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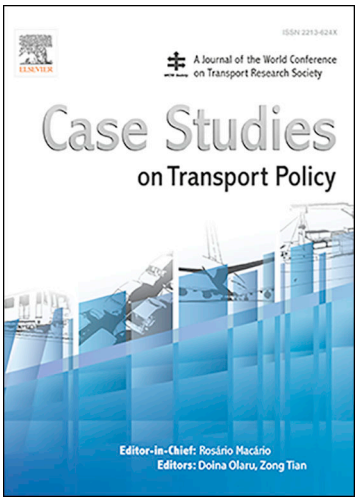

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Enhancing the learning-to-drive process for autistic learners in Qatar

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Enhancing the learning-to-drive process for autistic learners in Qatar

Abstract

Obtaining a driver's license can be a stressful task for autistic drivers because of autism related characteristics. Due to the absence of an autism-tailored driving training program in Qatar, instructors may lack the expertise and skills to apply a personalized approach. The current study investigated improving the learning-to-drive process for autistic learners in Qatar. The study consisted of three progressive phases: (1) Assess driving instructors' prior knowledge and practices regarding autism and driving. (2) Explore driving instructors' knowledge on autism and driving before and after an evidence-based workshop. (3) Compare the learning-to-drive process for autistic learners following 28 days of driving lessons from trained driving instructors to non-trained driving instructors. Eighty-four male driving instructors and six male autistic learners were included in the study. Results from the assessment phase indicated that most instructors lacked theoretical and practical knowledge about autism and driving. During the training phase, the workshop improved the driving instructors' knowledge on autism and driving. After the practice phase, trained driving instructors reported that they could better match their lessons to their autistic learners than non-trained driving instructors. Moreover, autistic learners who received driving training from the trained instructors showed a more positive attitude toward driving, had fewer driving concerns, and experienced less perceived stress compared to those who received training from non-trained instructors. The current results support the idea of a customized driving training program for autistic learners.

Keywords: Autism; driving training; driving instructor; workshop; practice

1. Introduction

Considering the more traditional viewpoint, autism is a neurodevelopmental condition characterized by impaired functions in different aspects of life (e.g., communication, social interaction, and interest) (American Psychiatric Association, 2013). However, recently neurological variations are seen as natural and valuable (e.g., Bervoets & Hens, 2020). In Qatar, attention has been given to improving the quality of life for all people, including autistic individuals, as outlined in the National Vision 2030 (Ministry of Public Health, 2020). In a large-scale study in Qatar by Alshaban et al. (2019), the prevalence rate of autism among children in mainstream schools (6 to 11 years) was estimated at 1.14% or 1 in every 87 children. The prevalence in terms of gender was 1 in 56 boys and 1 in 230 girls (ratio 4:1). Considering that, internationally, autistic girls are often underdiagnosed (Lockwood Estrin et al., 2021), this ratio might not present the actual gender distribution. Although there has been attention to autism in Qatar, not much is known about autism and driving. However, obtaining a driver's license is an essential step toward accessing education, job opportunities, and maintaining social networks, and improving quality of life (Wilson et al., 2018). Learning to drive (Smigiel, 2020), driving a car, and managing mobility independently (Ross et al., 2018c) contribute to improving the quality of life.

Adequate driving skills help autistic individuals to handle their travel independently and function in the community (Cox et al., 2012). However, certain autism-related characteristics can affect driving, such as limitations in planning, attention, and monitoring (Hill, 2004; Luna et al., 2007). For example, autistic learners are more likely to focus on smaller details in the environment instead of

assessing the whole picture of the driving situation (Tyler, 2013). Previous research indicated other issues as well, like problems with operational driving skills (Classen et al., 2013), impaired maneuvering quality (Wilson et al., 2018), lower lane keeping (Chee et al., 2017; Lindsay, 2017), and slow perception (Monahan et al., 2013). A recent study from Sheppard et al. (2023) identified three driving behavior difficulties (i.e., driving executive, understanding and social interaction factors) and relate them to scores on the Autism Quotient (AQ) scale. This study indicated that the group of autistic drivers experienced driving difficulties in more domains compared to a non-autistic group (three vs. one). Furthermore, these domains were related to two main diagnostic criteria related to autism (i.e., attention switching and communication).

Compared to non-autistic individuals, based on the rate and time to obtain a driving license, autistic individuals obtain their license at a significantly lower rate and also significantly later (Curry et al., 2018). Moreover, it has been found that autistic learners may need longer driving training sessions and more road driving tests than non-autistic individuals (Almberg et al., 2017). Therefore, autism characteristics could affect not only driving skills but also the driving training process, which was previously stated by Cox et al. (2017) and Almberg et al. (2017). In this regard, Tyler (2013), mentioned that the communication between an instructor and autistic trainee could be hampered by, for instance, limited ability to understand non-verbal communication (e.g., gestures). Finally, emotion regulation could form a barrier to the learning-to-drive process. Indeed, indications of driving apprehension in autistic learner drivers have been reported (Ross et al., 2018a). A recent study indicated that autistic drivers may experience more issues in managing difficult driving situations due to over-reactivity to negative affect (Fok et al., 2022). Tailored techniques that fit the needs of each autistic learner may help the learning process and could potentially also make this proc ess less stressful. To enhance the driving training for autistic learners, in a study by Tyler (2013), driv ing instructors employed various strategies. Some of these strategies include appropriate communicati on, visual markers, repetitive practice, breaking tasks down and working through smaller tasks in sequence. To apply such strategies, driving instructors must have the knowledge and experience regarding handling autistic learners in the driving context. In this regard, an educational program designed for driving instructors to tailor lessons for autistic learners may play an important role.

In some countries, like the Netherlands and Belgium, educational modules for instructors help them tailor their lessons towards autistic learners. For instance, in Belgium, the UHasselt Transportation Research Institute (IMOB) received partial funding from the information and communications technology (ICT) community for autism spectrum disorder (ASD) fund in 2016 for a project 'Shifting gears to autism.' During this project, a one-day workshop was developed for driving instructors who want to learn more about autism, including information on how to tailor their lessons to autistic trainees. To develop this workshop day, UHasselt teamed up with a driving school (Kara, located in Flanders, the Flemish-speaking part of Belgium) and a Flemish knowledge and expertise centre for transportation education (Edulogia) (Ross et al., 2018a). Moreover, during the former Yes I Drive project,[1] a booklet with information, tips and tricks was developed (Vanvuchelen et al., 2014). This booklet was based on input from experts in both the field of fitness-to-drive (e.g., CARA/VIAS) and autism (e.g., Autisme Centraal). To the best of our knowledge in many other countries, less attention has been given to autism-tailored educational modules for driving instructors to improve the driving lessons for autistic learners (Wilson et al., 2018). Likewise, there is no autism-specific training and support for driving instructors in Qatar. The current study is a part of a project funded by the Qatar National Research Fund to enhance the learning-to-driving process for autistic individuals.

[1] Yes I drive! Autism in traffic is a practical guide to give persons with autism more opportunities in traffic. (Authors: Marleen Vanvuchelen, Mark Tant, Ellen Jongen, Veerle Ross. Contributors: Renate van Leeuwen van Dorst (Spectrum Brabant), Peter Vermeulen (Autisme Centraal), Jeroen Smeesters (Federdrive), and Meike Reyskens).

1.2. Objectives

The aim of the current study was threefold. First, we assessed current knowledge and experience among driving instructors regarding autism and driving. Second, we assessed the usefulness of an evidence-based tailored practical guide combined with a workshop to improve driving instructors' knowledge regarding autism and driving. Third, we tested the potential effectiveness of the practical guide and workshop when applied to actual driving lessons for autistic learners.

2. Tools and materials

2.1. Participants and recuitment

Fig. 1 and Table 1 include the sample distribution and demographic information of participants respectively.

Table 1

Demographic information of driving instructors and autistic learners

Participants	Measures		Mean	SD
Driving instructors	Age		44.96	9.10
	Experience as instructors		7.43	5.64
	Measures		Frequency	Percentage
	Marital status	Married	76	90.5%
		Single	8	9.5%
	Nationality	India	42	50%
		Ghana	8	9.5%
		Philippines	7	8.3%
		Nepal	5	6.0%
		Kenya and Sri Lanka	4 each	4.8% each

		Sudan and Bangladesh	3 each	3.6% each
		Tanzania and Uganda	2 each	2.4% each
		Eritrea, Ethiopia, Indonesia and Mauritania	1 each	1.2% each

	Measures		Mean	SD
Autistic learners	Age		21.50	2.59
	At what age did they get diagnosed with ASD?		5.00	2.83
	Measures		Frequency	Percentage
	Educational level	College student	4	66.7%
		High school completed	2	33.3%
	Nationality	Qatar	2	33.3%
		India	2	33.3%
		Palestine	1	16.7%
		Egypt	1	16.7%

After obtaining ethical approval from Qatar University's Institutional Review Board (QU-IRB), a reference number QU-IRB 1078-FBA/19, participants for assessment, training and practice phases were recruited from the Karwa driving school (KDS).

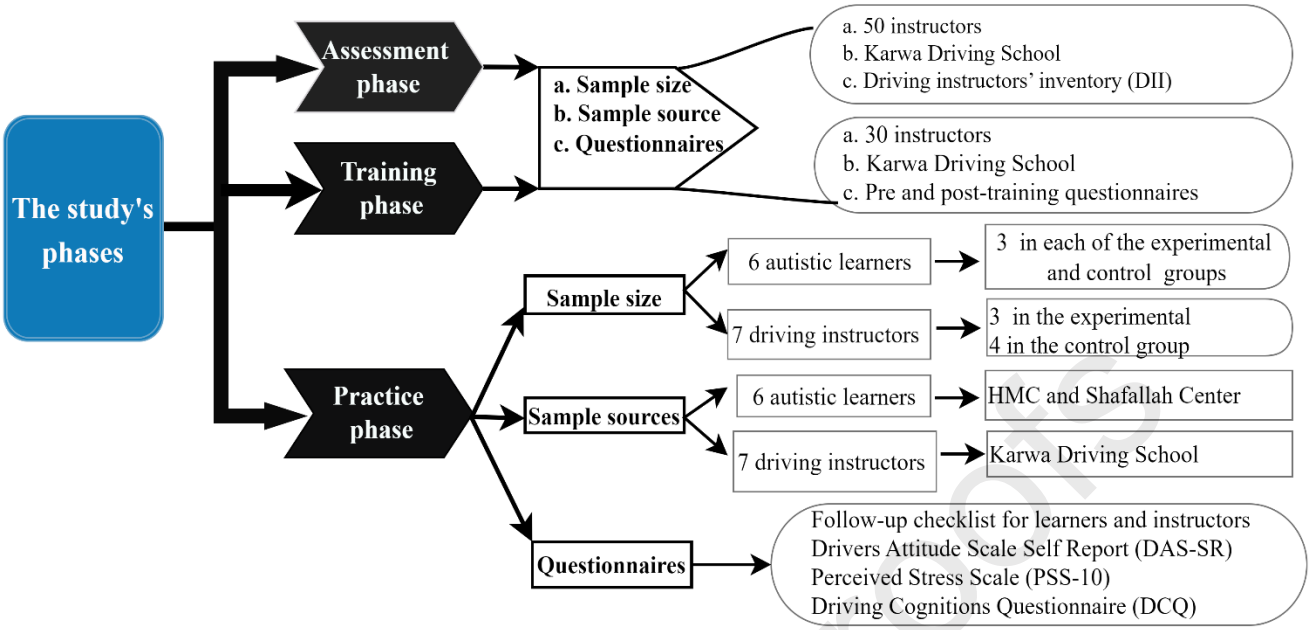

Fig. 1. Summary of the study's phases, sample size, sources of participants and instruments

The school restricted the number of participants in the initial two phases of the study. The school deemed that only a limited number of driving instructors could be absent without significantly disrupting the school's daily operations during their involvement in the study. Accordingly, a total of ninety male (eighty-four driving instructors and six autistic learners) were recruited using a purposive sampling technique. In the assessment phase, fifty male driving instructors were recruited based on their seniority and experience in giving training to many driving learners. We considered instructors with a minimum of four years' experience as senior and experienced, as per the recommendation of school personnel. Experienced driving instructors likely instructed many learners, some of whom might exhibit autism characteristics. We assume that this experience would provide valuable insights into the teaching methods used by instructors when working with learners who might show autism characteristics. In the training phase, thirty senior driving instructors, who were not a part of participants in the assessment phase, participated in a workshop. Finally, seven driving instructors and six autistic learners were recruited for the practice phase and allocated to either the experimental or the control group. The experimental group consisted of three autistic individuals, and three driving instructors who received training by participating in the workshop. The instructors for this group were recruited based on their better performance or score (nine or higher out of ten) on the Post-workshop Questionnaire. The control group consisted of four senior driving instructors, who did not participate in the workshop, and three autistic individuals. Every learner was trained by a single instructor, except for one learner who received training from two instructors since his first instructor was not able to complete the driving lessons. The six autistic learners were recruited from the Shafallah Center and Hamad Medical Corporation (HMC), institutions responsible for diagnosing and providing care to autistic individuals in Qatar.

This study used a paper-pencil format of self-report measures to obtain data from participants in the assessment, training, and practice phases. All tools and materials used per phase will be explained in the following subsections.

2.2. Assessment phase

Driving Instructors' Inventory (DII)

The DII was designed by the authors based on previous literature (Almberg et al., 2017; Chee et al., 2017; Myers et al., 2019; Ross et al., 2018c; Ross et al., 2015) to assess the instructors' knowledge and experience on autism and driving. It contained 31 questions (open-ended, multiple-choice, and 5-point Likert scale items) divided in 3 main sections. First, background information (e.g., what is your age). Second, driving instructors' experience related to learners with autism (e.g., do you have any experience with giving driving lessons to autistic learners?). Third, driving instructors' experience about the impact of autism on autistic learners (e.g., to what extent autistic persons experience difficulty in multi-tasking driving).

2.3. Training phase

Pre-workshop and Post-workshop Questionnaires

The Pre-workshop and Post-workshop Questionnaires were self-report measurements consisting of 10 items that assessed participants' knowledge of autism and driving (e.g., an autistic person may have difficulties using the context to give meaning to something). The authors designed these questionnaires based on information in the practical guide material (see part 2.5.2). Each item was designed to be answered on three choices: correct (3), incorrect (2), or, I do not know (1). Each participant completed the same questionnaire before and after the workshop. Afterward, the total sum of correct answers was calculated. If a participant selected 'I do not know', it was considered an incorrect response in the computing process.

2.4. Practice phase

2.4.1. Follow-up Checklist for Instructors and Autistic Learners

The Follow-up Checklist for Instructors and Autistic Learners were designed to gather data regarding instructional practices employed by driving instructors, and the autistic learners' assessments of the driving lessons. The checklist consisted of 28 yes – no items. The authors developed this checklist based on the practical guide. The checklist addressed aspects of communication, step-by-step teaching process, repeated practice, breakdown of skills into small partial skills, and give enough time to process information. Instructors completed the checklist based on their experience of teaching autistic learners in the experimental and control groups. Autistic learners in the experimental and control groups completed the checklist based on their experience with their instructors.

2.4.2. Drivers Attitude Scale Self-report (DAS-SR)

Cox and his colleagues designed the Drivers Attitude Scale Self Report (DAS-SR) to measure autistic learners' attitudes toward three driving components: when they are talking about driving, getting ready to drive, and while driving (Cox et al., 2020; Ross et al., 2018b). The scale consists of nine positive items (e.g., when driving, do you become relaxed, calm, and enjoy the experience of driving?) and nine negative items (e.g., when talking about driving, do you avoid talking about driving?). Each item is rated on a four-point Likert scale ranging from zero (Not at all) to three (A lot). For computing purposes, all nine negative items were reversely coded to create positive items.

2.4.3. Perceived Stress Scale (PSS-10)

The PSS-10 assessed the degree to which autistic learners perceived their learning-to-drive process as unpredictable, uncontrolled, and overloading. In this study, original items were adapted to

the context of the learning-to-drive process (e.g., 'In the last month, how often have you felt nervous and stressed?' was adapted to 'During your driving training, how often have you felt nervous and stressed?'). The scale was initially developed by Cohen et al. (1983) with 14 items, and was later updated to10 items and used by other authors (e.g., Andreou et al., 2011; Kechter et al., 2019; Örücü & Demir, 2009; Reis et al., 2010).

The 10 items were rated on a 5-point Likert scale, ranging from zero (never) to four (very often). The PSS-10 consists of two subscales: perceived helplessness (i.e., participants' feeling of being unable to manage their situation) and lack of self-efficacy (i.e., participants' perceived lack of ability to handle problems related to their driving training). Perceived helplessness was measured using six items (e.g., During your driving training, how often have you felt nervous and stressed?), and the remaining four items measured lack of self-efficacy (e.g., During your driving training, how often have you felt that the training was going as you expected?) (Taylor, 2015). Four positively stated items were reversely coded in the computing process to match them with the remaining negatively framed items (Cohen et al., 1994).

2.4.4. Driving Cognitions Questionnaire (DCQ)

The DCQ measured three areas of driving-related concerns: panic-related (e.g., I will not be able to think clearly), accident-related (e.g., I will injure someone), and social concerns (e.g., People will think I am a bad driver) (Ehlers et al., 2007). The DCQ was rated on a five-point Likert scale ranging from zero (never) to four (always) (Ehlers et al., 2007; Taylor et al., 2021). Autistic learners were asked to indicate how often each thought or idea passed through their minds while they attended driving training.

2.5. Procedures

2.5.1. Assessment phase

In collaboration with the KDS, a suitable time schedule was identified to approach driving instructors. Before the instructors completed the questionnaire, the data collectors informed participants regarding the study. Each participant was asked about his willingness to participate in the study by signing a consent form. After securing each participant's consent, they were invited to fill out the DII. The data for the assessment phase was gathered in October of 2021.

2.5.2. Driver instructors training phase

In the current study, a practical guide was prepared based on empirical evidence derived from several studies about autism and driving. Moreover, the information found in the practical guide was partly based on the booklet "Yes, I drive!" Autism in traffic (Vanvuchelen et al., 2014).

After completing the preparation of the practical guide, thirty experienced driving instructors in KDS received training on how to customize their driving lessons to autistic learners better. The training workshop addressed several issues concerning autism, such as, theoretical perspectives on autism, autism in Qatar, autism and driving, and practical recommendations about how to deal with autistic learners. The training started with exercises containing individual activities, group work, and discussions. The remainder of the training was delivered to participants using PowerPoint presentations, brainstorming, videos, quizzes, and questions. The training workshop was conducted in May of 2022, during which the data for both pre-training and post-training phases was gathered. The instructors in the control group did not receive any training and nor a practical guide.

2.5.3. Practice phase

Driving instructors assigned to the experimental group received the practical guide to help their preparation prior to delivering driving lessons to autistic learners. It was confirmed by instructors that they carefully read this guide prior to commencing their driving lessons to autistic learners. Each autistic learner received driving lessons for 28 consecutive days (one-hour session per day except weekend days). Once they finished the training sessions, the driving instructors were asked to fill out the Follow-up Checklist Instructors'. Similarly, autistic learners in both the control and experimental groups completed the Follow-up Checklist for Autistic Learners, DAS-SR, PSS-10, and DCQ). The data for the practice phase was collected in August of 2022.

2.6. Data analyses

In the assessment phase, as most driving instructors were unable to respond to the prerequisite questions, the subsequent questions in the DII could not be answered. As a result, the analyses in this phase only relate to the responses given to the prerequisite questions.

During the driver instructors training phase, a paired-sample t-test was employed to check a statistically significant difference between the sum score of instructors' knowledge of autism and driving before and after the training workshop.

In the practice phase, an independent sample t-test was employed for the driving instructors to determine the difference in instructional practices between trained and non-trained instructors. In this regard, the sum of 'correct' responses to the 28 checklist items was calculated. For the autistic learners in the experimental and control group, independent sample t-tests were computed to determine the difference on the mean scores of the DAS-SR, PSS-10, DCQ, and sum score of the checklist questions.

3. Results

In the assessment phase, the descriptive data showed that driving instructors' average age and driving experience in the assessment phase was M = 44.3 with SD = 9 and M = 6.90 with SD = 5.79 respectively. Based on driving instructors' responses to the question, "as a driving instructor, do you have any experience giving driving instructions to autistic learners?" only 3 out of 50 driving instructors responded that they had experience of instructing autistic learners. Thus, most driving instructors who participated in the survey lacked knowledge regarding autism, possessed no prior experience teaching autistic learners, and were unaware of how autism characteristics can impact driving.

With regards to the training phase for driver instructors, Table 2 and 3 include the descriptive and paired-sample t-test statistics. The paired-sample t-test indicated a statistically significant increase in the driving instructors' knowledge regarding autism and driving after the workshop, compared to before.

Table 2

Descriptive statistics of measures in the assessment, training and practice phases

Phases	Measures	Pre-training workshop	Post-training workshop

Training phase	Instructors' knowledge about autism and driving before and after training (10 items, 3-point Likert scale)		Mean	SD	Mean	SD
			4.67	1.47	6.87	1.68
	Measures		Experimental group		Control group	
			Mean	SD	Mean	SD
Practice phase	Follow-up Checklist (Yes/No)	Instructors' responses (28 items)	28.33	1.53	18.50	1.29
		Learners' responses (28 items)	24.33	1.53	15.67	1.15
	DAS-SR (4-point Likert scale)	Positive attitude toward talking about driving (6 items, α = .75)	2.39	0.35	1.33	0.50
		Positive attitude toward getting ready to drive (6 items, α = .78)	2.72	0.25	1.72	0.10
		Positive attitude toward when driving (6 items, α = .78)	2.44	0.10	1.67	0.17
	PSS-10 (5-point Likert scale)	Perceived helplessness (6 items, α = .72)	1.22	0.25	1.78	1.02
		Lack of self-efficacy (4 items, α = .75)	0.58	0.29	1.75	0.43
	DCQ (5-point Likert scale)	Panic concerns (7 items α = .77)	0.14	0.14	1.19	0.33
		Accident concerns (7 items, α = .90)	0.90	0.64	1.24	1.16
		Social concerns (6 items, α = .83)	0.39	0.53	1.61	0.25

In practice phase, Table 2 and 3 include the descriptive and independent t-test statistics. Independent sample t-test analysis showed that trained instructors scored significantly higher on the 28-item checklist than non-trained instructors. As for autistic learners group, the sum score on the 28-item checklist was significantly higher in the experimental group than in the control group. In the case of the DAS-SR, the scores of the experimental group were significantly higher than those of the control group in all three components. Compared to the control group, based on the mean scores in PSS-10 sub-scales, autistic learners in the experimental group reported less lack of self-efficacy and less perceived helplessness. However, the latter was insignificant. With regard to the DCQ, the control group reported more panic-concerns, social-concerns, and accident-concerns, although the last one was insignificant.

The reliability coefficients for the different sub-scales in DAS-SR, PSS-10, and DCQ ranged from $\alpha = 0.72$ to $\alpha = 0.90$ (see Table 2).

Table 3

Independent samples t-tests and paired sample t-test analyses of group differences

Phases	Measures	Within group (Paired-sample t-test analysis)		
		Dfs	t	P (2-tailed)
Training Phase	Instructors' knowledge about autism and driving before and after training workshop	29	-5.67	**
	Measures	Between autistic and non-autistics (Independent sample t-test)		
		Dfs	t	P (2-tailed)
	Follow-up checklist	Instructors' responses	5	9.26	**
		Learner s' responses	4	7.84	**

Practice phase	DAS-SR	Positive attitude toward talking abou driving	4	3.00	*
		Positive attitude toward getting ready to drive	4	6.36	**
		Positive attitude toward when driving	4	7.00	**
	PSS	Perceived helplessness	4	0.92	.41
		Lack of self-efficacy	4	3.88	*
	DCQ	Panic-related	4	5.05	**
		Accident-related	4	0.43	.69
		Social concerns	4	3.57	*

Note: ** and * the difference is significant at the alpha level of 0.01 and0 .05 respectively.

5. Discussion

Several researchers highlighted the need for specialized training programs for autistic learners, provided by trained driver instructors (Ross et al., 2018c; Vindin et al., 2021; Wilson et al., 2018).This study aimed to investigate enhancing the learning-to-drive process for autistic learners, utilizing a three-phase approach encompassing assessment, training, and practice phases.

The results showed that in the *assessment phase,* except for three instructors, none of the surveyed participants reported having prior knowledge and experience about autism and driving. These results again highlight the relevance of the current project. The *driver instructors training phase* showed that instructors enhanced their knowledge of autism and driving after they completed the training workshop. These results provide a first indication of the program's success. However, it is important to learn if the increased knowledge of driver instructors concerning autism and driving also translates to better-adapted driving lessons. Therefore, in the *practice phase,* we looked at the teaching-to-drive process of trained and non-trained instructors. Compared to non-trained instructors, trained instructors showed better practices for autistic learners (e.g., providing the driving lesson sequentially, focusing on one specific aspect at a time) compared to non-trained instructors. This finding is in line with Myers et al., (2019), who indicated that trained driving instructors are important for tailoring driving lessons to autistic learner drivers. An additional important factor is how autistic learners experience the driving lessons. Autistic learners in the experimental group reported a better attitude toward driving (e.g., demonstrating enthusiasm towards driving and/or learning how to drive), experienced less perceived stress (e.g., able to control frustration induced by

the driving training) and reported fewer driving panic concerns and social concerns (e.g., experience a reduced tremble during driving training) than autistic learners in the control group. In sum, these preliminary results indicate that individualized driving training instructions can contribute to a more positive training experience for autistic learners, which aligns with previous research (e.g., Almberg et al., 2017).

The current results have some implications as well. Access to tailored and alternative driving training programs could encourage otherwise hard to reach individuals to join driving classes (Almberg et al., 2017). In this regard, the study's results can be evidence to driving schools (e.g., KDS) in Qatar and outside Qatar to establish tailored training programs that may attract more autistic students to a driving school. Having well-trained instructors in a specific driving school may also make parents more eager to send their children to this driving school. However, before implementing the current program in driving schools, it is advised conducting more extensive field trials. Furthermore, it is possible that for some autistic learner drivers, additional assessment is necessary before they obtain their driving license, for instance, assessment of cognitive skills (Myers et al., 2021). This assessment would require a broader approach, including, for instance, testing in a specialized centre (such as the CARA centre in Flander, Belgium) or by other parties such as occupational therapists.

6. Limitations

The following shortcomings should be considered when interpreting the results. First, the sample size, especially the autistic learners and instructors in the practice phase, was very small. The cost associated with the driving training was the main reason for not including more participants. For this study, autistic learners were registered in the KDS as learner drivers, and the KDS covered the cost (3350 QR/ 920 USD each or 21,100 QR/5522 USD total) of their training as a collaboration to facilitate their learning-to-drive process. Therefore, the results of this study may not be generalized to other autistic individuals and follow-up studies using larger and more varied samples are necessary. Related to this, follow-up studies should also include females.

Second, the appropriateness of the questionnaires can be a limitation. Except for the DAS-SR and DCQ, the authors adapted (i.e., PSS-10) and developed all the remaining instruments in a checklist format.

Third, the current study only focused on the learning-to-drive process, but it did not address the driving test passing rate. In Qatar, the driving test is handled by the traffic police department, which is different from the driving training department with which we collaborated to conduct this study. Thus, the data for the driving test passing rate was not available. Future studies could link the process of learning how to drive with the passing rates as this would provide more information.

8. Conclusion

Due to a lack of autism awareness among driving instructors, autism-tailored driving lessons are often not available. This study consists of three aims. First, assess instructors' awareness and experience about autism and driving. Second, evaluate autism-related knowledge of driving instructors before and after a workshop aimed at providing theoretical and practical information on autism and driving during which they also received a practical guide. Third, compare the learning-to-drive process of autistic learners who received driving training from trained instructors with those who received training from non-trained instructors. It was found that most driving instructors lacked knowledge and experience of autism and driving. After following the workshop, the driver instructors' knowledge of autism and driving improved. In the practice phase, instructors who

followed the workshop and received the practical guide reported to better tailor their lesson to the autistic learners' needs than instructors who did not follow the workshop and receive the practical guide. Moreover, autistic learners taught by the trained instructors reported more positive driving-related attitudes, less lack of self-efficacy, and fewer panic and social concerns associated with driving than autistic learners in the control group. Although a firm conclusion cannot be made due to the low sample of learner drivers, these first results are very promising. Therefore, introducing a training package for driver instructors could be useful to help instructors tailor their lessons to the needs of autistic learners. Nevertheless, follow-up research with larger sample sizes is required to determine the efficacy of the current training.

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Highlights

- Three progressive phases were used to study the improvement of the learning-to-drive process for autistic learners.
- In the assessment phase, most instructors lacked theoretical and practical knowledge about autism and driving.
- During the training phase, the workshop improved the driving instructors' knowledge on autism and driving.
- After the practice phase, trained driving instructors were better able to match their lesson to their autistic learners than non-trained driving instructors.
- After practice phase, autistic learners who received driving training from the trained instructors showed better experience than those who received training from non-trained instructors.

CRediT authorship contribution statement

Wondwesen Girma Mamo: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing - original draft, Writing - review & editing. Wael K. M. Alhajyaseen: Conceptualization, Methodology, Validation, Formal analysis, Writing - review & editing, Project administration, Funding acquisition. Hélène Dirix: Methodology, Validation, Writing - review & editing. Kris Brijs: Conceptualization, Writing - review & editing. Tom Brijs: Conceptualization, Writing - review & editing. Abdrabo Soliman**:** Methodology, Validation, Investigation. Robert Makondo: Validation, Investigation. Hany Sayed: Investigation. Mohamed Tahir: Investigation, Writing - review & editing. Majid Alabdulla: Investigation. Cox Daniel: Conceptualization,

Methodology. Veerle Ross: Conceptualization, Methodology, Formal analysis, Writing - review & editing.