in enhancing technical wine assessment skills is now required, especially with regards to its impact on the assessment scores obtained by students.

## Conclusions

The analysis of student perception of learning of wine technical assessment has confirmed that experience of 'concrete' terms, the building of memory through discourse and ability to discuss perceptions with peers are all important. The learning of sensory vocabulary is challenging unless students have some '*yard-stick*' to guide them in building a memory of each descriptor. The *My Wine World*$^{TM}$ App is a tool that can contribute to the learning process by acting as a guide for which descriptors to remember. As one student indicated – "*you don't know what you don't know when you start learning about wine*". Furthermore, given the challenges faced by NESB students, the App could also be used in the future to help to build linguistic skills and associations of words with various perceptions during technical wine assessment.

Uptake and use of *My Wine World*$^{TM}$ by students will now depend on the extent to which academics at Universities with wine education programs promote and endorse it. However, the App is already being used in sensory practicals at USQ, while University of Adelaide winemaking and wine business students are being encouraged to use it to record tasting notes outside of University-led sensory practicals. University of Adelaide have also been promoting *My Wine World*$^{TM}$ via their massive open online course

(MOOC) on wine: *Wine101x: the World of Wine: From Grape to Glass* (https://www.edx.org/course/world-wine-grape-glass-adelaidex-wine101x-2), which includes a wine sensory module and has attracted more than 75,000 enrolments to date.

The use of mobile devices in educational settings has previously been demonstrated (Traxler 2005 and citations therein) and *My Wine World*$^{TM}$ certainly offers many of the affordances recommended of educational mobile technologies, i.e. portability, ubiquitous access and situated learning opportunities (Melhuish and Falloon 2010). There is also potential for *My Wine World*$^{TM}$ to be used as an evidence-based approach (Bruniges 2008) to learning and teaching involving technical wine assessment. The App will become an increasingly valuable resource as students compile extensive collections of tasting notes; i.e. as 'e-credentials' documenting students' sensory skills and wine tasting experience.

## Acknowledgements

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