Table 2. A comparison of the fault localization techniques. For each system, we show the technique with the best MFR in bold (the lower the better). DepGraph w/o Code Change shows the result after adopting Dependency-Enhanced Coverage Graph, and DepGraph shows the result of incorporating both Dependency-Enhanced Coverage Graph and Code Change Information. The number in the parentheses shows the percentage improvement over Grace [29]. The best result is marked in bold. Due to space constraints, the Tarantula results are not presented in the table but are available in our GitHub repository for reference [4].

System (# faults)	Techniques	Top-1	Top-3	Top-5	Top-10	MFR	MAR
Cli (39)	Ochiai	3	5	10	18	15.711	18.272
	Tarantula	3	3	8	15	15.763	18.051
	DeepFL	11	21	24	28	8.991	10.681
	GNN	14	24	26	30	7.861	9.903
	DepGraph w/o Code Change	15 (7%)	22 (-8%)	26 (0%)	31 (3%)	5.973 (24%)	7.118 (28%)
	DepGraph	**17 (21%)**	24 (0%)	**27 (4%)**	**34 (10%)**	**5.105 (30%)**	**6.223 (32%)**
Closure (174)	Ochiai	20	39	70	72	98.652	110.348
	Tarantula	20	37	68	70	97.745	109.634
	DeepFL	46	61	92	99	29.388	35.333
	GNN	51	78	102	121	12.854	14.814
	DepGraph w/o Code Change	58 (14%)	97 (24%)	123 (21%)	**148 (22%)**	4.844 (62%)	7.911 (47%)
	DepGraph	**60 (18%)**	**99 (27%)**	**126 (24%)**	**148 (22%)**	**4.542 (65%)**	**7.306 (51%)**
Codec (18)	Ochiai	3	12	**17**	17	2.701	3.461
	Tarantula	2	12	15	17	3.001	3.657
	DeepFL	5	10	12	16	2.742	4.803
	GNN	6	11	13	17	2.536	4.015
	DepGraph w/o Code Change	**7 (17%)**	**12 (9%)**	14 (8%)	16 (-6%)	**2.412 (5%)**	**3.265 (19%)**
	DepGraph	**7 (17%)**	10 (-9%)	14 (8%)	16 (-6%)	3.111 (-23%)	4.327 (-8%)
Collections (4)	Ochiai	1	1	2	2	3.871	3.431
	Tarantula	1	1	2	2	3.001	8
	DeepFL	1	1	2	2	1.512	1.519
	GNN	1	1	2	2	1.511	1.511
	DepGraph w/o Code Change	**1 (0%)**	1 (0%)	**2 (0%)**	2 (0%)	1.511 (0%)	1.511 (0%)
	DepGraph	**1 (0%)**	**2 (100%)**	**2 (0%)**	2 (0%)	**1.445 (4%)**	**1.445 (4%)**
Compress (47)	Ochiai	5	12	17	29	20.106	23.275
	Tarantula	6	13	17	29	16.979	19.927
	DeepFL	22	27	31	38	9.573	12.955
	GNN	23	29	34	42	5.383	6.987
	DepGraph w/o Code Change	24 (4%)	32 (10%)	**36 (6%)**	42 (0%)	4.384 (19%)	5.209 (25%)
	DepGraph	**25 (9%)**	**33 (14%)**	**36 (6%)**	**45 (7%)**	**3.361 (38%)**	**4.245 (39%)**
Csv (16)	Ochiai	3	8	10	12	5.625	5.782
	Tarantula	3	8	10	15	5.563	5.719
	DeepFL	7	8	9	11	5.623	5.971
	GNN	6	8	10	12	5.438	5.938
	DepGraph w/o Code Change	**8 (33%)**	**9 (13%)**	10 (0%)	**13 (8%)**	5.362 (1%)	5.581 (6%)
	DepGraph	**8 (33%)**	**9 (13%)**	**12 (20%)**	**13 (8%)**	**4.813 (12%)**	**5.001 (16%)**
Gson (18)	Ochiai	4	9	9	12	9.177	10.183
	Tarantula	4	9	10	13	9.056	9.667
	DeepFL	8	11	12	12	8.873	9.324
	GNN	11	13	14	15	6.471	6.755
	DepGraph w/o Code Change	12 (9%)	14 (8%)	15 (7%)	15 (0%)	2.177 (66%)	2.471 (63%)
	DepGraph	**14 (27%)**	**15 (15%)**	**16 (14%)**	**16 (7%)**	**1.353 (79%)**	**1.765 (74%)**
JacksonCore (26)	Ochiai	6	11	13	14	9.789	16.754
	Tarantula	6	12	14	16	4.368	16.892
	DeepFL	5	5	9	10	8.671	9.711
	GNN	9	13	14	15	6.471	6.755
	DepGraph w/o Code Change	9 (0%)	14 (8%)	**15 (7%)**	**17 (13%)**	3.474 (29%)	4.509 (28%)
	DepGraph	**12 (33%)**	**15 (15%)**	**15 (7%)**	16 (7%)	**3.052 (38%)**	**4.015 (36%)**
JacksonXml (6)	Ochiai	0	0	0	0	59.2	59.2
	Tarantula	1	1	1	3	27.8	27.8
	DeepFL	3	3	4	5	3.513	4.245
	GNN	3	3	4	5	2.401	2.401
	DepGraph w/o Code Change	**4 (33%)**	**5 (67%)**	**5 (25%)**	**5 (0%)**	0.411 (83%)	0.411 (83%)
	DepGraph	**4 (33%)**	**5 (67%)**	**5 (25%)**	**5 (0%)**	**0.409 (83%)**	**0.409 (83%)**
Jsoup (93)	Ochiai	15	40	48	57	14.944	20.209
	Tarantula	16	41	47	58	15	20.342
	DeepFL	33	39	46	49	10.23	11.444
	GNN	40	64	72	77	8.223	9.669
	DepGraph w/o Code Change	50 (25%)	70 (9%)	77 (7%)	82 (6%)	4.022 (51%)	6.815 (30%)
	DepGraph	**53 (33%)**	**73 (14%)**	**78 (8%)**	**83 (8%)**	**3.023 (63%)**	**4.6174 (52%)**
Lang (64)	Ochiai	25	45	51	59	4.68	5.15
	Tarantula	32	55	56	59	2.613	2.993
	DeepFL	42	53	55	57	2.833	3.08
	GNN	43	53	57	58	2.113	2.462
	DepGraph w/o Code Change	45 (5%)	**55 (4%)**	58 (2%)	**61 (5%)**	1.564 (26%)	1.902 (23%)
	DepGraph	**48 (12%)**	**55 (4%)**	**60 (5%)**	**61 (5%)**	**1.153 (45%)**	**1.481 (40%)**
Math (106)	Ochiai	23	52	62	82	9.73	11.72
	Tarantula	25	57	68	88	4.192	6.312
	DeepFL	52	81	90	95	3.95	4.911
	GNN	64	79	92	97	2.355	3.082
	DepGraph w/o Code Change	67 (5%)	90 (14%)	96 (4%)	100 (3%)	1.185 (50%)	1.528 (50%)
	DepGraph	**72 (13%)**	**92 (16%)**	**97 (5%)**	**102 (5%)**	**1.115 (53%)**	**1.454 (53%)**
Mockito (38)	Ochiai	7	14	18	23	20.22	24.77
	Tarantula	9	17	20	26	16.861	21.81
	DeepFL	10	18	23	26	13.541	17.001
	GNN	16	24	26	29	9.611	13.621
	DepGraph w/o Code Change	20 (25%)	28 (17%)	**34 (31%)**	**34 (17%)**	2.361 (75%)	3.307 (76%)
	DepGraph	**21 (31%)**	**29 (21%)**	32 (23%)	**34 (17%)**	**2.194 (77%)**	**2.998 (78%)**
Time (26)	Ochiai	6	12	13	16	16.14	18.98
	Tarantula	7	12	14	16	15.354	17.121
	DeepFL	12	15	18	20	12.722	13.754
	GNN	11	16	20	21	7.842	8.448
	DepGraph w/o Code Change	16 (45%)	19 (19%)	20 (0%)	**22 (5%)**	3.321 (58%)	4.465 (47%)
	DepGraph	**17 (55%)**	**20 (25%)**	**21 (5%)**	**22 (5%)**	**3.044 (61%)**	**4.371 (48%)**
Total (675)	Ochiai	121	260	340	413	20.753	24.038
	Tarantula	135	278	350	427	16.95	20.567
	DeepFL	257	353	427	468	8.726	10.338
	GNN	298	416	486	541	5.678	6.851
	DepGraph w/o Code Change	336 (13%)	470 (13%)	534 (10%)	588 (9%)	3.049 (46%)	3.957 (42%)
	DepGraph	**359 (20%)**	**481 (16%)**	**541 (11%)**	**597 (10%)**	**2.562 (55%)**	**3.272 (52%)**