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Finding a mathematical disposition instrument of junior high school students in Indonesia

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Abstract: The study aimed to find an instrument for measuring the mathematical disposition of junior high school students in Indonesia. The research type was research and development, which used to develop instruments of students' mathematical disposition. Data were collected from 384 respondents, who filled out a questionnaire with a total of 7 indicators and 25 statement items. 384 responses were divided into two criteria, stage 1 and stage 2 with each test having 197 respondents. Stage 1 analysis used the Exploratory Factor Analysis (EFA) approach, while stage 2 used the Confirmatory Factor Analysis (CFA) approach. Stage 1 obtained validation of 23 items with a loading factor of more than 0.4, consisting of 1 invalid item and 1 item was not meet expectations. The results of the CFA analysis have proven that 23 items were valid with a loading factor of more than 0.4. The reliability coefficient was 0.59 with an SEM value of 3.98. In sum, this instrument has 23 statements that have fulfilled the validity and reliability of the instrument and were feasible to use.

Keywords: Mathematical Disposition; Exploratory Factor Analysis, Confirmatory Factor Analysis; Instrument.

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INTRODUCTION

Learning achievement in mathematics is still a problem in the world of education in Indonesia, starting at the elementary, middle, and even tertiary or higher education levels (Nurkamilah et al., 2018). Purnomo (2017) states the reason behind this is the attitude of students who are not enthusiastic or positive about mathematics lessons. In fact, an attitude is one of the dominant factors that influence the activities of teaching and learning mathematics. The positive attitude shown by students toward mathematics will lead to a good results and vice versa. The National Council of Teachers of Mathematics also states that students' attitudes toward mathematics can affect their achievement in Mathematics (National Council of Teachers of Mathematics, 2000).

In line with Purnomo and NCTM, one of the needed competencies in learning mathematics is showing a positive attitude towards mathematics, curiosity, not giving up easily and self-confidence (Mendikbud, 2016). This definition shows that mathematics does not only touch the cognitive domain but also the affective domain. In short, attitudes toward learning mathematics are truly important to have special attention and concern (Hairunisa et al., 2017). The terminology of a positive attitude in learning mathematics is called a mathematical disposition. In other words, one of the abilities to capture various attitudes in mathematics is called a mathematical disposition (Hakim, 2019).

Two decades ago, Hirsch (1992) defined mathematical disposition as an interest in and appreciation of mathematics, namely a tendency to think and act in positive ways. The term disposition is characterized as the character of the student's point of view and belief in mathematics which will affect himself and his surroundings (Dina & Ikhsan, 2019; Young et al., 2021). This influence can be positive or negative, like or dislike mathematics (Hwang & Choi, 2020).

Supriadi (2020) defines a mathematical disposition as a mathematical ability that tends to self-think. Students are encouraged to be independent and confident in exploring their ideas to solve problems, think and be critical, and appreciative of learning mathematics. Mathematical disposition is an affective domain that emphasizes the belief that a student must have the ability to motivate themselves, work hard, and always try their best, as well as a strong determination that they can excel and have new mathematical skills (Awofala et al., 2020).

Balala et al (2021) defines disposition as an attitude or affective element involved in learning mathematics. This involvement will affect the student's learning climate, such as the level of students' preference for mathematics, active participation in mathematics lessons, and a strong determination to always try to understand mathematics.

According to NCTM (Bagley & Gallenberger, 2020) states that mathematical disposition includes the indicators of (1) Confidence in solving mathematical problems, communicating ideas, and giving reasons; (2) Flexibility in exploring mathematical ideas and trying various alternative methods to solve problems; (3) Strong determination to complete mathematical tasks; (4) Interest, curiosity, and ability to discover in a problem of mathematics; (5) The tendency to monitor and reflect on self-thinking and self-performance processes; (6) Assessing the application of mathematics in other fields and everyday life, and (7) Appreciation of the role of mathematics in culture and its values, both mathematics as a tool and mathematics as a language.

Young (2020) explains that mathematical disposition is characterized by four psychological categories. First, Identity is a personal view of a tendency toward mathematical ability. Second, Self Efficacy is a student's view of the ability to do mathematical tasks. Third, Interest is a tendency to self-motivate to always be involved in learning mathematics. And, utility is the subjective feeling of the usefulness of mathematics. Meanwhile, Supardi (2020) shows a mathematical disposition with six criteria, including confidence in mathematical abilities, finding alternatives in completing mathematical models, diligently completing mathematical tasks, interest in playing a role in carrying out tasks, applying mathematics in everyday life, and appreciating the role of mathematics.

Feldhaus (2014) and Awofala (2020) have another view of disposition. Their view emphasizes more productive dispositions, where the function of mathematics is a function of a live interaction which has four elements of personal experience, views people towards mathematics, Infrastructure view, and Cultural interpretation.

These statements have their respective views on mathematical dispositions, so each similarity may be written in the form of a conclusion that mathematical dispositions have seven attitudes or tendencies toward behavior, including, first, confidence in solving mathematical problems, communicating mathematical ideas, and giving logical reasons. Second, flexible in exploring mathematical ideas and trying various methods to solve problems. Third, have a strong determination to complete mathematical tasks which is shown in an attitude of persistence, perseverance, and high enthusiasm. Fourth, curiosity to find something new in mathematics. Then, the ability to reflect to monitor thinking processes and performance. After that, applying mathematics in other fields and everyday life. And, appreciation of the role of mathematics in culture and values, both mathematics as a tool and mathematics as a language.

Along with the formation of indicators of mathematical disposition and the absence of clear instruments to measure students' attitudes, it needs to create instruments to measure students' mathematical attitudes, in particular mathematical dispositions. For this reason, this study aims to obtain an instrument for measuring students' mathematical disposition in terms of the 7 indicators.

METHODS

The type of research was Research and Development, namely developing instruments to measure students' mathematical dispositions. The procedure for developing the instrument follows the steps written by Istiyono (2018). First, it determined the measurement objectives, namely testing the instrument to make good items as standard instrument products. Second, choosing the format of the instrument, namely the preparation of the instrument construct from conceptual and operational definitions. Third, it compiles an instrument guideline, namely a description of indicators from operational definitions. And, it determines the length of the instrument, which is determined by the time and the fatigue level of the participants filling it out. In this study, the instrument consisted of 25 statement items from 7 indicators. To complete, Focus Group Discussion (FGD) conducted when developing this instrument, to view and improve the items of the instrument, such as in terms of content, typos, and language.

Data collection was obtained from the responses of 197 students from the distribution of questionnaires using Google Forms and also paper-based. The responses were analyzed through exploratory factor analysis (EFA), assisted by SPSS 26 software. Valid items were followed up by analysis using Confirmatory Factor Analysis (CFA) with the same number of respondents of 197 and assisted by JASP 0.14.1.0 software. The results of the test showed valid items and were feasible to use to measure mathematical disposition.

RESULTS AND DISCUSSION

Results

The first step was to test the adequacy of the sample using SPSS 26. The sampling adequacy test is presented in Table 1, concerning the Bartlett test values and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO-MSA) values.

Table 1. Test Results of KMO and Bartlett

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.804
Bartlett's Test of Sphericity	Approx. Chi-Square	1537.221
	df	300
	Sig.	.000

Table 1 showed the Bartlett test value of 1537,221 with degrees of freedom of 300 and a p-value of less than 0.01. These results indicate that the sample size of 197 used in this study was adequate. This decision was also corroborated by the KMO-MSA result of 0.804, which is higher than 0.5. The second step was to assess the items' feasibility. The item feasible test was analyzed using factor analysis and occurred when the correlation coefficient value was higher than 0.5. These results was presented in Table 2.

Table 2. Anti-Image Matrices

Anti-image Matrices																										
		V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22	V23	V24	V25
Anti-image Covariance	V1	0,557	-0,095	0,162	-0,154	-0,050	0,016	0,014	-0,183	0,055	0,018	-0,045	-0,174	0,018	-0,036	-0,058	0,102	0,024	-0,004	-0,007	-0,062	-0,029	0,003	0,051	-0,038	0,039
	V2	-0,095	0,503	-0,148	-0,059	-0,021	-0,164	-0,110	0,089	-0,034	-0,059	0,044	0,027	0,017	-0,032	-0,013	-0,050	-0,010	-0,079	0,049	-0,029	0,049	0,123	-0,018	0,038	-0,007
	V3	0,162	-0,148	0,578	0,070	-0,137	0,027	-0,041	-0,117	0,106	-0,016	-0,013	-0,069	-0,021	-0,014	-0,031	0,112	0,000	0,022	-0,110	-0,035	-0,003	-0,039	-0,033	-0,094	-0,007
	V4	-0,154	-0,059	0,070	0,565	-0,013	-0,016	0,015	0,054	0,046	-0,126	-0,103	0,062	-0,018	-0,060	0,033	0,046	0,089	0,060	0,071	-0,069	-0,020	-0,043	-0,086	-0,081	-0,033
	V5	-0,050	-0,021	-0,137	-0,013	0,519	0,085	0,108	0,029	-0,050	0,068	-0,051	0,012	-0,120	-0,041	0,015	-0,024	-0,069	0,018	-0,082	-0,069	0,004	-0,010	0,049	-0,020	0,017
	V6	0,016	-0,164	0,027	-0,016	0,085	0,533	-0,020	-0,079	-0,058	0,016	-0,101	-0,002	-0,001	0,064	-0,099	-0,020	0,000	0,034	-0,034	0,000	-0,003	0,014	-0,009	-0,023	-0,044
	V7	0,014	-0,110	-0,041	0,015	0,108	-0,020	0,479	-0,075	-0,042	-0,027	-0,025	-0,077	0,015	-0,084	0,043	-0,062	0,032	-0,055	-0,074	-0,014	-0,152	0,038	0,023	-0,027	0,052
	V8	-0,183	0,089	-0,117	0,054	0,029	-0,079	-0,075	0,657	0,105	-0,051	-0,031	0,094	0,013	0,010	-0,031	-0,038	-0,077	-0,004	-0,026	0,001	0,032	-0,080	-0,134	0,008	-0,112
	V9	0,055	-0,034	0,106	0,046	-0,050	-0,058	-0,042	0,105	0,748	-0,028	-0,101	-0,016	-0,066	-0,003	-0,105	0,046	0,071	-0,014	0,040	-0,156	-0,052	-0,087	0,023	-0,093	0,057
	V10	0,018	-0,059	-0,016	-0,126	0,068	0,016	-0,027	-0,051	-0,028	0,635	-0,057	-0,183	-0,091	0,003	-0,028	-0,032	-0,002	0,046	0,018	0,040	0,051	0,036	0,011	0,055	-0,008
	V11	-0,045	0,044	-0,013	-0,103	-0,051	-0,101	-0,025	-0,031	-0,101	-0,057	0,407	0,024	0,071	-0,091	-0,015	-0,047	-0,105	-0,051	0,044	0,082	-0,030	0,118	-0,075	0,069	-0,032
	V12	-0,174	0,027	-0,069	0,062	0,012	-0,002	-0,077	0,094	-0,016	-0,183	0,024	0,625	0,052	0,070	-0,009	-0,077	0,006	-0,004	-0,005	-0,024	0,048	-0,016	-0,163	-0,025	-0,160
	V13	0,018	0,017	-0,021	-0,018	-0,120	-0,001	0,015	0,013	-0,066	-0,091	0,071	0,052	0,536	0,002	0,019	0,051	-0,066	0,022	-0,051	-0,120	0,014	-0,010	-0,063	-0,076	-0,076
	V14	-0,036	-0,032	-0,014	-0,060	-0,041	0,064	-0,084	0,010	-0,003	0,003	-0,091	0,070	0,002	0,583	-0,114	-0,104	0,019	0,020	0,016	0,048	0,003	-0,088	-0,008	0,061	-0,149
	V15	-0,058	-0,013	-0,031	0,033	0,015	-0,099	0,043	-0,031	-0,105	-0,028	-0,015	-0,009	0,019	-0,114	0,596	-0,096	0,010	-0,053	-0,022	0,082	-0,062	0,032	-0,002	-0,032	0,042
	V16	0,102	-0,050	0,112	0,046	-0,024	-0,020	-0,062	-0,038	0,046	-0,032	-0,047	-0,077	0,051	-0,104	-0,096	0,553	0,072	-0,011	-0,098	-0,090	-0,115	-0,015	-0,020	-0,156	0,069
	V17	0,024	-0,010	0,000	0,089	-0,069	0,000	0,032	-0,077	0,071	-0,002	-0,105	0,006	-0,066	0,019	0,010	0,072	0,618	0,117	0,011	-0,151	-0,073	-0,090	-0,031	-0,002	0,042
	V18	-0,004	-0,079	0,022	0,060	0,018	0,034	-0,055	-0,004	-0,014	0,046	-0,051	-0,004	0,022	0,020	-0,053	-0,011	0,117	0,769	0,007	0,038	-0,017	-0,077	-0,001	-0,089	-0,076
	V19	-0,007	0,049	-0,110	0,071	-0,082	-0,034	-0,074	-0,026	0,040	0,018	0,044	-0,005	-0,051	0,016	-0,022	-0,098	0,011	0,007	0,578	-0,048	0,015	-0,137	-0,012	-0,003	0,012
	V20	-0,062	-0,029	-0,035	-0,069	-0,069	0,000	-0,014	0,001	-0,156	0,040	0,082	-0,024	-0,120	0,048	0,082	-0,090	-0,151	0,038	-0,048	0,501	0,039	0,002	-0,055	0,022	-0,001
	V21	-0,029	0,049	-0,003	-0,020	0,004	-0,003	-0,152	0,032	-0,052	0,051	-0,030	0,048	0,014	0,003	-0,062	-0,115	-0,073	-0,017	0,015	0,039	0,603	0,013	-0,025	0,033	-0,173
	V22	0,003	0,123	-0,039	-0,043	-0,010	0,014	0,038	-0,080	-0,087	0,036	0,118	-0,016	-0,010	-0,088	0,032	-0,015	-0,090	-0,077	-0,137	0,002	0,013	0,552	-0,072	-0,029	0,034
	V23	0,051	-0,018	-0,033	-0,086	0,049	-0,009	0,023	-0,134	0,023	0,011	-0,075	-0,163	-0,063	-0,008	-0,002	-0,020	-0,031	-0,001	-0,012	-0,055	-0,025	-0,072	0,751	0,121	0,091
	V24	-0,038	0,038	-0,094	-0,081	-0,020	-0,023	-0,027	0,008	-0,093	0,055	0,069	-0,025	-0,076	0,061	-0,032	-0,156	-0,002	-0,089	-0,003	0,022	0,033	-0,029	0,121	0,771	-0,094
	V25	0,039	-0,007	-0,007	-0,033	0,017	-0,044	0,052	-0,112	0,057	-0,008	-0,032	-0,160	-0,076	-0,149	0,042	0,069	0,042	-0,076	0,012	-0,001	-0,173	0,034	0,091	-0,094	0,639
Anti-image Correlation	V1	.722a	-0,179	0,286	-0,274	-0,092	0,030	0,027	-0,303	0,086	0,031	-0,096	-0,295	0,032	-0,063	-0,101	0,183	0,040	-0,006	-0,012	-0,118	-0,049	0,005	0,078	-0,058	0,066
	V2	-0,179	.802a	-0,274	-0,111	-0,042	-0,317	-0,223	0,155	-0,055	-0,105	0,097	0,049	0,032	-0,060	-0,024	-0,094	-0,019	-0,127	0,090	-0,057	0,088	0,233	-0,029	0,061	-0,013
	V3	0,286	-0,274	.666a	0,122	-0,250	0,049	-0,077	-0,191	0,161	-0,027	-0,027	-0,114	-0,037	-0,024	-0,053	0,198	0,000	0,032	-0,191	-0,065	-0,005	-0,070	-0,051	-0,141	-0,012
	V4	-0,274	-0,111	0,122	.789a	-0,023	-0,029	0,029	0,089	0,071	-0,210	-0,216	0,104	-0,033	-0,105	0,057	0,082	0,150	0,090	0,125	-0,130	-0,034	-0,078	-0,132	-0,123	-0,056
	V5	-0,092	-0,042	-0,250	-0,023	.842a	0,162	0,217	0,049	-0,080	0,119	-0,111	0,022	-0,227	-0,074	0,027	-0,045	-0,121	0,029	-0,150	-0,135	0,008	-0,019	0,079	-0,031	0,029
	V6	0,030	-0,317	0,049	-0,029	0,162	.883a	-0,040	-0,134	-0,092	0,027	-0,216	-0,004	-0,002	0,115	-0,175	-0,037	0,000	0,053	-0,062	-0,001	-0,005	0,026	-0,014	-0,036	-0,076
	V7	0,027	-0,223	-0,077	0,029	0,217	-0,040	.865a	-0,133	-0,070	-0,049	-0,057	-0,141	0,029	-0,158	0,081	-0,120	0,058	-0,091	-0,141	-0,029	-0,282	0,073	0,038	-0,045	0,093
	V8	-0,303	0,155	-0,191	0,089	0,049	-0,134	-0,133	.626a	0,150	-0,079	-0,059	0,147	0,021	0,016	-0,050	-0,064	-0,121	-0,006	-0,041	0,002	0,051	-0,133	-0,190	0,011	-0,174
	V9	0,086	-0,055	0,161	0,071	-0,080	-0,092	-0,070	0,150	.526a	-0,041	-0,183	-0,024	-0,103	-0,004	-0,158	0,071	0,104	-0,019	0,061	-0,255	-0,077	-0,136	0,031	-0,123	0,082
	V10	0,031	-0,105	-0,027	-0,210	0,119	0,027	-0,049	-0,079	-0,041	.849a	-0,113	-0,290	-0,157	0,006	-0,045	-0,054	-0,004	0,066	0,030	0,071	0,082	0,060	0,015	0,079	-0,013
	V11	-0,096	0,097	-0,027	-0,216	-0,111	-0,216	-0,057	-0,059	-0,183	-0,113	.851a	0,048	0,153	-0,186	-0,030	-0,099	-0,209	-0,091	0,091	0,182	-0,061	0,249	-0,135	0,123	-0,064
	V12	-0,295	0,049	-0,114	0,104	0,022	-0,004	-0,141	0,147	-0,024	-0,290	0,048	.699a	0,090	0,116	-0,014	-0,131	0,009	-0,006	-0,009	-0,043	0,078	-0,028	-0,239	-0,036	-0,253
	V13	0,032	0,032	-0,037	-0,033	-0,227	-0,002	0,029	0,021	-0,103	-0,157	0,153	0,090	.864a	0,003	0,033	0,094	-0,115	0,035	-0,091	-0,232	0,025	-0,018	-0,099	-0,118	-0,130

V14	-0,063	-0,060	-0,024	-0,105	-0,074	0,115	-0,158	0,016	-0,004	0,006	-0,186	0,116	0,003	.846[a]	-0,193	-0,184	0,032	0,030	0,028	0,089	0,005	-0,156	-0,013	0,091	-0,245
V15	-0,101	-0,024	-0,053	0,057	0,027	-0,175	0,081	-0,050	-0,158	-0,045	-0,030	-0,014	0,033	-0,193	.897[a]	-0,168	0,016	-0,078	-0,037	0,150	-0,104	0,056	-0,003	-0,048	0,068
V16	0,183	-0,094	0,198	0,082	-0,045	-0,037	-0,120	-0,064	0,071	-0,054	-0,099	-0,131	0,094	-0,184	-0,168	.773[a]	0,123	-0,017	-0,173	-0,172	-0,199	-0,027	-0,031	-0,239	0,117
V17	0,040	-0,019	0,000	0,150	-0,121	0,000	0,058	-0,121	0,104	-0,004	-0,209	0,009	-0,115	0,032	0,016	0,123	.799[a]	0,170	0,019	-0,271	-0,120	-0,154	-0,045	-0,003	0,067
V18	-0,006	-0,127	0,032	0,090	0,029	0,053	-0,091	-0,006	-0,019	0,066	-0,091	-0,006	0,035	0,030	-0,078	-0,017	0,170	.862[a]	0,011	0,062	-0,026	-0,118	-0,002	-0,116	-0,108
V19	-0,012	0,090	-0,191	0,125	-0,150	-0,062	-0,141	-0,041	0,061	0,030	0,091	-0,009	-0,091	0,028	-0,037	-0,173	0,019	0,011	.839[a]	-0,089	0,025	-0,243	-0,018	-0,005	0,019
V20	-0,118	-0,057	-0,065	-0,130	-0,135	-0,001	-0,029	0,002	-0,255	0,071	0,182	-0,043	-0,232	0,089	0,150	-0,172	-0,271	0,062	-0,089	.791[a]	0,071	0,005	-0,089	0,036	-0,001
V21	-0,049	0,088	-0,005	-0,034	0,008	-0,005	-0,282	0,051	-0,077	0,082	-0,061	0,078	0,025	0,005	-0,104	-0,199	-0,120	-0,026	0,025	0,071	.848[a]	0,023	-0,037	0,049	-0,278
V22	0,005	0,233	-0,070	-0,078	-0,019	0,026	0,073	-0,133	-0,136	0,060	0,249	-0,028	-0,018	-0,156	0,056	-0,027	-0,154	-0,118	-0,243	0,005	0,023	.826[a]	-0,112	-0,045	0,057
V23	0,078	-0,029	-0,051	-0,132	0,079	-0,014	0,038	-0,190	0,031	0,015	-0,135	-0,239	-0,099	-0,013	-0,003	-0,031	-0,045	-0,002	-0,018	-0,089	-0,037	-0,112	.647[a]	0,159	0,132
V24	-0,058	0,061	-0,141	-0,123	-0,031	-0,036	-0,045	0,011	-0,123	0,079	0,123	-0,036	-0,118	0,091	-0,048	-0,239	-0,003	-0,116	-0,005	0,036	0,049	-0,045	0,159	.571[a]	-0,134
V25	0,066	-0,013	-0,012	-0,056	0,029	-0,076	0,093	-0,174	0,082	-0,013	-0,064	-0,253	-0,130	-0,245	0,068	0,117	0,067	-0,108	0,019	-0,001	-0,278	0,057	0,132	-0,134	.756[a]

a. Measures of Sampling Adequacy(MSA)

In the anti-image correlation value, all items have an MSA value of > 0.5. So, the items in this instrument are feasible for further analysis using factor analysis. The next step was to determine the number of factors formed. This determination was based on eigenvalues > 1, which can be seen in Table 3 concerning the total variance expired.

Table 3. Total Variance Explained

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,889	23,556	23,556	5,889	23,556	23,556	3,416	13,662	13,662
2	2,802	11,208	34,764	2,802	11,208	34,764	3,147	12,587	26,249
3	1,767	7,068	41,832	1,767	7,068	41,832	2,193	8,771	35,020
4	1,420	5,682	47,514	1,420	5,682	47,514	1,950	7,799	42,820
5	1,153	4,611	52,125	1,153	4,611	52,125	1,728	6,911	49,730
6	1,148	4,593	56,718	1,148	4,593	56,718	1,463	5,853	55,583
7	1,030	4,120	60,838	1,030	4,120	60,838	1,314	5,255	60,838
8	0,887	3,546	64,384						
9	0,829	3,314	67,698						
10	0,808	3,232	70,930						
11	0,750	3,002	73,932						
12	0,705	2,820	76,752						
13	0,662	2,649	79,401						
14	0,614	2,456	81,856						
15	0,580	2,321	84,177						
16	0,548	2,192	86,370						
17	0,536	2,145	88,515						
18	0,517	2,068	90,583						
19	0,446	1,784	92,367						
20	0,401	1,602	93,969						
21	0,369	1,476	95,445						
22	0,323	1,292	96,737						
23	0,304	1,216	97,953						
24	0,279	1,115	99,068						
25	0,233	0,932	100,000						

Extraction Method: Principal Component Analysis.

Table 3 showed the factors formed are 7 factors from the 25 analyzed items. This grouping corresponds to the initial indicators of mathematical disposition, which were 7 indicators. The five factors formed explain 60,838% of the variability of the 25 analyzed items. These factors can also be seen on the scree plot as shown in Figure 1.

In Figure 1, the number of factors is indicated by the steepness of the eigenvalue acquisition graph. The figure shows 7 factors were measured in this mathematical disposition instrument. These factors can be seen in the rotation stages of the matrix components as shown in Table 4.

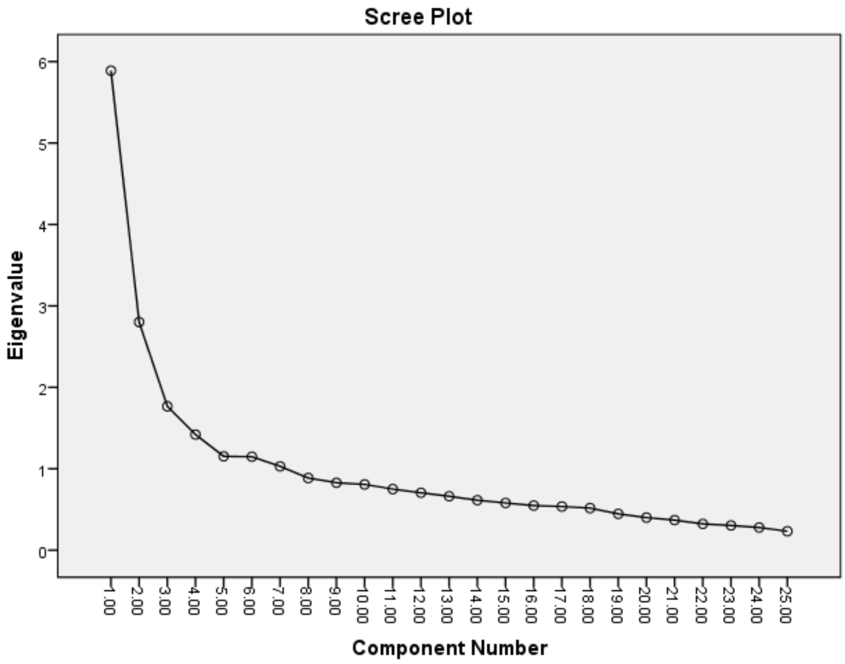

Figure 1. Scree Plot

Table 4. Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
V1	0,165	-0,040	0,687	0,060	0,281	0,065	0,080
V2	0,297	-0,022	0,120	0,762	0,145	0,078	-0,050
V3	-0,017	0,536	-0,445	0,268	0,093	0,143	0,396
V4	0,147	-0,015	0,752	0,188	0,108	-0,002	-0,065
V5	-0,140	0,746	-0,061	-0,115	-0,188	0,072	0,006
V6	0,484	-0,140	0,128	0,489	0,179	-0,050	-0,067
V7	0,575	-0,184	-0,052	0,362	0,301	0,149	0,014
V8	0,372	0,164	0,104	-0,126	0,342	-0,100	0,531
V9	0,279	0,208	0,087	0,080	0,017	0,099	-0,737
V10	0,094	-0,101	0,365	0,422	0,444	0,028	0,013
V11	0,578	-0,179	0,428	0,307	0,044	-0,210	0,011
V12	0,050	-0,072	0,201	0,193	0,705	0,290	0,052
V13	-0,245	0,730	-0,004	-0,084	-0,004	0,137	-0,069
V14	0,673	-0,040	0,287	0,044	-0,054	0,049	0,120
V15	0,638	-0,197	0,067	0,164	0,092	0,064	-0,111
V16	0,635	-0,088	-0,131	0,042	0,288	0,219	-0,189
V17	-0,039	0,654	-0,044	-0,146	-0,015	-0,333	0,102
V18	0,335	-0,328	-0,044	0,028	0,068	0,424	0,013
V19	0,076	0,472	-0,471	-0,237	0,244	0,178	0,098
V20	-0,180	0,734	-0,018	-0,056	0,184	0,020	-0,236
V21	0,696	-0,106	0,116	0,055	-0,031	0,075	0,032
V22	-0,056	0,408	-0,228	-0,628	0,184	0,099	0,034
V23	0,166	0,177	0,075	-0,071	0,638	-0,364	0,050
V24	0,103	0,201	-0,011	-0,053	0,010	0,738	-0,101
V25	0,362	-0,006	0,378	0,135	-0,036	0,406	0,391

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 10 iterations.

Table 4 showed several items that switch factors, so there are several factors with only have 1 item, namely factor 7. In addition, item 19 does not involve into any factor, which means the item is invalid. This requirement is based on the value of the factor loading which must be higher than 0.4 (Retnawati, 2016). Seven factors were appropriate to the initial instrument based on the steps taken in factor analysis using EFA with the help of SPSS 26 software. Of the 25 items, 1 item was invalid, namely item 19. Then, 24 items were analyzed for the next stage.

The next step was the instrument test using Confirmatory Factor Analysis (CFA) with the help of JASP 0.14.1.0 software. The results of the CFA were seen in the first stage, in the chi-square value, shown in Table 5.

Table 5. Chi-square test

Model	X^2	df	p
Baseline model	1823.557	253	
Factor model	201.636	215	0.734

Table 5 showed the value of x^2 < 2 df (201.636 < 2 x 215) (Arbuckle, 1997), p-value = 0.734 > 0.5 (Pedhazur, 1982). Then, it analyzed the RMSEA value in the Other Fit Measures table, shown in Table 6.

Table 6. Other fit measures

Metric	Value
Root mean square error of approximation (RMSEA)	0.000
RMSEA 90% CI lower bound	0.000
RMSEA 90% CI upper bound	0.023
RMSEA p-value	1.000
Standardized root mean square residual (SRMR)	0.075
Hoelter's critical N (α = .05)	244.213
Hoelter's critical N (α = .01)	259.719
Goodness of fit index (GFI)	0.952
McDonald fit index (MFI)	1.035
Expected cross validation index (ECVI)	1.651

Table 6 showed the RMSEA value was 0.00 <0.08 (Ferdinand, 2002). Tables 5 and 6 showed that all the criteria for developing this instrument already have good construct validity because they meet the criterias, including chi-square value < 2df, p value > 0.5, and RMSEA value < 0.08. The results of the loading factor of the instrument items were presented in Figure 2 and Table 7.

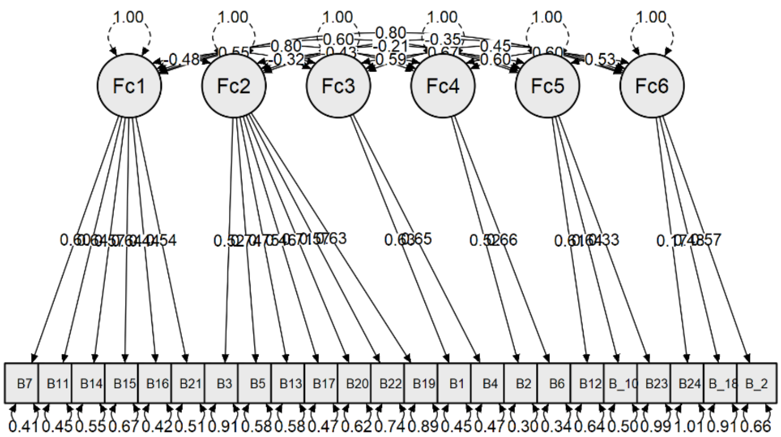

Figure 2. Plot model of loading factor

Table 7. Loading Factor

Factor	Indicator	Symbol	Estimate	Std. Error	z-value	p	95% Confidence Interval Lower	Upper	Std. Est. (all)
Factor 1	B7	λ11	0.573	0.046	12.398	< .001	0.482	0.663	0.650
	B11	λ12	0.716	0.045	15.764	< .001	0.627	0.805	0.772
	B14	λ13	0.549	0.045	12.269	< .001	0.461	0.636	0.585
	B15	λ14	0.642	0.051	12.593	< .001	0.542	0.742	0.618
	B16	λ15	0.358	0.043	8.254	< .001	0.273	0.443	0.457
	B21	λ16	0.504	0.044	11.581	< .001	0.419	0.590	0.564
Factor 2	B3	λ21	0.469	0.049	9.517	< .001	0.372	0.565	0.431
	B5	λ22	0.757	0.054	14.029	< .001	0.651	0.863	0.713
	B13	λ23	0.747	0.053	14.058	< .001	0.643	0.852	0.699
	B17	λ24	0.465	0.039	11.881	< .001	0.388	0.541	0.560
	B20	λ25	0.667	0.052	12.891	< .001	0.566	0.769	0.629
	B22	λ26	0.650	0.052	12.612	< .001	0.549	0.751	0.626
	B19	λ27	0.604	0.052	11.622	< .001	0.502	0.706	0.533
Factor 3	B1	λ31	0.623	0.076	8.157	< .001	0.474	0.773	0.674
	B4	λ32	0.661	0.081	8.157	< .001	0.502	0.820	0.698
Factor 4	B2	λ41	0.510	0.068	7.470	< .001	0.376	0.643	0.669
	B6	λ42	0.677	0.091	7.470	< .001	0.499	0.854	0.766
Factor 5	B12	λ51	0.597	0.077	7.729	< .001	0.446	0.749	0.593
	B10	λ52	0.724	0.091	7.961	< .001	0.545	0.902	0.752
	B23	λ53	0.262	0.057	4.576	< .001	0.150	0.374	0.249
Factor 6	B24	λ61	0.030	0.048	0.636	0.525	-0.063	0.124	0.030
	B18	λ62	0.482	0.087	5.542	< .001	0.312	0.652	0.450
	B25	λ63	0.535	0.097	5.544	< .001	0.346	0.725	0.539

Figure 2 and Table 7 showed that the loading factor (standardized estimate) met the standards, which was > 0.4.

Discussion

The research was development research. The product being developed was, to produce instruments to measure the mathematical dispositions of junior high school students in Indonesia. This instrument was developed with 7 indicators. They are Confidence, Connectedness and high curiosity, Flexibility, Perseverance, Reflective, assess the application of mathematics, and Appreciation. The instrument guideline was shown in Table 8.

Table 8. The Guidline of mathematical disposition instruments

Variable	Indicators	No. Item
Mathematical Disposition	Confidence	2,3,4,6,15,25
	Connectedness and high curiosity,	1,9,12,22
	Flexibility	5,8,11,13,24
	Perseverance	7,10,18
	Reflective	14,16,17,19,23
	Assess the application of mathematics,	20
	Appreciation	21

This instrument consisted of 25 items. The results were obtained from an FGD, which invited 2 psychometric experts, 2 Indonesian grammar experts, and 3 mathematicians. Furthermore, this instrument was tested on 197 students, spread across Indonesia via Googleform access and also conventionally at Junior High School Fadris in Tasikmalaya, West Java, Indonesia.

Then, respondent data was analyzed using Exploratory Factor Analysis (EFA), which produced 24 valid items and 1 invalid item. Item changes also occurred by switching some items to other indicators. Changes to these items was presented in Table 9.

Table 9. Validity Results of EFA

Indicators	No. Item	Questions/Statements	Loading Factor
Self Confidence	7	I still try to do math assignments even though sometimes it is difficult	0,575
	11	I am always active in the process of solving mathematical problems	0,578
	14	I read a summary of the math material that has been studied	0,673
	15	I am happy when doing math problems regularly	0,638
	16	I feel satisfied when I can answer math questions correctly	0,635
	21	I look for other sources to solve math problems	0,696
Connectedness and high curiosity	3	I am embarrassed to ask the teacher when I do not understand a particular material	0,536
	5	When the teacher gives math problems, I am lazy to find answers to these problems from various sources	0,746
	13	I am lazy to check the results of math work	0,730
	17	Mathematics is not useful at all for me in everyday life	0,654
	19	I feel afraid if the teacher asks me to represent the group to conclude the material	0,472
	20	I only study mathematics when there is a test	0,734
	22	I feel afraid when math class starts	0,408
Flexibility	1	I always ask the teacher if I have difficulty understanding a problem in the questions provided by the teacher	0,687
	4	I dare to express my opinion when discussing	0,752
Perseverance	2	I try to think and complete by myself first when completing math work	0,762
	6	I try to solve math problems confidently	0,489
Reflective	10	I like to share opinions with fellow friends in solving math problems	0,444
	12	I prefer to discuss in solving math problems	0,705
	23	I get discouraged when I get confused in solving math	0,638
Assess the application of mathematics	18	The successfulness in mathematics support success in other subjects	0,424
	24	I connect math material with other material	0,738
	25	I read math material that has never been taught by the teacher	0,406
Appreciation	8	I do not like when my friends have different answers	0,531

Table 9 showed a very surprising result, where the points or items were not part of the indicator due to, firstly, they were predicted to be part of the indicators. Instead, the item moves to another indicator, even with a valid loading factor. These results were brought to the Forum Group Discussion (FGD) and sought advice from experts. Input from several experts states that these results may be used as a reference to obtain a good instrument because have been scientifically proven. In addition, input from the expert team suggests omitting items in indicator 7 of appreciation as only one item, whereas in 1 factor must have at least 2 items.

After obtaining the EFA results, continue to confirmatory factor analysis (CFA). The number of data responses is the same as that obtained during the EFA test, which is 197 students of junior high school. This result emphasizes that the obtained instrument can be very feasible to use because it has passed various stages of validity testing.

The CFA results show that the 6 factors from the EFA were valid as fulfilling a loading factor value of more than 0.4 (Table 7). This result supports the instrument which is formed from a disposition guideline of 25 items from 7 indicators, resulting in 23 items with 6 indicators.

The developed instruments in this study were very logical, considering that not all indicators of mathematical disposition were used in the measurement. Research by Mastuti (2018) uses mathematical disposition indicators in the domains of self-confidence, curiosity, persistence, and flexibility. Also, research by Zaozah et al (2017) chose indicators of mathematical disposition without indicators of appreciation.

After the developed instrument has been obtained, it continued to measure the level of reliability. The calculations used a Cronbach alpha, in which the reliability coefficient shows a value of 0.59. it means adequate. Besides reliability, measurement error must also be considered. The test used the standard error of measurement (SEM) in classical test theory (Allen & Yen, 2001; Crocker & Algina, 2008), and obtained a value of 3.988446. Based on the SEM value, the higher the SEM value, the lower the reliability. It means the measurement error is higher (Kartowagiran et al., 2021). In this case, the instrument has adequate reliability. Then, it was feasible to use.

CONCLUSION

Mathematical disposition has 7 main indicators with the development of 25 instrument items. The results of the EFA test obtained 24 valid items and 1 invalid item. Then, the items changed to 24 items. Suggestion from the expert team, one item on the appreciation indicator was omitted as, in 1 factor, at least has 2 points. After that, the instrument consists of 23 items. These items were then tested using CFA. The analysis showed the items on the instrument meet the standard loading factor and produce 6 fixed indicators with 23 valid items. Reliability was at a coefficient of 0.59 with an adequate category, while the measurement errors were at a value of 3.98. In short, this instrument was feasible to use.

As a suggestion, this instrument should be re-tested on students of junior high school whose maturity level is higher, for example, class IX. This effort is important to obtain better respondents in completing the instrument in obtaining data.

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